The Relationship between Students' Satisfaction and Motivation and their Perceived Learning Outcome in an Online Peer Feedback Module

STUDIES ON EDUCATION, SCIENCE, AND TECHNOLOGY 2022

Editors
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PREFACE

Education, science, and technology disciplines are closely and extensively connected in all formats and levels. The outbreak of COVID-19 has further squeezed this interconnection where the delivery of education in different scientific fields of studies at all education levels is almost impossible without the presence of technology. Today, there is a need more than ever to explore the intersection of education, science, and technology at both administrative and classroom levels. Educational leaders and policymakers should be aware of the requirements (e.g., role of culture, educational governance) for effective teaching and learning in the post-COVID-19 era. Teachers, instructors, and researchers need to be proficient in the way to convey knowledge with effective and innovative adoption of technology (e.g., online peer feedback) to the young generation as they are called "digital natives". This book focuses on addressing and exploring these needs and recommends solutions from multiple perspectives.

The book is divided into three sections related to studies on education, science, and technology. While each of the fist two sections includes five chapters, the last section involves four chapters. The chapters' contributors are from the following countries: Albania, Australia, Azad Kashmir, Ghana, Indonesia, Iran, Kazakhstan, Morocco, Philippines, Singapore, the Netherlands, the USA, Tunisia, and Turkey. The diversity of the chapters from 14 different countries brings an international perspective to the book.

The first section involves five chapters on education. The first section starts with the chapter titled "Flipped learning method: a strengthening or contradiction of the educational governance principles?" by Elmaataoui Ouiam and Elkhider Abdelkader from Morocco. The flipped learning methods are today widely used in many fields. Language teaching, mathematics, and quantitative methods, IT's are among the prominent examples. The flipped learning method can take different forms based on different tools that will be provided in this chapter. In total, of the hundred or so articles identified, the authors have specifically selected

articles in French or English relating to higher education. Research having been carried out at the primary and secondary levels was excluded. Then, the results of the analysis were translated into a narrative synthesis describing the relationship between the flipped teaching method and university governance.

The second chapter titled “Factors Influencing the Creation of Dignity Culture in Young Teachers” is written by Magdalini Vampa and Mitjana Profiri from Albania. The culture of dignity in educational institutions is essential in educating students as active and goal-oriented citizens, with high integrity, aiming towards a happy life. Human dignity still remains highly vulnerable in post-communist and totalitarian societies. Albanian society and its institutions, even after several decades, manifest the presence of cultural elements such as reminiscence in current teacher models. There were 15 purposeful selected students who were trained on the 'Model of Dignity' and made it part of classroom teaching culture during their internship in high schools. Their experience was interviewed and used in inductive conventional content analyzes.

The third chapter titled “Analysis of Elementary Curriculum with Reference to National Qualification Framework” by Tahzeeb Mahreen from Azad Kashmir is conducted with faculty members from the selected institutes which turned out 42 in number. Coding agenda and questionnaire were used as research instruments. The validity of the tools was evaluated and confirmed by referring to the experts. Participants rated all the problems very high which show a significant gap in the delivery of communication and social competence. The highest rated problem was ‘lack of audio- visual aids’ whereas the second highest rated problem was ‘Insufficient funds for ICT material’. Majority of the faculty suggested three measures as most effective for the incorporation of communication and social competence which were ‘collaborative ventures between universities’, ‘use of student-oriented approaches’, and ‘continuous professional development of teachers’.

The next chapter titled “Exploring the Nature and Effects of Cross – Age Peer Tutoring on Primary School Pupils' Reading Competence and Self-esteem” by Ebrahim Talaee, Azad Mohammadi, and Golrokh Bararpour from Iran. The authors report the nature and effects of cross – age peer tutoring on primary school students’ reading competence and self-esteem. The conlusions are made based a conceptual analysis of the nature of peer tutoring and its theoretical foundations including psychological, social and neuroscientific perspectives and

an empirical study of fourth graders who do the tutoring for the second graders in reading. The authors state that peer tutoring program increases primary school students' reading fluency and comprehension, and self-esteem.

The last chapter of the first section includes a chapter titled "Combining Teaching for and through Entrepreneurship and Interaction between Developed Skills" by Chaker Hajer and Dellagi Hatem from Tunisia. This chapter describes the impact of combining two entrepreneurship teaching methods on developing students' entrepreneurial skills. The authors state that entrepreneurial intention is supposed to depend on students' creativity which depends on three variables: teaching methods, managing ambiguity, and core self-evaluation. Core self-evaluation depends not only on entrepreneurial attitude but also on entrepreneurial knowledge which depends on financial literacy and develops entrepreneurial mindset.

The second section involves five chapters on science. The first chapter of this section is titled "Trends in Calculus-Based Mathematics in the New Senior Secondary Queensland Certificate of Education" Musarurwa David Chinofunga, Philemon Chigeza, and Subhashni Taylor from Australia. In this work, Quantitative methods were applied to analyse student participation using data from the Queensland Curriculum and Assessment Authority (QCAA), Socio-Economic Indexes for Areas (SEIFA) from the Australian Bureau of Statistics (ABS); schools' Index of Community Socio-Educational Advantage (ICSEA) values from the Australian Curriculum, Assessment and Reporting Authority (ACARA); and schools transfer ratings from the Department of Education (DoE). Trends show that the SEIFA Indexes, schools' ICSEA Indexes, schools transfer ratings positively correlate with student dropouts. Targeted support for schools located in low socioeconomic areas and having high transfer ratings is significant to promote the uptake and continued participation in calculus-based mathematics.

Another study titled "Development and Validation of Academic Hardiness Questionnaire in Learning Chemistry during COVID-19 Pandemic using Rasch Model" by Ifan Rivaldo, Hari Sutrisno, and Alusti Cundo Manik from Indonesia developed a questionnaire in learning chemistry. The researchers implemented the Rasch model to determine the quality of psychometric scale for the reliability of measurements, item fit statistics, use of rating scale, and Differential Item Functioning (DIF). It is stated that Likert rank scale functioned well and

free from disordered threshold and DIF by gender is not detected or negligible for all items.

In this section, the study titled “History of Mathematics and Students’ Performance in Mathematics: The Mediating Effect of Mathematics Study Interest” by Yarhands Dissou Arthur and Bright Asare from Ghana followed a survey approach, and the relationship between mathematics history and students’ performance in mathematics was ascertained using statistical modeling. Some empirical studies in the past have been conducted on the use of mathematics history as a pedagogy tool. However, most of these studies have been exploratory in nature, with limited attention on how it directly affects students’ performance. It is recommended that the history of mathematics as a pedagogical tool should be inculcated in the senior high schools. Thus, teacher trainees at the various tertiary institutions should be equipped with the required knowledge on the histories behind the various concepts taught in mathematics.

The chapter titled “Integrating Community Leadership and Social Innovation in the University Curriculum: A CLASIC Approach” by Intan Azura Mokhtar, Wei Ming Dan Chia, Nguan Hwee Steven Tay, Oran Zane Devilly, and Yaacob Ibrahim from Singapore focus on the educational goals of the Singapore Institute of Technology and the pedagogical approaches and initiatives it adopts in developing and nurturing students to be both industry-ready and socially aware and attuned. The authors mention the social innovation projects undertaken by the faculty and students, curated by the Community Leadership and Social Innovation Centre (CLASIC) in the University.

In their chapter titled “Scientific Production and Science Policy in Kazakhstan: A Survey Study”, Diana Amirbekova, Meruyert Kussaiyn, and Timur Narbaev from Kazakhstan examine the current characteristics (stagnant financing of academic research and qualified researchers), problems (bureaucracy, lack of international collaboration, and the English language barrier in publication writing), and opportunities (growing research internships and the recent changes toward a comprehensive scheme of science financing) for conducting research in higher education institutions. The issues mentioned in this chapter can be helpful for researchers and policymakers in higher education in other countries.

The last section involves four chapters on technology. The chapter titled “Sentiments Analysis on Limited Face-to-Face of College Students in the New Normal” by Kathryn P.

Acosta and Thelma D. Palaoag from Philippines report the results of a sentiment analysis to investigate students' views and ideas in the resumption of the limited face-to-face classes. The researchers used Rule Induction as a text analyzer for sentiment analysis. In the study, a positive polarity of the students' sentiments is found in the resumption of limited face-to-face classes. The study endorses adopting limited face-to-face classes for an effective learning method to ensure quality education.

In this section, the next chapter titled "The Comparative Effects of Technology and Hands-On Modeling on High School Students' Performance in a Biology Classroom" by Kimesha Brooks and Emily Surber from the USA explain three interventions used to determine which intervention yielded the highest post-test scores in the biology classes. The interventions were delivered within a six-week timeframe using the 5E method of instruction throughout the unit. Students completed pre- and post-tests to measure content retention following the unit lessons. Students were also recorded for on-task behaviors during the instruction. It is reported that a hands-on modeling with supplemental technology was most effective in improving students' performance.

The chapter titled "The Relationship between Students' Satisfaction and Motivation and their Perceived Learning Outcome in an Online Peer Feedback Module" by Marzieh Parvaneh Akhteh from Turkey, Mohammadreza Farrokhnia, Seyyed Kazem Banihashem, and Omid Noroozi from the Netherlands explores students' satisfaction and motivation when engaging with online peer feedback activity and the relationships between students' satisfaction and motivation and their perceived learning in the context of argumentative essay writing. The results show that high satisfaction and motivation among students concerning the designed online peer feedback module exist and students with high motivation and satisfaction perceive a high level of learning when engaging with online peer feedback.

The last chapter titled "Assessment in Students' Performance and Behavior towards the Use of Online Platform through Data Analysis" by Lenigrace L. Mecias and Thelma D. Palaoag from Philippines report the impact of online learning on high school students' performance and attitudes during the pandemic. It is clear that the COVID-19 pandemic forced educational sectors to facilitate digital learning modalities. Upgrading the pedagogical approaches in all institutions to adapt online platform will sustain the lifelong learning among high school students. Online distance learning opens a massive opportunity to extend the learning

competencies through the use of online platforms and enable the students achieve their academic performances.

In the end, we would like to thank all the authors for their contribtuion to this book and other influential people who helped us bring this book to life. We hope that this book will be useful for the readers and will contribute to advancement of the field of education, science, and technology.

Omid Noroozi & Ismail Sahin

The editors

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SECTION I - STUDIES ON EDUCATION

Chapter 1 - Flipped Learning Method: A Strengthening or Contradiction of the Educational Governance Principles?

Elmaataoui Ouiam, **Elkhider Abdelkader**

Chapter Highlights

- This chapter is part of a pragmatic epistemological posture (Creswell, 2007), in the sense that we are essentially interested in "what works" in a given teaching context, by granting an equivalent value as much to research carried out in a positivist rather than an interpretative paradigm.
- In order to describe the current state of scientific knowledge relating to the flipped classroom in higher education, both from the point of view of students and teachers, by making a diagnostic reading dissecting the points of similarities and differentiating between flipped teaching and educational governance, we conducted a literature search in databases and search engines.
- The results of the analysis were translated into a narrative synthesis describing the relationship between the flipped teaching method and university governance.
- We reinforced our study with a questionnaire addressed to international students in a German university to which the reverse teaching method was applied in the teaching of the German language.

Introduction

The context of higher education is undergoing profound change. Many pressures emerge from different spheres of society to ensure that education systems best meets their needs. We can namely mention the policies that are increasingly seeking to guide and control the content and teaching methods of university programs (Pelletier, 2009). From the professionals point of view, there is an increased desire to implement a skills-based approach that places great emphasis on learning about the world of work (work-based learning) and so-called transversal skills (or soft skills), such as communication, teamwork or critical thinking (Billett, 2009).

Some authors speak of a "vocationalization" of higher education (Maclean, 2010) in reference to vocational education. From the pedagogical sphere are emerging pressures for higher education to make a transition from lecture-based teaching to more learner-centred teaching (Akturk & Saka Ozturk, 2019; Tennant, McMullen & Kacznski, 2010; Mostrom & Blumberg, 2012), promoting active learning modalities and more collaborative approach in higher education. Learner groups are no longer homogeneous: there is growing social and cultural diversification as well as a significant increase in students with a non-traditional relationship to studies in Quebec (Julien & Gosselin, 2015) and in the United States (Kena et al., 2015). From literature review based on students' point of view, nine aspects are mainly addressed regarding the flipped learning method, namely the impact on academic success, the impact on satisfaction, the learning pace, the learning modalities, the development of higher-order skills, the socioeconomic environment, the difficulties related to ICT, the course preparation and the workload. But few studies have addressed the relationship between the university governance model and the flipped teaching method.

While governance as a paradigm and university as a turbulent environment maintain being a focus of educators and researchers around the world, the flipped classroom is currently on the top of their interests as an emerging method adequate to the current time characterised by globalization, internationalization of education. Bishop and Verleger (2013) talk about the incredible number of new websites dedicated to it as well as the effervescence of scientific production around this theme. This craze raises many questions: does such an approach produce the announced effects? Does it present unanticipated advantages or interests? Is it working on the same page with governance principles, or they contraduse each other?

In order to answer these questions, at least in part, and much more, recognize the possible linkage between reversed teaching methods and governance, we propose a review of the literature that aims to provide a current state of scientific knowledge on the flipped classroom in higher education, strengthened by a survey addressed to some international students enrolled in a German university. We also highlight some recommendations for its implementation in the classroom.

Problem Statement and Research Questions

The main idea we are trying to deal with by this paper is to recognize the similarities and contradictions between flipped learning method and educational governance specifically in higher education. In order to do so, we are going to answer the following question: Is the Flipped learning method a strengthening or contradiction of the educational governance principles?

The sub-questions are the following:

- What are the similarities / differences between the flipped learning and university governance?
- Is there an intersection between the implementation of governance practices and flipped teaching?
- Does flipped teaching accelerate learning and achieve good results as one of the goals of good governance or not?
- Does flipped teaching contribute to the achievement of the objectives of academic governance or not? And vice versa?

Research Methodology

This article is part of a pragmatic epistemological posture (Creswell, 2007), in the sense that we are essentially interested in "what works" in a given teaching context, by granting an equivalent value as much to research carried out in a positivist rather than an interpretative paradigm. Thus, in this perspective, in order to describe the current state of scientific knowledge relating to the flipped classroom in higher education, by making a diagnostic reading dissecting the points of similarities and differentiating between flipped teaching and educational governance, we conducted a literature search in databases and search engines. In

total, of the hundred or so articles identified, we have specifically selected articles in French or English relating to higher education. The results of this analysis were translated into a narrative synthesis describing the relationship between the reverse method and university governance. Similarly, we reinforced our study with a questionnaire addressed to international students in a German university to which the reverse teaching method was applied in the teaching of the German language. The primary data was collected from a questionnaire consisting of closed-ended questions and some open-ended questions from intubated e-mail.

Research Sampling and Participants

In the framework of this study, which is based on participant observation and the opinion of the authors themselves, 67 students participated, distributed according to the international programs to which they belong, namely 7 students from the economics department, including one of the authors. All students were informed about the purpose of this study and gave their consent for this research.

Flipped Learning Method and Governance: Conceptualization Essay

The flipped classroom can be defined simply: everything that is traditionally done in the classroom is done at home, while what is done at home is done in the classroom (Alharthi & Zhang, 2021; Çakır et al., 2021; Cevik et al., 2022; Hodgson et al., 2017; Lage, Platt & Treglia, 2000; Murat & Cam, 2021; Shukla & Mcinnis, 2021; Summak, 2022; Weinhandl et al., 2020). Nevertheless, this definition does not present all aspects of the flipped classroom. Beyond that, the flipped classroom is a place where students confront and raise their understanding of the material, through active learning exercises, mostly done in groups. To do this, they prepare themselves before the course by reading and watching videos on the subject that will be worked on in class. As such, the flipped classroom can be defined as a pedagogical approach as it reorganizes well-known pedagogical methods outside of the classroom and student-centred methods within the classroom.

Referring to the work of Bishop and Verleger (2013), the available literature on the flipped classroom draws on several so-called student-centred learning theories. These theories argue on the one hand, that in order for learning to be meaningful and more effective, active

learning activities must be central to the planning of a course, and this with the goal of making students able to take charge of their own education while creating connections with their prior knowledge (Bishop & Verleger, 2013). On the other hand, regarding the out-of-class portion, the theoretical literature is based on more teacher-centred theories, such as that of explicit teaching (Borman, Hewes, Overman & Brown, 2003). Similarly, the increased accessibility to ICT allows for the disembodiment of information transmission activities that do not necessarily require the presence in class, the immediate involvement of the teacher or that of other students. Based on these two assumptions, the flipped classroom ultimately suggests making the most of classroom presence, allowing maximum time for interaction and active learning.

In the lecture approach, according to Skelton's (2005) typology, the teacher must deliver knowledge from the top down. However, in the flipped classroom, the teacher is no longer necessarily the primary source of information. He or she becomes a guide and facilitator, in order to assist the application and integration of knowledge (Golberg & Mckhann, 2000; Nurhayati et al., 2021; Ozturk. & Ozturk, 2022; Tune, Sturek & Basile, 2013). In a way, in the new model of teaching, as expressed by Sherbino, Chan and Schiff (2013), the role of the teacher is then to accompany and answer the complex questions already done by the student and then explain the course. This besides responding and fulfilling the specific needs of a student or group of students.

Since the goal of educational governance is to achieve the best possible student outcomes, high success rates and low repetition rates, lecture-based teaching has always served the goals of university governance in this sense. Flipped teaching itself collaborates with the governance model to achieve its goals. Numerous studies of flipped classrooms have attempted to measure the impact of this approach on student success. In the majority of this research, regardless of discipline at both the undergraduate and graduate levels, a positive impact on academic outcomes in terms of higher GPAs is reported when the flipped classroom is employed (Dobson, 2008; Flumerfelt & Green, 2013; Forsey et al., 2013; Fulton, 2012; Goldberg & Mckhann, 2000; Kellogg, 2009; Makruf et al., 2021; Mason et al, 2013; McLaughlin et al, 2014;Moravec et al, 2010; Pierce, 2013; Pierce & Fox, 2012; Tune et al, 2013; Wilson, 2013). However, it is important to note here that in several other articles, no statistically significant positive impact on outcomes was reported (Choi, 2013; Davies et al., 2013; Love et al., 2013; Lucke et al., 2013). Similarly, none of the works consulted

reported a negative impact on students' academic outcomes after the implementation of the flipped classroom.

About Governance

Referring to the National Center of the Public Territorial Function (CNFPT), the five governance principles are the following:

- Legitimity, less constraint and social contract
- Substantial democracy and citizenship based on rights and co-responsibility
- Democracy of process
- Partnership between actors
- Partnership intra and inter- governance.

The Higher Education Code of Governance, published by the Committee of University Chairs and revised in 2018, embodies these principles:

- Adherence to purpose. "Autonomy as the best guarantee of quality and international reputation. Academic freedom and high-quality research, scholarship and teaching."
- Dedication to the interests of stakeholders. "Protecting the collective student interest." Transparency. "The publication of accurate and transparent information that is publicly accessible."
- Accountability. "A recognition that accountability for funding derived directly from stakeholders requires Higher Education Institutions to be clear that they are in a contract with stakeholders who pay for their service and expect clarity about what is received. Full and transparent accountability for public funding will be provided."
- Gender and Ethnic Diversity. "The achievement of equality of opportunity and diversity throughout the institution. The principle that Higher Education should be available to all those who are able to benefit from it."

Flipped Learning and Governance Principles in University: A Narrative Debate-based Literature

University and Governance

Setting goals and promoting values through quality leadership and mobilizing the resources necessary to achieve the goals approved by management are the basis for successful university governance and administration. The traditional values of university governance

that appeal to public management dating back to Taylorism are the core managerial values of accountability, productivity, effectiveness and efficiency. Today, despite the role that these values play in achieving effective governance, universities cannot function without concern for their own educational and ethical values. The autonomy of the university is linked to its social value and mission.

Beyond the creation of knowledge for practical purposes: economic profit, social relevance, collective welfare and generally development, universities are also institutions that have a function of interaction with society. These social values involving the community, and in the educational context, the students, should necessarily include truth, knowledge, autonomy, collective welfare and social protection. Similarly, as a public institution, a university should manage its activities with a view to efficiency while promoting respect for democracy, gender and ethnic equality and sustainable development. Stimulating the motivation and satisfaction of the university's stakeholders is also part of its governance objectives. After all the above, we can see that there are similarities, intersections and relationships between the principles of university governance and flipped teaching. The following section will aim to study the potential relationship that exists.

Educational governance is also concerned with educational reform, including the pedagogical issue and the process of renewal of teaching techniques.According to researchers who have tried to examine the possible impacts of this reorganization of pedagogical activities towards flipped teaching (Bishop and Verleger, 2013; Karabulut-Ilgu, Jaramillo Cherrez and Jahren, 2017), the advantages of this method can be presented as follows:

- Increased autonomy, control, and the possibility of individualized progression to students
- Access to numerous contents from different sources and availability of information
- Facilitated dialogue and exchange between students, teachers and external experts.

All of these benefits achievable through this emerging teaching method perfectly reinforce the principles and practices of university and even national governance by creating future employees and decision-makers with deontological ethics, utilitarianism and virtue ethics. And this through the promotion of these values through education that come far ahead of control and monitoring, (Iikka Niiniluoto, 2006).

Complex Governance, Flexible Flipped Education

About Governance

In order to properly designate and respond directly to citizens' needs, many OECD countries have decentralized the management of their education systems and granted more autonomy to educational institutions and local school authorities over the past decades. Accessibility to information on school and student outcomes has become readily available. Similarly, other stakeholders, including parents, teachers, students, and unions, have all become more demanding and more involved in educational decision-making. The increase in the number of stakeholders coupled with the increased use of data related to assessments and accountability, make governance mechanisms increasingly complex. As a result, education systems find themselves in need of a new approach to governance (Tracey & Florian, 2016).

For complex systems, there are five elements of modern governance. Modern educational governance must be able to juggle the dynamism and complexity of the system at the same time. Governance can be considered effective and modern when it is characterized by the following 5 elements:

- It focuses on processes, not structures. Most governance structures can be effective under the right conditions. It is not the number of different levels, and the power held at each level, that determines the effectiveness or weakness of a system, but rather the strength of the alignment across the system, the involvement of actors, and the processes that underpin governance and reform. This is very similar to the principle of the flipped classroom involving the need for group work, resulting in effective communication between participants and mutual relationships to ensure maximum learning by pairs. Like power in governance, knowledge held by one person leads nowhere. The involvement of the whole group, the harmonious collective work makes it possible to achieve the objectives of the course.
- It is flexible and able to adapt to change and unforeseen events such as the use of digitalization. Likewise, the adaptation and improvement process must make use of the maximum feedback and bypass it to adopt information. This can be favorable to guarantee more quality assurance and accountability. We conclude then that flexibility is a common aspect between university governance and the flipped classroom. The latter is largely flexible compared to the lecture, it gives more possibility of learning, and adapts to any spatial or temporal context since it is often

based on distance learning and uses technology. The feedback provided during the class also leads to the improvement of the learning process for the classes that follow, therefore, more quality of teaching, commitment and accountability are guaranteed.

- It relies on capacity building, stakeholder involvement, and open dialogue. However, further stakeholder involvement is only effective when there is a strategic vision and set of processes to leverage their ideas and contributions. Student dialogue and involvement is also one of the main keys to successful flipped learning.
- It requires a comprehensive, system-wide approach. This requires alignment of policies, roles, and responsibilities to increase efficiency and reduce potential overlap or conflict (for example, between accountability and trust, or between innovation and risk prevention).
- It draws on evidence and research to inform policy and reform development. A robust knowledge system combines descriptive system data, research findings, and expert knowledge. Thus, the creation of knowledge through both formal and flipped learning contributes directly to changes in the performance of formal education, which in turn contributes to scientific research and improved governance. This, in turn, contributes to the improvement of educational services.

Flipped Classroom - Time for your Teaching

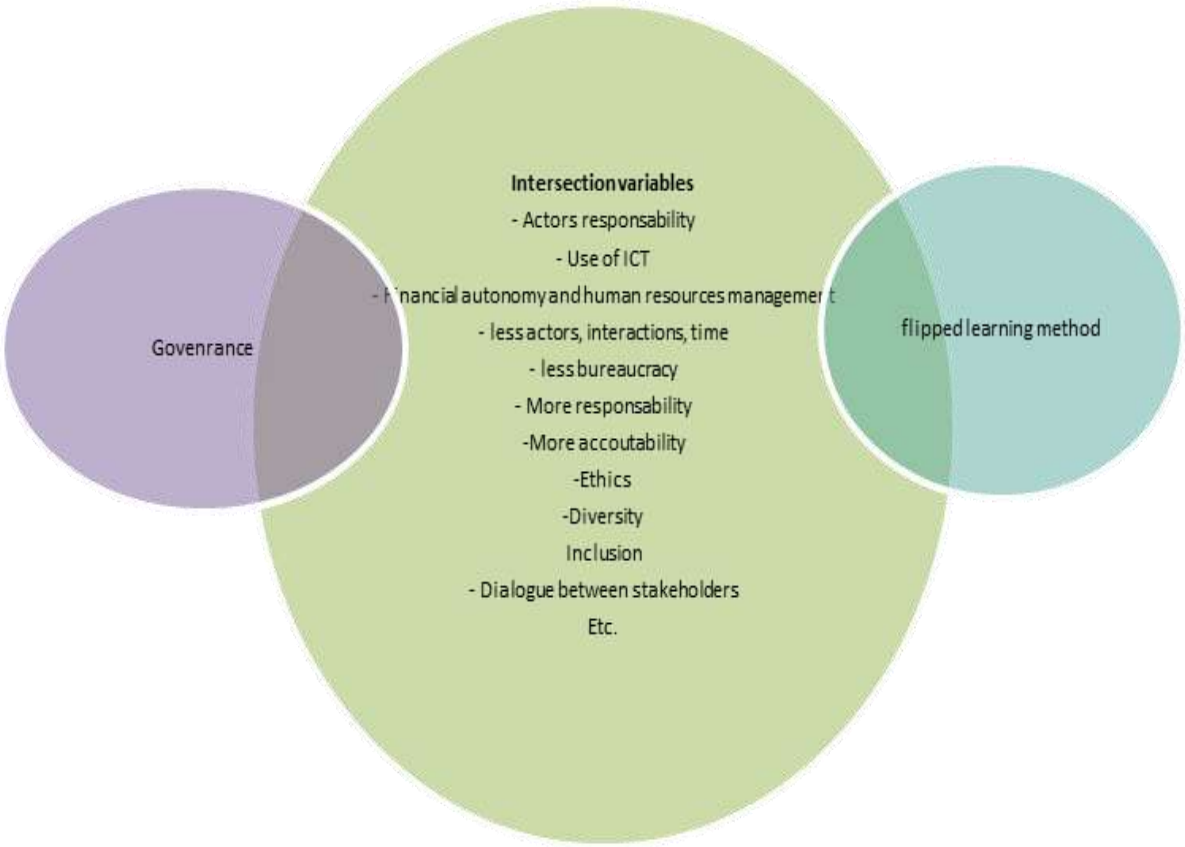
The flipped classroom method has featured prominently in discussions about modern forms of teaching, including those using digital media, for some years now. The basic idea is that in classes that actually take place, the amount of teacher talk is often excessive. Based on the flipped learning method principle, the students arrive prepared for the lesson to solve tasks together and have in-depth discussions. The teacher plays the role of an assistant who supports the students in their work and gives them feedback. Thus, he or she has enough time to study for his or her own, developing his or herself personally and professionally.

Ethics, Diversity, Governance, and Inclusion in Reversed Classes

With regard to the inclusiveness and equity of opportunity among students widely advocated by the Principles of Good Governance, marginal education has often sidelined students with disabilities, especially in developing countries where the infrastructure of higher education institutions is not conducive to their inclusion. In contrast to the flipped classroom, the

population most likely to benefit from the use of such a pedagogical approach seems to be students with disabilities or learning difficulties (Flumerfelt & Green, 2013). According to this study alone, these students are more successful in a flipped classroom than students who do not have disabilities or learning difficulties. Note that the cost to educational institutions is also reduced as there would be less need for note-taking assistance or other services offered to support students with learning disabilities or disabilities (Enfield, 2013; Vajoczki & Watt, 2010). While cost savings are possible, the cost of multimedia production associated with the flipped classroom must also be included.

To recapitulate, here is a synthetic representation of intersection between governance and flipped learning classes:



Flipped Class: A Remedy for Dysfunctional Governance?

Governance is asserted as a system that articulates other systems in the formation of the norm. Nevertheless, it is presented above all as a mode of management and social

legitimization of the norm that makes it possible to combine the principles of legitimacy and effectiveness. Within the framework of the social contract between citizens and government, the latter is obliged to respond to the socio-economic needs of its agents by resorting to good governmental, administrative and, recently, governance practices. In this sense, and in its quest to serve the community, national governance seeks to contribute positively to the poverty reduction process. By respecting the principle of equality of opportunity, each of the citizens belonging to a society must enjoy a stable and decent standard of living. (Maslow's pyramid of needs). In terms of education, socioeconomic background is one of the important factors affecting the success rate of students in higher education (Young, Johnson, Hawthorne &Pugh, 2011).

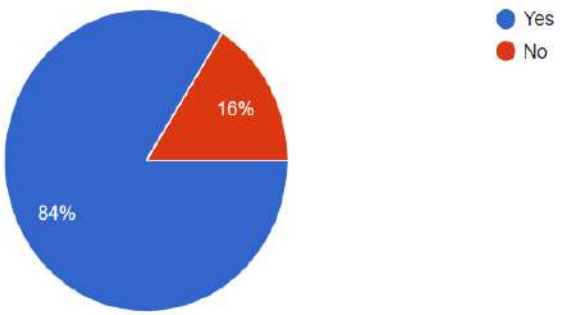
Vezeau and Bouffard (2010) have shown that so-called "first generation" students, referring to those who have no family members who have previously graduated from college or university, generally have low success rates, achieve low scores compared to their peers, and have difficulty adapting to the educational environment and course outlines. This appears to be related to the lack of transmission of knowledge about the educational system in general and of cognitive and metacognitive strategies, normally provided by parents or, to a lesser extent, by another educated family member. If national governance fails to reduce poverty and educational governance fails to build agents capable of correctly transmitting cognitive strategies or even raw knowledge, the flipped classroom could mitigate the influence of these two factors. This is done through the following two means. The teacher's supervision during the class period would allow for a much more individualized approach to meet the specific needs of the students and thus favor the transmission of cognitive and metacognitive strategies (Sherbino et al. , 2013). Similarly, according to Taylor (2011), the flipped classroom could also allow for the partial replacement of costly textbooks and books with resources offered for free online. This may help to alleviate the academic bill for the most vulnerable students.

Results

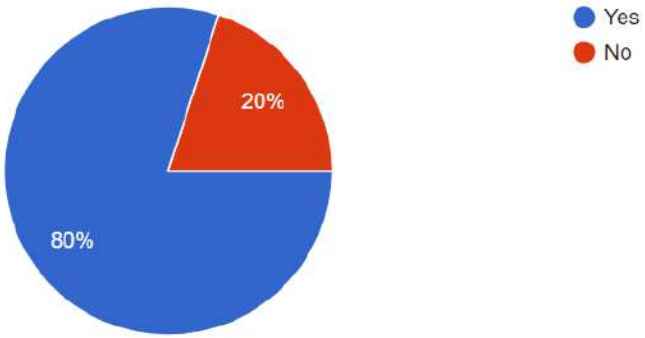
As a part of our questionnaire, we did ask participant students some questions related to our study topic and here is some visual presentation of their answers.

The questions are the following:

- *Through flipped learning courses, do you think that your sense of responsibility has improved?*



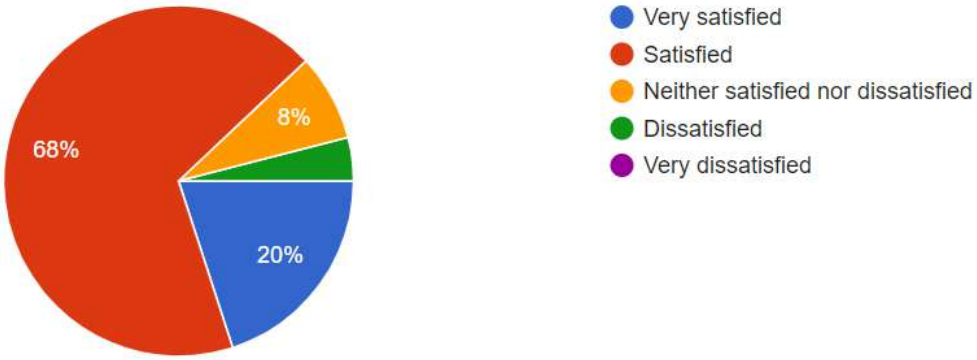
- *Through flipped learning courses, do you think you become more efficient in allocating your resources (time, energy, money) to study?*



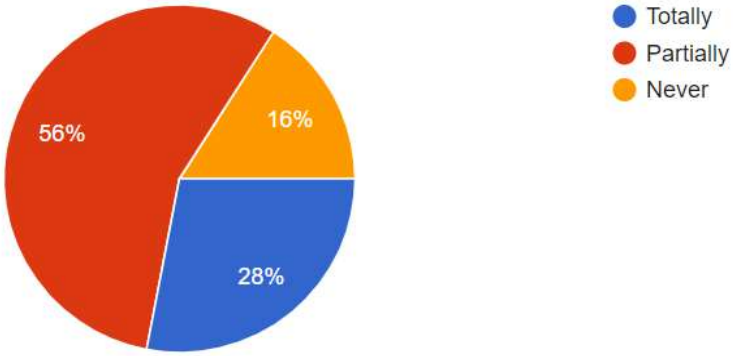
The following are some statistical analysis to other questions linked to university governance (materials, professors, exams...), and globally principles from the point of views of students' who contributed in the survey of our study. The following are the questions we asked:

- *How do you judge your commitment in doing pre-requested homework for the flipped class course?*

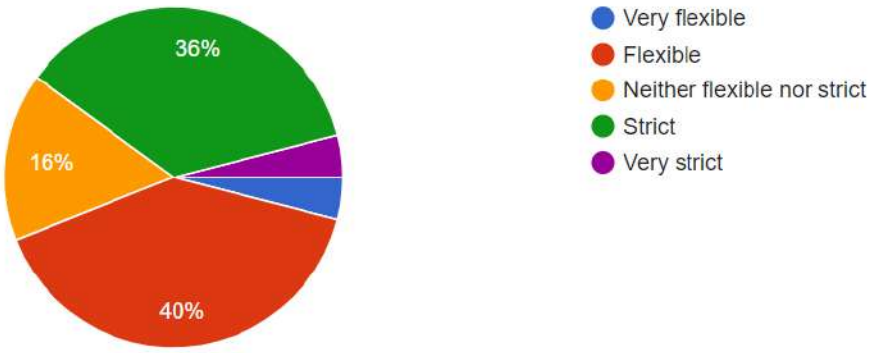
- *How satisfied are you with the work of your professors during the class?*



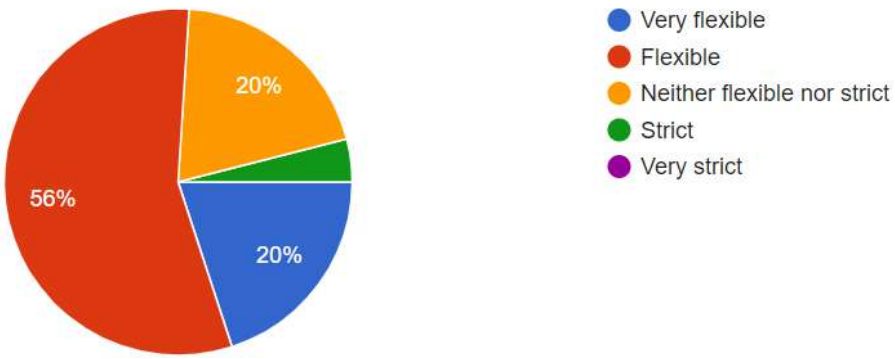
- *How much do the professors include you in choices linked to the study planning or activities for each class?*



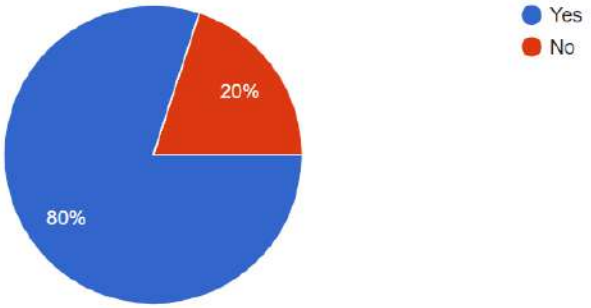
- *How do you judge your professors' flexibility regarding doing homework?*



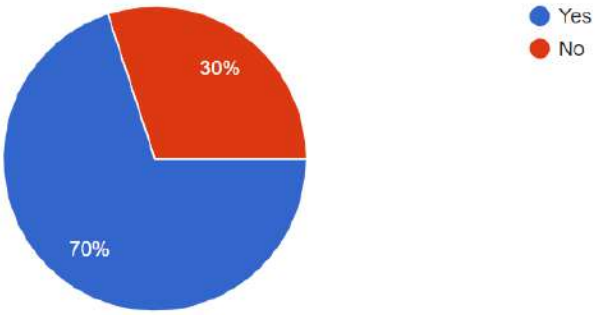
- *How do you judge the professors' flexibility regarding your absenteeism?*



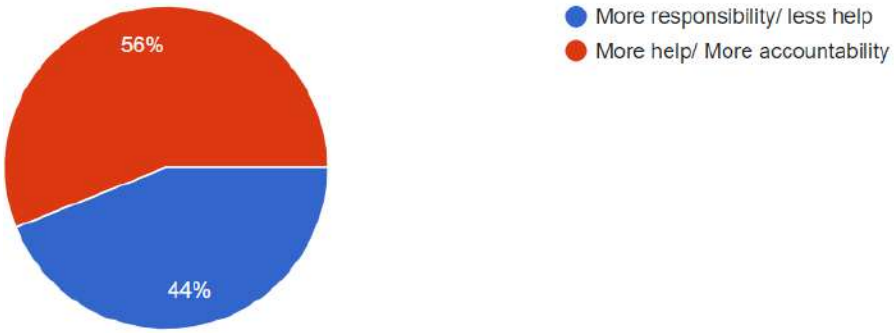
- *Do the teaching materials are easily accessible for you?*



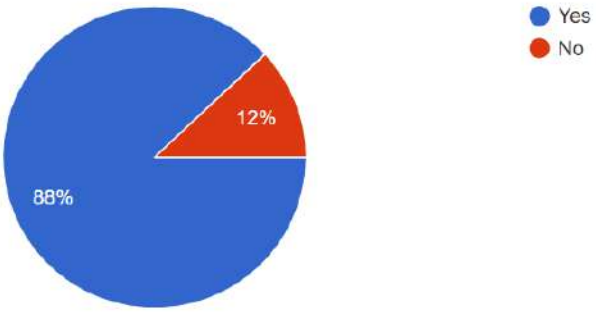
- *Does your parents compensate your technological needs (computer, internet, smartphones, headphones, etc.)?*



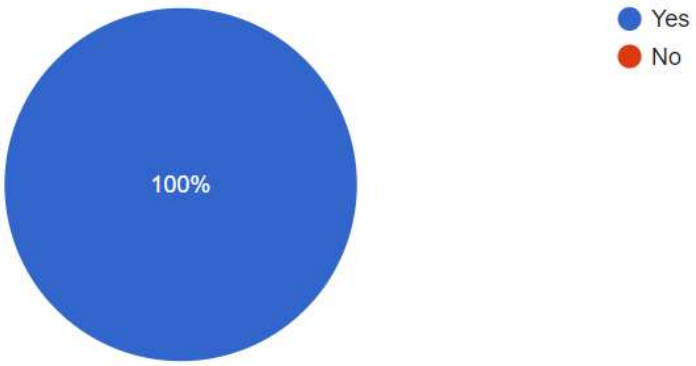
- *What do you think is best for better performance in studying: freedom/self-taught study through flipped classes with less accountability but more responsibility or you prefer less responsibility but more help accompanied with class formalities?*



- *Do you think that self-learning at home did enhance your sense of commitment to studies or other life aspects?*



- *Suppose that your sense of responsibility and commitment did evolve throughout flipped learning classes, are you willing to use those principles in your future professional life?*



Based on the binary correlation, there is a significant correlation between the communication language used during the flipped class and improvement of students' language skills on a level of 0.01, (Annex 1). With a possible error of 0.05, there is a significant correlation between Student's motivation to study via the flipped learning method compared to classic classes and the variable "study style preference: freedom, less accountability but more responsibility or less responsibility but more help accompanied with class formalities, (Annex 2). Similarly, on the same level of error (0.05), there is a significant correlation between entertainment of flipped classes and Improvement of your German language skills, (annex 3). Regarding university governance, the student satisfaction regarding the university material used for flipped teaching is significantly correlated to students' motivation to study via flipped teaching methods, (annex 4). Furthermore, difficulties in dealing with teaching platform is significantly correlated to efficiency in time allocation in studying through flipped learning method, (annex 5). Regarding parents contribution in students' technological needs and ease of access to teaching materials, they are both correlated significatively on a level of 0.05, (annex 6).

In general lines, the results obtained in the first part of literature analysis have proved that there is a huge intersection between governance principles and flipped learning methods. Thus, this new teaching method is enhancing governance norms in practice and in the behaviour of students. In the other side, university governance is highly facilitating the feasibility of flipped learning application. The results obtained in the second part of our study based on a questionnaire recording the point of view of students' have shown that most of the

students perceived flipped learning classes as a flexible and entertaining method of teaching. Regarding sense of responsibility, commitment, and applying the governance principles they learned in their future professional life, the totality had agreed.

Conclusion

The purpose of the study was to investigate the intersection between governance principles and flipped learning methods. This paper has shown that there is huge similarities and linkage between the two. In one hand, flipped learning method enhance the application of governance principles upon students and education stakeholders. In the other hand, university governance makes the practices of flipped learning easier with providing facilities, materials, and regulations.

Through the literature review, we were able to recognize the similarities and differences between the two variables making it feasible asking the right questions two the students' investigated. Participants in this study showed approvment to apply commitment, responsibility, and motivation in their future life. They also indicated that professors was more available for them outside of classes comparatively to normal classes.. This finding can provide insight to educators, students and all educational systems' stakeholders. Thus, we suppose that this study results can be for a good help for stakeholders including educators and administrators to improve the governance of educational institutions' while taking into account the flipped learning method.

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Annex

Annex 1

		communication language during flipped classes	Improvment of your German language skills
communication language during flipped classes	Corrélation de Pearson	1	,365**
	Sig. (bilatérale)		,002
	Somme des carrés et produits croisés	16,119	8,821
	Covariance :	,244	,134
	N	67	67
Improvment of your German language skills	Corrélation de Pearson	,365**	1
	Sig. (bilatérale)	,002	
	Somme des carrés et produits croisés	8,821	36,269
	Covariance :	,134	,550
	N	67	67

**. La corrélation est significative au niveau 0.01 (bilatéral).

Annex 2

		Motivation to study via the flipped teaching method compared to classical class	Study style preference: freedom/self-taught study through flipped classes with less accountability but more responsibility or less responsibility but more help accompanied with class formalities?
Motivation to study via the flipped teaching method compared to classical class	Corrélation de Pearson	1	-,250*
	Sig. (bilatérale)		,041
	Somme des carrés et produits croisés	120,627	-10,791
	Covariance :	1,828	-,164
	N	67	67
Study style preference: freedom/self-taught study through flipped classes with less accountability but more responsibility or less responsibility but more help accompanied with class formalities?	Corrélation de Pearson	-,250*	1
	Sig. (bilatérale)	,041	
	Somme des carrés et produits croisés	-10,791	15,403
	Covariance :	-,164	,233
	N	67	67

*. La corrélation est significative au niveau 0.05 (bilatéral).

Annex 3

		Improvment of your German language skills	entertainment of flipped classes
Improvment of your German language skills	Corrélation de Pearson	1	-,227*
	Sig. (unilatérale)		,032
	Somme des carrés et produits croisés	36,269	-5,194
	Covariance :	,550	-,079
	N	67	67
entertainment of flipped classes	Corrélation de Pearson	-,227*	1
	Sig. (unilatérale)	,032	
	Somme des carrés et produits croisés	-5,194	14,418
	Covariance :	-,079	,218
	N	67	67

*. La corrélation est significative au niveau 0.05 (unilatéral).

Annex 4

		student satisfaction regarding the materials used for flipped teaching at your university	Motivation to study via the flipped teaching method compared to classical class
student satisfaction regarding the materials used for flipped teaching at your university	Corrélation de Pearson	1	,383**
	Sig. (bilatérale)		,001
	Somme des carrés et produits croisés	29,642	22,881
	Covariance :	,449	,347
	N	67	67
Motivation to study via the flipped teaching method compared to classical class	Corrélation de Pearson	,383**	1
	Sig. (bilatérale)	,001	
	Somme des carrés et produits croisés	22,881	120,627
	Covariance :	,347	1,828
	N	67	67

**. La corrélation est significative au niveau 0.01 (bilatéral).

Annex 5

		Difficulties in dealing with the teaching platform	Efficiency of time allocation in studying through flipped learning
Difficulties in dealing with the teaching platform	Corrélation de Pearson	1	,413**
	Sig. (bilatérale)		,001
	Somme des carrés et produits croisés	16,657	15,358
	Covariance :	,252	,233
	N	67	67
Efficiency of time allocation in studying through flipped learning	Corrélation de Pearson	,413**	1
	Sig. (bilatérale)	,001	
	Somme des carrés et produits croisés	15,358	83,104
	Covariance :	,233	1,259
	N	67	67

**. La corrélation est significative au niveau 0.01 (bilatéral).

Annex 6

		Parents contribution in your technological needs	Ease of access to teaching materials
Parents contribution in your technological needs	Corrélation de Pearson	1	,292*
	Sig. (bilatérale)		,017
	Somme des carrés et produits croisés	15,672	4,030
	Covariance :	,237	,061
	N	67	67
Ease of access to teaching materials	Corrélation de Pearson	,292*	1
	Sig. (bilatérale)	,017	
	Somme des carrés et produits croisés	4,030	12,179
	Covariance :	,061	,185
	N	67	67

*. La corrélation est significative au niveau 0.05 (bilatéral).

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Chapter 2 - Factors Influencing the Creation of Dignity Culture in Young Teachers

Magdalini Vampa, Mitjana Profiri

Chapter Highlights

- The main aim of this study is to explore on the culture of dignity in preparing new teachers and the factors that influence this model.
- In achieving this goal, was applied a qualitative method with the participation of teaching-interns in social sciences, mathematics - physics, biology - chemistry, from the Faculty of Human and Natural Sciences, at University of Korca, Albania.
- There were 15 purposeful selected students who were trained on the 'Model of Dignity' and made it part of classroom teaching culture during their internship in Korca high schools.
- Categories and sub-categories related to factors that can influence the creation of a culture of dignity in young teachers were defined as: personal (teacher's cultural background, specialty profile), teacher competence (scientific, professional competence), communication and behavior (classroom leadership style, verbal communication, nonverbal communication, traditional model, desirable teacher model).
- This chapter brings to attention the importance of culture of dignity in educational institutions and influencing factor such as inherited culture and traditional teachers' models that face the culture of dignity.

Introduction

The educational institution is defined as the most important institution in which instruction, or the transmission of knowledge, is carried out intentionally. The teacher's role is to lead or direct this process. "The language they (leaders) employ may or may not reinforce dignity in the workplace, and that language of dignity transcends the inspirational language that is sometimes necessary" (Latemore, 2017, p. 149). Henry Adams in his book "The Education of Henry Adams" republished several times (1983, p. 290) points out, "Teachers influence eternity. They never know where their influence ends." Continuing this thought, Maya Angelou says, "Students will remember how you and your classroom culture made them feel more important than the content they were taught."

Respect for human dignity is a fundamental universal right that provides the foundation for the Universal Declaration of Human Rights. (UN, 1976) The culture of dignity in Albanian schools was granted special attention, discussed from the teachers' ethics point of view. All of the above, is reflected over the years in documents and instructions provided by the Ministry of Education such as: The Code of Ethics for Teachers in Public and Private Pre-University Education (MES, 2011; MES, 2013) and by the Institutions subject to it (IZHA, 2019). The attempt to eliminate school violence is evident, by considering it impermissible. In the study field of civil society institutions (Save the children, 2017) or international institutions such as the Council of Europe (2019), its presence in school is still brought to attention.

Albanian youth themselves consider human dignity their most important value. This would be emphasized in the results of two empirical studies conducted by the "Friedrich Ebert" Foundation (2013, 2015) "The most important values among young people in Albania are personal dignity, tolerance and punctuality." (2013, p. 27) "At the edge of the hierarchy of values identified by respondents, we see that personal dignity is the most important value with 61.5 percent of respondents qualifying it as the most important value" (p. 48). When asked about their own values, over 40 percent of youth believe that personal dignity is the first and most important value they uphold (2015, p. 19).

This study intended to describe the influencing factors for building a culture of dignity. "Factors influencing dignity are said to be dynamically subjective" (Mannokian et al, 2013, p.1), but the creation of a culture of dignity in young teachers can be externally influenced by

his or her upbringing and circumstances. The study found that traditional models (of teachers and school models) were the most essential contributing factors that influenced the individual's and new teachers' education. "Many of us remember the teachers who shaped our lives in a positive way, but also such teachers or principals, who degraded the dignity of children, favored males over females, or vice versa, or were interested only in the children of influential parents" (Gluchmanova, 2013, p. 152). Interventions in these "old" models, which tend to harm dignity in its vulnerability, require the education and training of new teachers with a culture of dignity that can serve as a model of knowledge and behavior, and equally as a teaching model and work process. "Educating ourselves about the significant role dignity plays in our lives and how to treat others with the full recognition that they matter should be a top priority in our educational system, but it is not" (Hicks, 2018, p. 54).

Albanian society comes from a totalitarian regime, as do some Eastern European countries "throughout the twentieth century, many European countries had authoritarian governments and many were occupied by what we now call rogue nations" (Kozercka & Stec, 2018, p. 1116), where individuals were "stripped" of their dignity by declaring them "class enemies, misappropriating them of their private property" (p. 1116; AQSH, 1956, D. 78). The early years of this regime's establishment in Albania projected the teacher's model primarily characterized by proletarian discipline (AQSH, 1967, D. 10), which aimed at the formation of `red commissars`fueled by communist ideology. According to Vaclav Havel "the red ideology offered human beings the illusion of dignity (Havel, 1979, ed. 2018, p. 17) …also, post-totalitarian systems hit people at every turn, with their gloves on" (p. 18). The Ministry of Education of Albania and organizations in between their collaboration, have conducted studies related to the violation of dignity, such as the exercise of violence in schools (IZHA, 2019) with subsequent applications of documents and legal acts aimed at preventing and punishing it (Kodi i Etikës (Code of Ethics) 2012, 2013). This study seeks to describe the factors that influence the culture of dignity in schools by focusing its education towards young teachers. Finding those factors will help new teachers improve their understanding of this internship, help improve the curricula that prepare new teachers in education faculties across the country, and promote a culture of dignity in the classroom.

Methodology

This qualitative study was conducted in Korça, Albania, during the period 2021-2022, using

inductive content analysis. This analysis is considered to be the most appropriate method to find and describe the factors that can influence or undermine the culture of dignity in young teachers, in the Albanian school environment. Content analysis must predict or infer phenomena that they cannot directly observe. "The inability to observe phenomena of interest tends to constitute the main motivation for using content analysis" (Krippendorff, 2004, p.10). The observational technique in detecting influential factors in a teaching culture of dignity would compromise the validity of the data. The interns defined in the sample would 'hide' reality by seeking positive evaluation from their teachers, assigned in the role of observers, as well as highlighting factors influencing the culture of dignity. All of this would hide the real data.

“Content analysis is an unobtrusive technique that allows researchers to analyze relatively unstructured data in view of the meanings, symbolic qualities, and expressive contents they have and the communicative roles they play in the lives of the data`s source” (Krippendorff, 2004, p.44). Referring to the nature of this topic, due to the theoretical insufficiency in recognizing the influential factors on the culture of dignity in the Albanian school reality, the study used conventional content analysis, one of the three content analysis approaches (Hsieh & Shannon, 2005). “This type of design is usually appropriate when existing theory or research literature on a phenomenon is limited. Researchers avoid using preconceived categories, instead allowing the categories and names for categories to flow from the data” (Hsieh & Shannon, p. 1279).

Participants

Participants in the study were 15 second-year students in the Professional Master's Programs "Teachers in Secondary Education," consisting of 9 females and 6 males, divided equally across three profiles Social Science Teachers, Biology-Chemistry Teachers and Mathematics, Physics, and Computer Science Teachers. Participants were deliberately selected and trained in 7 weekly sessions prior to the internship with the Dignity Model according to Donna Hicks (2018, p. 15):

Identity acceptance. Give others freedom to express their authentic selves without fear of being negatively judged, etc.

Recognition. Validate others for their talents, hard work, thoughtfulness, help, etc.

Acknowledgement. Give people your full attention by listening, hearing, validating.

Inclusion. Make others feel they belong, at all relationship levels family, school, country.

Safety. Make people comfortable on two levels: physically and psychologically, etc.

Fairness. Treat people fairly, with equality.

Independence. Empowerpeople to act on their own behalf.

Understanding. Believe that what others think matters, etc.

Benefit of the doubt. Treat people as if they are trustworthy, etc.

Accountability. Take responsibility for your actions; apologize if you have violated another person's dignity.

Teaching practice is an important element of the program that occupies 7% of the course credits capacity. Interns develop it in Korca district high schools and in a duration of 8 weeks, two weeks consist of passive practice and 6 weeks of active practice. The internship is the subject concluding the students' professional preparation in teaching programs.

(1) The willingness to be an active part of the training, (2) practicing the dignity model, and (3) the criterion of being non-religious practitioners were the indicators upon which their involvement in the study was based. The latter was considered by both scholars to be avoided because research on this factor's interventions in the new teachers' personality and behavior would require religious explanation and knowledge. In the secular school setting, we thought we would not confuse the participants and the final interview with these interventions. At the end of the internship they will be interviewed through semi-structured questionnaires about the experience and feedback of the implementation of the dignity model during teaching.

Table 1. Participant Demographic Data

Participant	Gender	Age	Participant High school (city or village)	Specialty profile	Who/what motivated them choose the teaching profession	School where they perform the professional practice
1ASS	female	27	village	social sciences	parent	high school village
2KSS	female	22	city	social sciences	passion	private high school City
3TSS	female	22	city	social sciences	friends	high school city
4ESS	female	23	village	social sciences	family	high school village

Participant	Gender	Age	Participant High school (city or village)	Specialty profile	Who/what motivated them choose the teaching profession	School where they perform the professional practice
5ESS	male	26	village	social sciences	family	high school city
6AM	female	22	city	math-physics-informatics	passion	high school city
7DM	male	23	city	math-physics-informatics	passion	high school city
8SM	male	22	fshat	math-physics-informatics	parent	high school city
9PM	male	23	city	math-physics-informatics	family	high school city
10AM	female	22	city	math-physics-informatics	family	high school city
11KB	female	30	village	biology-chemistry	friends	hight school village
12AB	female	28	city	biology-chemistry	desire	private hight school city
13BB	female	22	city	biology-chemistry	parent	high school city
14EB	male	23	city	biology-chemistry	parent	high school city
15OB	male	22	village	biology-chemistry	desire	high school city

Data Collection

Research data was collected using semi-structured individual in-depth interviews. Student participants were asked to describe their experience in 4 of the 8 weeks of active teaching in respect of the culture of dignity, a model under which they were trained for 7 weeks. In June 2021, they were interviewed for two weeks in the presence of both authors of this study. The data collected from the interview was recorded by the researchers. The demographic data presented in Table 1 was collected at the beginning of the training, while the communication in the interview about the teaching experience according to the dignity model was based on general and equal questions such as:

- Do you find the culture of dignity applicable?

- What has it changed about you personally and professionally?
- Which of the elements of the dignity model has been easiest to implement, but most difficult?
- How do you rate students today?
- What is your attitude toward the class in which you have been teaching?
- What have you changed about controlling student choice, responses, and perspective?

These questions were progressively followed by more specific questions, such as:

- Can you explain the most difficult elements of communication?
- What stood in your way?
- How did you feel when you apologized?
- Did you feel that this pattern was causing you more fatigue and stress?

Each interview was conducted face-to-face and lasted 40-60 min. Interviews were handwritten alternating in time by both authors. "Credibility can be established through activities such as peer debriefing, prolonged involvement, persistent observation, triangulation, negative case analysis, referential adequacy, and member checking" (Lincoln & Guba, 1985; Manning, 1997, as cited in Hsieh & Shannon, 2005 p. 1280). Any notes taken were used by both authors in the coding and categorization process, independent of each other. This ensured the construction of the coding scheme and extraction of categories, up to the abstract idea of discovering the factors of the traditional model affecting the classroom culture of dignity.

Data Analysis

A conventional inductive content analysis was performed for data analysis in this study. Researchers were fully engaged in in-depth interviews of participants then listened carefully to their responses. In addition, they kept notes (a common protocol) by alternating the length of the interview, up to 60 min. These manuscripts were thoroughly and carefully read, individually. The first stage of the coding process, "open coding" (Pace, p.190) was performed independently by both researchers, valuing the importance of identifying concepts as meaningful as possible. Subsequently, the other two coding steps were jointly processed by both researchers resulting in category and main category. "Each category is named using

words, characteristic of its content. Subcategories with similar events and incidents are grouped together as categories and categories are grouped as main categories" (Dey, 1993, Robson 1993, Kynga¨s & Vanhanen 1999, as cited in Elo & Kyngas 2008, p. 111). The process of abstraction has been more confidently confirmed by both researchers. "Abstraction means forming a general description of the research topic through the generation of categories. The process of abstraction continues as far as is reasonable and possible" (Robson, 1993, Burnard, 1996, Polit & Beck, 2004, as cited in Elo & Kyngas 2008, p. 111). The manuscripts were kept confidential by the researchers to be available for any replication of the study by the researchers themselves or by other researchers. Specifically, the coding process from open coding to the main category is presented in Table 2

Table 2. Coding Process

Sub-category	Generic categories	Main category
Cultural background of the practicing teacher	Personal	The traditional teacher and school model influences the application of the culture of dignity in this institution.
Specialty profile		
Professional satisfaction	Teacher's compentency	
Scientific Competence		
Professional Competence		
Communication style	Communication and style	
Evaluation		
Control		
Punishment		
Prejudice		

Ethical Consideration

Study participants were trained by two researchers who are also professors of the subject Cultural Foundations of Education and Professional Ethics, as well as of pedagogical practice. The training was conducted after written approval from the department heads and professional practice professors. Students willingly incorporated themselves into the 7 weeks of training into 2 hours per week. The dignity model does not detract from the development of practice according to the planned schedule. It only enriches the knowledge about the

teaching style, behavior, reaction and attitude of the teacher, where the standards that respect the Universal Convention of Human Rights are applied, as well as the guidelines of the Ministry of Education mentioned in the previous section. The experience interviewed in the manuscript avoided using the names of teachers or students when they were brought in for the interview, using codewords in the manuscript: such as student A, mentor X, etc.

Results

In this section, we will present the interns' experience with the culture of dignity and the factors influencing them in implementing the dignity model in the classroom beginning from their perspective.

Personal Interaction

The study participants during the interview emphasized that the "cultural background of teachers and students" are important factors in implementing a culture of dignity, understanding dignity itself, and the mechanisms of its protection when violated:

> Student 11KB, age 30: “Before the training, for me, the dignity of the teacher was the authority of the teacher being a scientific authority over the students. During this experience, the former was mixed with a more human perspective.”

> Student 1ASS, age 27: “I think there is a contradiction between the dignity model and the traditional model of classroom behavior. I don't remember high school teachers ever saying 'sorry' when they were wrong scientifically. I did, I apologized. The students themselves were amazed, saying one by one, quickly `it's okay, no problem`. I felt like them. Like children. I don't know whether it will be appropriate or not, to apologize again in front of the class, when, in case it happens, I would have made a mistake somewhere!”

There were no differences observed in the participants' age, gender, or urban/rural education. There were similar opinions and attitudes in terms of personal category.

The specialty profile demonstrated an impact on the willingness of making culture of dignity an integral part of the entire lesson. Specifically, student 8SM, age 22, profile math-physics and informatics:

> the moment they don't listen to me but talk to each other while I am teaching, I will protec my dignity and authority. I think of my favorite math teacher who turns to my classmates in the same situation and says under his breath: after one week we have a test. There you can talk!!!

Social science teachers were not subjected to this type of "threat" with evaluation or control in the case of challenging behavior. Interview the following questions (student 8SM):

> Did this intervention work?
>
> Of course, as always.
>
> Do you think their dignity was violated?
>
> Mine has been violated, too. If I allow noise, my authority is lost, my dignity is violated.

Although trained and with a clear perspective on the dignity model, teacher authority, a concept and style established in their minds through culture, is very compromising in the application of the former. Student 12AB, an intern at a private school:

> The leaders of the private school in the introductory meeting asked for formal attire and considerate communication devoid of insults and threats. -We get paid by the students and their parents, - said the principal. The orientation of my performance was more toward human impact than practical accomplishment. I addressed them with the 'you' of courtesy, while they (the students) never addressed me in the same way.
>
> For this institution to function as a private enterprise, students expected ethical behavior and respect for their dignity from teachers, but they saw it more as an obligation because they did not apply it to each other or to teachers.

Significant culture interference and the way practicing students and teachers conceive of the teacher emerges from the above interviews, following an authoritarian model that can rarely be wrong.

Teacher Competency

Most of the interviewed students identified teacher competence as one of the influential factors in implementing a teaching culture of dignity. Based on their attitudes, "scientific competence," "professional competence," and "professional commitment" (satisfaction and

choice of profession) were selected as subcategories that influence the creation of this dignity climate. Participant 6AM, age 22, who loves the teaching profession, says during her practicum experience in a private school,

> Geometry explanation hours are the hours when I can expect every question from students, encourage them to ask questions, work on exercises one step at a time. I also know when to intervene with (Socratic) questions in order for them to overcome the difficulty and move toward a solution. I have also prepared exercises for every student level. I allow them to develop their algorithm all the way through, so that they do get convinced of their error, as well as not being ashamed of being wrong in front of me or their classmates. When I listen carefully to them when they make mistakes, their classmates do not laugh. The student is not offended by being wrong. The training made me realize something; "When I take the student to the board and after they answer, they will go back to their bench without any subsequent comment, even if they made a mistake in their answer."

> The teaching profession is not a very passionate choice", says student 11KB, age 30: Professional practice in trying to apply the dignity model challenged me with `fairness`. In the chemistry experiment (one of the few that can be applied due to lack of lab equipment), I did not follow my mentor instructions to have only the `good` students to design the experiment and the others to observe it.

> Those who have never perform an experiment by themselves, today could do it...the reluctance was short lived, they didn't think this proposal was serious. Can we do it?!... and then enthusiasm and commitment made them accountable. Impartiality was important. The next time, those whom the teacher had consistently rated, below average, wanted to respond insistently.

Practitioner 15OB said:

> Five min before teaching class, I got some advice from the mentor teacher and just walked into the classroom. I started the class and the mentor teacher came in right away and said out loud: -wear your masks well, quick, you and you- addressing two or three students in the class, with his index finger, -split up, leave one chair empty- and he turned to me - Here come the mask inspections...don't leave students without masks on their noses until the principal arrives with the two health inspectors!

> I too felt insulted: -for me your health is a concern, I am a chemist, biologist and I know the importance of distance and masks. I wear the mask to protect you. You have to safeguard me and each other! How does the virus spread? How heavy is it? Why do we keep the windows open, etc.? Several times I clearly stated: your safety is my concern...this was the sentence I was certain of. I wanted to tell them that I valued them and that their physical and psychological safety is an institutional concern.

Satisfaction with the profession, based on the mode chosen, in the demographic data in Table 1, it was found that 53.3% of the participants chose the teaching profession encouraged by their parent and family, 33.3% pursued their passion, and the desire of some of the interviewers had been formed by their model teachers, 13.3% were influenced by their living society. The evidence for these career choice data findings is supported (Broen, 1992, p. 296). "The possibility of a shift toward a 'free market' education system and the 'ideology of kinship' in Russia and other post-communist nations must remain an open question." In addition, last year's nationwide survey on choice of profession found that "family influence (36%) was the highest scoring item, followed by teacher influence (29%) and peer influence (14%)" (Nano et al., 2022, p. 87).

However, in our study, this variable did not influence the dignity model in either its understanding or classroom implementation. New teachers show the same interest and willingness to apply the culture of dignity. Also, the interview about the experience of applying the dignity model did not differ, with respect to this variable.

Communication and Behavior

This is the category that participants brought to the attention of the interview as the most influential and direct factor of model implementation in their attitudes and opinions. This can be seen in the interview quotes and in “the authoritative or formal style, in verbal and nonverbal communication” (Mohanna et al, 2008, p. 6). Some very traditional elements such as bias against students (age range), discipline or punishment, and control over student choices are influential factors in the new teachers' acquisition of the dignity model and the return of this model to a culture of dignity.

Communication Style

"Try to gain authority," the mentor told the student 2KSS, age 22:

> I've been trained these past few weeks to be dignified and to treat students with dignity.

> Yes, that's what I'm saying: authority and dignity are established as soon as you enter the classroom. Don't let them make fun of you.

Choice Control

Student X in grade 11 says to 2KSS:

> We never choose, nor do we choose elective subjects ourselves. The custodial teacher decides that.

Punishment and Discipline

Discipline comes from the past of a primitive model in which the words proletarian discipline, iron discipline, etc, are derived from communist vocabulary and its reminiscences are still evident. Specifically, student 1ASS:

> If they interrupt class and talk without permission, have a conversation, make a phone call, etc., send him or her outside the classroom, send him or her to the principal, or to me. You have noticed my way of communications during the first two weeks of intership?! Tell them (pupils)! The test date is here and there you will prove how smart you are!!!

Students stated that discipline was the concept involving the other two (punishment and detention) and that the punishment (expulsion or being sent to directorship, etc.) brought short-term solutions to the problematic situation, but was still repeated by the same student or their friends. Related to discipline, everyone in the interview felt that: "the form of setting 'new' rules based on the model of dignity, did not produce any result.

Prejudice

In the question that guided the interview: Which of the elements of the dignity model is most difficult to adapt? Participants began to build a picture of the classroom, judging the trends of this generation, parental interest or disinterest, their passions away from the book, students who do not have personal libraries, students who do not read, etc.:

> When I wanted to get to know their identity and stimulate with rewarding words their characteristics and talents displayed during the learning activity, I found myself very quickly moralizing them, telling them how they should be, what's in store for them in the future, etc. (student 3TSS, age 22, interning at a city high school)

Attire

Student 12AB states that:

> The uniform selected by the school was a dignified solution. When I walked in in a suit, a significant distance was established between me and the students. Whereas when I walked in in casual attire, they felt a greater freedom to talk. The first day they looked at me from head to toe. There I realized the importance of attire. The clothing communicated the importance I placed on the learning process.

Infrastructure

City schools, especially those in the city center, feature infrastructure that preserves the student's dignity. That infrastructure serves them well. In private schools, the infrastructure is dignified.

> I would love to work in such a school. (Student 2KSS)

In country schools,

> the lack of hygiene in the restrooms, as well as the lack of labs, is not dignified. (Student 1ASS)

At the end of this section, one can state that the culture components and teacher models that shaped the desirable mind and profile of young teachers have a direct relationship. Training in this culture of dignity can lead to an improved understanding of dignity and its importance in today's societies. In addition, this training will serve to improve the teacher model that

prepares people to be multifaceted knowledgeable individuals and dignified citizens of the future.

Discussion

The factors that influence new teachers' acquisition of the dignity model and its application in the school are numerous and complex. Based on the study findings, we list several factors that directly affect the application of the culture of dignity: personal, teacher competence and tradition models. Referring to the Universal Declaration of Human Rights, teachers are particularly aware of the right and usefulness of respect for dignity regardless of age, gender, religion, social status or intellectual ability. In the first steps of this study's application, the goal was to create awareness about dignity. "Human dignity is the fact that every being has by nature: a defined objective position within the diversity and heterogeneity of the species, which requires respect and protection, moreover the realization of these two in relation to others and with oneself" according to Rahner Karl (1975, p. 236). This is because teachers, according to Adams (1983, p. 290) see themselves as “good influencers with abilities and a source of power”, towards students. But first, they must know and believe that at the center of this inner source is Dignity and awareness in this regard allows us to develop mutually beneficial relationships with others and positive changes in our relationships with others and with reality, and the world around us. "Managing our power wisely and sincerely can only happen if we recognize the value and vulnerability of ourselves and others and do not abuse it" (Hicks, 2018, p. 11).

Prior to the practicum, the training made students aware of the dignity of themselves and each other. The stages of the practicum helped them understand the implementation of the dignity model. The results showed that even after the training, after the classroom experience, new teachers "confuse or substitute" the concept of dignity with the teacher's authority. "Your teaching style...may have been emulated by some particular models you admired and influenced your style. You may have unconsciously tried to emulate a teacher you found inspiring in the past, or you may have purposely avoided being like a teacher with a discouraging style. Or.... you may have been influenced by the training and feedback you received while preparing for your role as a teacher" (Mohanna et al., 2008, p. 77). With respect to the results of the study it should be noted that the inherited teacher model prevails in the style that young teachers display in front of the classroom. This again emphasizes the

importance of training and continuing education that higher education institutions should develop with teachers by putting themselves in the service of the new educational paradigm with the student at the center to function as a more democratic and effective model to prepare the next generation.

In the GLOBE study presented in 2004, conducted in 62 companies, the expert group of this very important project in the field of leadership culture argues about the following cultural clusters for Western Europe: "The most common explanation of the Eastern European cluster is based on Soviet Hegemony. The Soviet factor, while obviously important, does not reflect other relevant forces..." (House et al, 2004, p. 182). “Western European countries tend to value achieved status: that is, social standing and prestige reflecting the ability of an individual to acquire an established position in society as a result of individual accomplishments. This study highlights the trend toward this factor through education and training. In contrast, Eastern European countries tend to value ascribed status: i.e., social position or prestige that is the result of inheritance or hereditary factors” (Smith, Dugan, & Trompenaars, 1996 as cited in House et al, 2004, p. 185).

The interview with the participants clearly showed that the inherited figure as a teacher role model appears to be a primary tendency of behavior and style in their early experience toward teaching and the profession. Specifically, the difficulty in apologizing to students (lower intellectual position), threatening with a test grade, etc., indicate authoritative behavior; furthermore, the autocratic style, when teachers do not allow students to choose, perspectives, interpretations and arguments other than the text or the teacher's algorithm according to the Janus aspect of education (Bruner, 1996, p. 15). The variable that could interfere with the construction of the new “teacher's personality, such as religiosity” (Manookian et al 2013, p. 7) was almost excluded in this study from the time of sample selection. This is because, as teachers, they serve a secular system and interviewing on this variable could be confusing. Student participants reported that they were not interns and that they belonged to a Muslim or Christian religion based on family affiliation. These data were not presented in Table 1, because they were considered to be avoided in their intended impact.

The direct impact of teacher proficiency on respect for dignity is also evident. The possession of knowledge, makes them more confident and enhances interactive communication, allows

for pupils questions, encourages them to research and suggests ways toward research, clarifies rules of evaluation, ways to check, respect for one's dignity and make sure not to step on it. "Teachers' respect for their students' dignity should also manifest itself through the way they fulfill their professional obligations; one of which is to clarify to students, from the very beginning, the details of their study, the evaluation criteria, the dates of their sessions, etc. Each lecture or seminar should start on time and provide students with help or advice if needed (Glucmanova, 2013, p. 152).

While the inability to master scientific knowledge makes them more likely to use authoritarian language and behaviors that tend toward psychological violence, so they can command the classroom and avoid the scientific and professional uncertainty that can be challenged very quickly by students. "Teacher education in Albania is in a state of uncertainty." (UNESCO, 2017, p. 137) and "...is not moving at the right pace; the challenges to improve new curricula are great and the need for new, well-prepared teachers is unquestionable". (MAS Report, 2014, p. 33). Meanwhile, the OECD 2020 Report (Maghnouj et al. 2020 p. 23), "major curriculum reform since 2014 has changed expectations about teachers' roles. For example, teachers are now expected to use student-centered approaches to support learning in their classrooms. However, many teachers in Albania continue to use a traditional approach to teacher-centered instruction, and teacher interviews show limited application of some of the more innovative aspects of the reform such as formative assessment and 21-st century skills teaching."

Throughout the study we can emphasize that the professional preparation of new teachers must aim to create a dignity model so that they see this behavior not only in the classroom but also in the school environment beyond its backyard. Communication and behavior are directly related to the patterns of tradition. The preferred teacher, or model of the traditional teacher in our society, remains in the mind of the new teacher. "Studies have shown that even though the Albanian educational system is implementing many reforms, teacher professional development still remains a problem" (Lama et al, 2011, p. 48) "Albanian teachers currently vary in their qualifications and experience with more interactive and student-centered pedagogies. Studies have shown that approximately 70 percent of Albanian teachers were educated during the communist regime" (p. 48). This was evident in the interviews. They often mention and compare their behaviors according to the dignity model with the tradition model.

Judging the class, the generation of children and saying they are not interesting in reading books, the ways of exercising punishment by seeking discipline, the tendency to evaluate what pupils don't know(and not what they know), are old elements that stay in their minds. "With the help of supervisors...perhaps teachers can learn to monitor their own judgment, attribution, and control choices" (Raths, 1964, p. 340). In the 10 elements of the Dignity Model (Hichs, 2018, p. 16), young teachers discover how the old teacher tradition influences their behavior: they identify with themselves the good pupils, which come from families with good reputation, etc.; they do not show concern for their health, physical and psychological safety, but for being comfortable with the rule or leader (the case of the masks); they select the group of students in which they feel comfortable while neglecting and overlooking the rest who ask for help from other "scaffolds", etc. Based on the above, the study concluded that tradition along with its elements has a deterrent effect on the implementation of this model. In these findings, education of young teachers with a culture of dignity is an issue that should encourage university curriculum designers and the Faculties of Education to consider this model as a starting point in the process of making dignity culture part of the educations institutions.

Conclusions

The culture of dignity in the school is at the core of the training and education of the active citizen, who aims with courage and confidence to succeed towards an uncertain future. This study highlighted several factors that influence the implementation of this culture by young teachers in the Albanian school environment, such as: personal characteristics, teacher competence, style, inherited patterns of communication and behavior. The results of the study brought to attention, in line with previous studies (Hicks, 2011, 2016. 2018; Hodson 2004; Latemore, 2017), the importance of a culture of dignity in various organizations and institutions in society and especially educational ones. This is important because it promotes the personal and social well-being of the individual which directly affects the success of the organization and the progress of society. It is evident that teachers are accompanied by anxiety and stress towards student achievement; and adding to this the elements of the tradition of a post-totalitarian society, the violation of dignity remains a concern for the institution of education.

The students involved in this study were confronted in their experience of implementing the dignity model with elements of tradition, and the study resulted in describing some elements of communication and behavior that inhibited the implementation of this model. Discipline as an old concept and punishment as part of it, should require a reconceptualization, based on the preservation of dignity, because in any case will not yield results. "If a great power agreed to make me always think what is true and do what is right, on the condition of being a kind of watch and waking up every morning before I got out of bed, I should be instantly done with the offer" (Huxley, 1893 cited in Skinner, 1971, p. 69). Referring to the results of the study, the high scientific and professional preparation of the teachers in the faculties of education should be considered and promoted, as well as the proposal of on-the-job training and incentives for continuous qualification, etc., for the incumbent teachers.

The infrastructure of the educational institution must be dignified, because it indirectly conveys the respect that the state and society pay to teachers and students as an irreplaceable institution of generational education. They should promote a culture of dignity to school leaders so that they themselves can be confident in its impact on staff well-being when they feel equally important to the institution. These are part of the "secret curriculum" concept that educates young students and teachers alike with respect to the intentional content of education.

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Chapter 3 - Analysis of Elementary Curriculum with Reference to National Qualification Framework

Tahzeeb Mahreen

Chapter Highlights

- The current study was conducted to analyze B.Ed. (Hons.) Elementary Curriculum with reference to National Qualification Framework 2015, with a special focus on the integration of communication and social competence by using mixed methods research design.
- Under mixed methods design, the embedded design was used with two-phased (sequential) approach.
- Qualitative data was analyzed through thematic analysis while quantitative data by using descriptive statistics measures.
- The results of the study showed that communication skills (CS), cooperation and teamwork (CT), solution finding and resolving interpersonal conflicts, management and social responsibility(SM), monitoring (M), and effective usage of information communication skills (ICTS) are six main characteristics of communication and social competence.
- The results of the content analysis showed that against six components of communication and social competence, “communication skill” is assimilated into the curriculum with the highest ratio while “cooperation and teamwork” with the second highest ratio.
- Strong responses of teachers towards the use of all the approaches show their knowledge of curriculum and understanding of the effective use of these approaches.

Introduction

Communication and social competence is a not a new phenomenon rather it is classical and established subject and considered a prerequisite for spending life since the inception of human life. It is the fundamental need of human capability (Gresham & Reschly, 1987). Communication and social competence is an important component to be an effective member of the society as well as it is the demand of the globalized structure so need to develop it in our future generations is obvious. But the key reason to focus on it is its need to students at every level. Poor development of communication and social competence of students lead to some augment atrocities such as behavioral problems like peer rejection, poor self-concept, academic failures, isolation from peers, concentration difficulties and problems in interpersonal relationships (Hartono & Ozturk, 2022; Murphy, 2005). A study carried out on the topic "Social Competence and Behavior Problems in Preschool Children" showed that students who are having difficulties with social skills and impulsive behaviors are likely to suffer more with anger expressions and low self-esteem. Theodore Newcomb, a social psychologist conducted a research on college students in 1930's and found out that students who were socially active and remained in leadership positions during the four years of college had a different attitude than those who remained isolated and did not integrate socially well (Goethals, 1999; Valero Haro et al., 2022). According to a recent study in Pakistan, students who are rejected by their peers have more stress level as compared to those students who are accepted by peers in a relationship (Iqbal, Liaquat, Latif & Abbas, 2016) which implies that social competence gap is found among students which need to be filled. Rejection not only creates emotional problems but also the wellbeing of students get in danger (Iqbal, Liaquat, Latif & Abbas, 2016).

The current study is carried out and teacher educator program turned into the primary need/priority of the researcher because teacher educator program intends to develop future teachers who are just one stage away from practice, so any gaps in their social competence development could be filled by analyzing their curriculum. If the teachers are not educated on social competencies, children who are simply in need of skill sets to improve their interactions with peers and adults will often be facing challenges (Doveston & Keenaghan, 2010). Thus, it is necessary to educate teachers on social competence.

This research study is an endeavor to channel the gap between communication and social

competence and the elementary years by creating an understanding of this development among elementary pre-service teachers so they may implement practices to ensure children are developing social competence. Therefore, it provides an analysis of the presently used curriculum of B.Ed. (Hons.) Elementary and aims to check the presence of "communication and social competence" in it. B.Ed. (Hons.) Elementary is a four-year honors program created with the intention/expectation to prepare forthcoming prospective teachers and a separate curriculum has been developed for this program known as B.Ed. (Hons.) Elementary Curriculum.

The curriculum states the scheme of studies in detail along with the description of eligibility criteria for getting enrolled in B.Ed. the four-year degree program (elementary), and overall structure of the scheme. The structure of the scheme of studies is comprised of compulsory courses, professional courses, foundation courses, content courses and teaching practice. The total number of credit hours is 135. The term social competence is interchangeably used with interpersonal competence and communication competence (Gedvilienė, Gerviene, Pasvenskiene & Ziziene, 2014). It does not have one standard definition rather characterized and clarified from multiple points of view at different settings. Viewpoints of different authors regarding communication and social competence are as follows.

Communication and social competence refer to those skills necessary for effective interpersonal functioning. They include both verbal and nonverbal behaviors that are socially valued and are likely to elicit a positive response from others (Stanberry, 2016). Social competence is an extensive term used to portray social effectiveness, one's capacity to build up and keep up satisfying and fulfilling relationships and to avoid negative treatment or exploitation from others (Welsh & Bierman, n.d.). Social competence is indexed by effectiveness and appropriateness in human interaction and relationships (Han & Kemple, 2006). Social competence is defined as a combination of personal behavior, interpersonal relationships and ability to achieve targeted goals by adaptive and effective use of social skills (Higher Education Commission, 2015).

As mentioned earlier that social competence do not have a particular definition and everyone explains it with his own understanding or according to his own circumstances so it was important to choose one particular concept to carry out the study. The researcher acquired a support from National Qualification Framework developed by the higher education

commission (HEC) of Pakistan. HEC makes it a clear demand to develop communication and social competence in teacher education programs by highlighting it as one key component in this framework (Higher Education Commission, 2015). As Higher Education Commission governs all the higher educational institutes in Pakistan and the focus of the study is a higher degree program so this was the most relevant framework for the proposed study and also because this framework fulfills the global definition of communication and social competence. According to higher education commission of Pakistan, communication and social competence is the ability to interact effectively and appropriately for perspective sharing, to be able to cooperate with people in the community in general and specifically resolving issues in collaboration with experienced people, building positive social relationships, creating a good social environment by organizing activities, monitoring developments in the fields by assessing work progress and work quality, coordination and using information communication skills for quality relations (Higher Education Commission, 2015).

The researcher has also taken substantial support from National Education Policy 2009 because it additionally discusses teacher education programs' importance and underlines that teacher education programs ought to be in accordance with national professional standards of Pakistan. The national professional standards of Pakistan clarifies thoroughly the significance of communication and social competence and features to cultivate its components, for example, communication skill, cooperation, and collaboration, monitoring, management and responsibility and solution finding and resolving interpersonal conflicts. The current study advantages teacher educators because social competence makes an important component of a teacher's professional development. It helps them to develop an environment which is socially friendly and cooperation, communication, management, use of ICT technology is its main characteristics.

Social competence plays a role to impart professionalism in the teacher and the current needs and the future needs are fulfilled with the better acquisition of knowledge and skills. There are two reasons to develop teachers and improve their qualification. First that information based economy creation requires to refresh and update knowledge and skills on regular basis with a good acceptance of technologies in the process of education and keeping in mind the end goal to gain new teaching techniques, prerequisites and needs that are consequently changing the social relations. The second reason is the expanding needs of the students, their

mechanical innovativeness is frequently higher to that of the educators. Research shows that the youngsters rapidly and effortlessly adjust to innovations and ace them significantly faster.

To conclude, the study bridges the gap for pre-service teachers with relevant understanding and training of communication and social competence. It provides an analysis of the presently used curriculum of B.Ed. (Hons.) Elementary and aims to check the presence of "communication and social competence" by an in-depth qualitative analysis of the curriculum while the deliverance of it through teaching practices of teacher educators. The study aims to fulfill following research questions:

1. What is communication and social competence and its characteristics?
2. How communication and social competence is embedded in B.Ed. (Hons.) Elementary Curriculum?
3. What are the teaching approaches employed by the teachers to incorporate communication and social competence in students?
4. What are the problems faced by the teachers in integrating communication and social competence in students?
5. What measures can be taken in order to incorporate communication and social competence in the curriculum of the teacher education program?

Methodology

The design chosen for the study was mixed methods design. Under mixed methods design, embedded design was used with two phased approach. The population of the study was comprised of all the faculty members of B.Ed. (Hons.) Elementary program in universities of Rawalpindi and Islamabad. Universal population sampling technique has been used because population of the study was 42 which was less than 100, so the entire population was considered as a sample because Gay (2003) contends that if the population size is fewer than 100, whole population can be taken as a sample(Gay, 2003). After pilot testing the sample size was calculated as 37.

Both primary and secondary sources were used to provide effective results and for the fulfillment of research objectives. The primary research instruments were the researcher developed coding agenda and the questionnaire whereas the secondary instruments were books, articles, journal articles, and websites. Coding agenda was formulated as the

preliminary instrument for the qualitative content analysis on communication and social competence. The questionnaire was chosen as a data collection instrument.

Questionnaire was comprised of three sections. The first section was entitled to record the demographic data of faculty members where their institution name, academic qualification, and designation was required. As the study followed embedded design so the analysis of the data of the two phases qualitative and quantitative was conducted differently. After a detailed content analysis where the categories' points of discovery were marked and counted, a percentage frequency of the categories was computed with respect to their presence and a descriptive interpretation was made according to the frequency results. Qualitative data analysis was carried out manually using thematic analysis. Quantitative data was gathered through questionnaires and analyzed by descriptive statistics in which percentage of respondents in each category was computed. A computer program known as a statistical package for social sciences (SPSS) was used for analyzing close-ended statements.

Results

Factors of communication and social competence were derived from national qualification framework with the support of literature review and named as "categories" of communication and social competence. Based on these derived categories, coding agenda was formulated which gave a detailed explanation of these categories along with their codes and definitions. The categories derived were as follows:

- Communication skills (CS)
- Cooperation and teamwork (CT)
- Solution finding and Resolving Interpersonal Conflicts (SFRIC)
- Management and social responsibility (MSR)
- Monitoring (M)
- Effective usage of Information communication skills (ICTS)

These categories were further divided into sub-categories to analyze the curriculum.

Table 1 delineates the reflection of all six categories of communication and social competence in the curriculum by displaying the aggregate recurrence and percentage distribution of categories.

Table 1. Frequency Distribution of Communication and Social Competence in the Curriculum

Communication and Social Competence	Compulsory courses	Professional Courses	Foundation courses	Content courses	Developmental practicums	No of occurrences	Percentage of occurrences
Communication skill	83	37	12	15	5	152	27%
Cooperation and teamwork	24	38	34	11	24	131	23%
Solution finding and resolving interpersonal conflicts	7	22	12	4	10	55	10%
Management and social responsibility	13	15	15	8	15	66	12%
Monitoring	5	15	34	11	7	72	13%
Effective usage of ICT skill	52	18	6	5	5	86	15%
Total	184	145	113	54	66	562	100%

The total frequency and percentage for each category have been computed for each course by counting the points of discovery with the help of codes generated for categories. As shown in the table out of the six factors of communication and social competence, 'communication skills' and 'cooperation and teamwork' were deciphered as the two main categories supported by the curriculum content where the former was found in the highest proportion and computed as 27% while the later was acclimatized in the second most elevated extent and figured as 23%. Other three categories namely 'Effective usage of ICT skill', 'Monitoring', and 'Management and Social responsibility' were found to a moderate extent and were computed as 15%, 13%, and 12% respectively. 'Solution finding and resolving interpersonal conflicts' was computed in the least proportion and was computed as 10%. It can be concluded that curriculum gave more emphasis on 'communication skill' and 'cooperation and teamwork' which means that there is a need to inculcate these two components of communication and social competence as compared to other components.

Table 2 shows the cumulative percentage distribution of communication and social

competence in all five units of the curriculum through categories.

Table 2. Percentage Distribution of Communication and Social Competence across Units of Courses

Communication and Social Competence Categories	Compulsory course unit	Professional course unit	Foundation course unit	Content course unit	Developmental practicums	Total
Communication skill (CS)	15%	6%	2%	3%	1%	27%
Cooperation and teamwork (CT)	4%	7%	6%	2%	4%	23%
Solution finding and resolving interpersonal Conflicts (SFRIC)	1%	4%	2%	1%	2%	10%
Management and social responsibility (MSR)	2%	3%	3%	1%	3%	12%
Monitoring (M)	1%	3%	6%	2%	1%	13%
Effective usage of ICT skill (ICTS)	9%	3%	1%	1%	1%	15%
Total	32%	26%	20%	10%	12%	100%

The percentage was computed by counting the no of occurrences of each category in all five components of courses separately, divided by the total amount of categories coded. As shown in the table above, communication skill has been assimilated to a greater extent in compulsory courses and least reflected in developmental practicums. The second category 'cooperation and teamwork' have been supported in the highest manner in professional courses and least supported by content courses. 'Solution finding and resolving interpersonal conflicts' has found to a greater extent in professional courses while minimal assimilated by content courses.

Table 3 demonstrates the frequencies (f) and percentages (p) for the learning and teaching approaches, teachers employ to incorporate and promote communication and social competence in students. Teachers were intrigued by the six main approaches using the scale

"extent of use". Results outlined in the table depict that the majority of the teachers responded for "often" for all six approaches where the percentage computed was ranging from 39% to 71%.

Table 3. Distribution of Extent of Use of Learning and Teaching Approaches

Learning and teaching approaches	Never		Rarely		Sometimes		Often		Always		Total
	F	P	F	P	F	P	F	P	F	P	
Communicative approach	0	0	0	0	7	23	15	48	9	29	100
Integrative approach	0	0	2	7	4	13	22	71	3	10	100
Inquiry approach	0	0	1	3	9	29	12	39	9	29	100
Interactive exploration approach	0	0	2	7	9	29	12	39	8	26	100
Interactive teaching approach	0	0	4	13	2	7	13	42	12	39	100
Cooperative learning approach	0	0	3	10	5	16	14	45	9	29	100

Table 4 shows the responses assembled to check the effectiveness of the learning and teaching approaches for developing communication and social competence.

Table 4. Distribution of Effectiveness of Learning and Teaching Approaches

Learning and teaching approaches	Not at all effective		Slightly effective		Moderately effective		Effective		Very Effective		Total
	F	P	F	P	F	P	F	P	F	P	
Communicative approach	0	0	0	0	10	32	12	39	9	29	100
Integrative approach	0	0	0	0	6	19	19	61	6	19	100
Inquiry approach	0	0	0	0	5	16	17	55	9	29	100
Interactiveexploration approach	0	0	0	0	4	13	18	58	9	29	100
Interactive teaching approach	0	0	0	0	2	7	12	39	17	55	100
Cooperative learning approach	0	0	1	3	1	3	21	68	8	26	100

The responses of the teachers have been computed in the form of frequency (f) and percentage (p). As revealed in the table the major proportion of the teachers supported "effective" for all the given teaching approaches where the percentage of the responses ranged from 39% to 68% which means that teachers find all approaches imperative thus employing them for better student learning. Against six main approaches, using the given scale, 'Cooperative learning approach' was ranked highest because through hand-on activities and projects it enhances students' communication and social competence and employed by 68% of the teachers. 'Integrative approach' was computed as 61% and ranked as a second most used approach. 'Communicative approach' and 'Interactive teaching approach' were ranked lowest employed by 39% teachers only. The communicative approach is ranked lowest for effectiveness because teachers when unable to communicate in English and do not find enough time to switch to alternative strategies.

Table 5 explains the results in frequencies (f) and percentages (p) of different teaching methods and strategies used by teachers in support of approaches used for inculcating communication and social competence.

Table 5. Distribution of Effectiveness of Teaching Methodologies/Strategies

Teaching methodologies/Strategies	Never		Rarely		Sometimes		Often		Always		Total
	F	P	F	P	F	P	F	P	F	P	
Lecture/Teacher talk	1	3	4	13	4	13	18	58	4	13	100
Class discussion	2	7	0	0	4	13	16	52	9	29	100
Problem solving method	1	3	4	13	8	26	15	48	3	10	100
Lecture cum demonstration method	3	10	3	10	9	29	13	42	3	10	100
Case studies	3	10	9	29	13	42	5	16	1	3	100
Oral presentations	1	3	2	7	5	16	17	55	6	20	100
Group work	2	7	3	10	4	13	18	58	4	13	100
Research projects	2	7	4	13	8	26	11	36	6	19	100
Mind mapping	1	3	9	29	6	19	12	39	3	10	100
Dialogue	4	13	6	19	12	39	4	13	5	16	100
Role play	2	7	4	13	13	42	8	26	4	13	100

The respondents were asked to indicate the extent on five-point scale to which they use different teaching methods and strategies. The frequency of the responses shown in the table portrays that the most frequent choice of the majority of the teachers was 'often' whose rate went from 13% to 58% which shows that teaching strategies play a significant role in enhancing the teaching approaches so teachers use them for better acquisition of communication and social competence. Of the 31 respondents, 18(58%) teachers selected Lecture/Teacher talk and 'Group work' as the best strategy for communication and social competence positioning these two as the exceptionally utilized. Lecture/Teacher talk has been found the best strategy because it is easy to implement. Group work has been equally supported because teachers find it best to convey the information by themselves first and along with it involve students in activities to promote communication and social competence. On the other hand, 4(13%) teachers chose 'dialogue' as the strategy used to the minimum because teachers' role as a facilitator is important which is not present in the case of dialogue.

Table 6 elucidates the level of improvement in students regarding the acquisition of communication and social competence in the form of frequency (f) and percentage (p). 'Scale of improvement' was used by the respondents to rate the components. The results in the table above indicate that the majority of the teachers agreed over the improvement.

Table 6. Distribution of Components of Communication and Social Competence

Communication and Social competence Components	Not at All		A Little		Some		Much		Very much		Total
	F	P	F	P	F	P	F	P	F	P	
Language skills	0	0	0	0	8	26	15	48	8	26	100
Role taking	0	0	3	10	7	23	19	61	2	7	100
Planning and problem solving	0	0	3	10	7	23	15	48	6	19	100
Valuing other's opinion	0	0	0	0	6	19	19	61	6	19	100
Flexibility	0	0	0	0	8	26	13	42	10	32	100
Adapt to change	0	0	1	3	12	39	13	42	5	16	100
Problem recognition	0	0	2	7	12	39	15	48	2	7	100
Generating alternative solutions	0	0	1	3	09	29	16	52	5	16	100

Communication and Social competence Components	Not at All		A Little		Some		Much		Very much		Total
	F	P	F	P	F	P	F	P	F	P	
Relationship building	0	0	1	3	02	7	23	74	5	16	100
Management of projects	0	0	1	3	06	19	19	61	5	16	100
Be responsible	0	0	0	0	05	16	21	68	5	16	100
Assessment	2	7	0	0	09	29	11	36	9	29	100
Effective coordination	0	0	0	0	07	23	20	65	4	13	100
Feedback/reporting	0	0	0	0	07	23	18	58	6	19	100
ICT related knowledge and activities	3	10	1	3	07	23	12	39	8	26	100
ICT skill development	0	0	2	7	11	36	09	29	9	29	100

Table 7 presents the frequency (f) and percentage (p) distribution of the assessment techniques used by the teachers to assess communication and social competence of students.

Table 7. Distribution of Assessment Techniques

Assessment techniques	Never		Rarely		Occasionally		Frequently		Almost every time		Total
	F	P	F	P	F	P	F	P	F	P	
Rubrics	5	16	0	0	10	32	10	32	6	19	100
Oral assessments	0	0	1	3	9	29	13	42	8	26	100
Questionnaires/set of questions	0	0	5	16	7	23	13	42	6	19	100
Task-based summaries	2	7	1	3	8	26	16	52	4	13	100
Portfolios	3	10	4	13	10	32	6	19	8	26	100
Peer assessments	5	16	4	13	3	10	17	55	2	7	100
Reflective journals	3	10	7	23	7	23	10	32	4	13	100
Behavioral checklists	5	16	4	13	12	39	9	29	1	3	100
Sociometric ratings	5	16	10	32	6	19	4	13	6	19	100

The results revealed that ‘frequently’ was the most voted choice by the majority of the

teachers and created a percentage range between 13% and 55%. Of the 09 assessment techniques teachers were inquired about, the responses of the teachers ranked 'peer assessments' the highly used as 55% because peer assessment is the one where students' communication and social competence is improved through interaction with others. 'Task-based summaries' were ranked number 2 and totaled as 52% because of its simplicity. 'Oral assessments' and 'Questionnaires/set of questions' were figured to be used 42% and ranked the third highly used assessment technique because it requires less time to assess than other techniques. 'Rubrics' and 'Reflective journals' were supported by a moderate level and counted as 32% because developing rubrics require time and effort of the components to a greater extent thus responding to 'much' the most. The percentage for the indicator 'much' ranged from 29% to 74%. Moreover, the highest response was counted as 23(74%) for the component 'relationship building' while the second most enhanced component was 'be responsible' as 21(68%) teachers ranked it improving at a greater level. The component 'ICT skill development' was ranked lowest with a 9(29%) response because teachers are not provided with enough resources of ICT.

Table 8 presents the responses for the teaching Aids employed by teachers to incorporate communication and social competence in frequencies (f) and percentages (p). Of the 31 respondents (teachers), a maximum number of teachers chose the response 'often'.

Table 8. Distribution of Teaching Techniques and Aids

Teaching techniques	Never		Rarely		Sometimes		Often		Always		Total
and Aids	F	P	F	P	F	P	F	P	F	P	
Active listening	0	0	1	3	8	26	17	55	5	16	100
Projectors	0	0	3	10	7	23	15	48	6	19	100
Models/posters	1	3	7	23	10	32	10	32	3	10	100
Diagrams	0	0	4	13	9	29	11	36	7	23	100
Construction of summaries by students	0	0	3	10	6	19	19	61	3	10	100

The percentage computed as 61% for the ones who chose 'often'. Out of the five teaching aids, the highly employed is 'Construction of summaries by students' as responded by

19(61%) teachers claiming to practice it. The second highest rated technique was 'active listening' and computed as 55%'. 'Projectors 'were supported by 48% teachers to be using. The least rated techniques were 'diagrams' and 'Models/posters' hence calculated as 36% and 32% respectively. 'Sociometric ratings' were favored to the minimum as the weightage remained 13% because it is not used ordinarily and teachers are not much aware of this technique.

Table 9 offers a picture of frequency (f) and percentage (p) distribution of activities that teachers use in the classrooms for effective development of communication and social competence.

Table 9. Distribution of Activities

Activities	Never		Rarely		Sometimes		Often		Always		Total
	F	P	F	P	F	P	F	P	F	P	
Summary papers	2	7	4	13	9	29	14	45	2	7	100
Portfolio tasks	3	10	5	16	14	45	7	23	2	7	100
Writing dialogues	3	10	8	26	11	36	5	16	4	13	100
Field trips	9	29	3	10	8	26	9	29	2	7	100
Open book tests	8	26	3	10	9	29	10	32	1	3	100

Results make it evident that majority of the teachers chose 'sometimes' as their best response and the percentage computed for 'sometimes' range between 26% to 45% whereas the response which has received the less priority was 'always' whose percentage lied between 3% to 13%. 'Portfolio tasks' have been rated higher because out of 31 teachers, 14(45%) teachers have voted for it because it gives an assessment of overall work of a student while 8(26%) teachers voted for 'field trips' making it the lowest rated activity because arranging a field trip requires more resources.

Table 10 depicts the computed responses of the teachers in the form of frequency (f) and percentage (p) about the problems they face to inculcate communication and social competence in students. Upon viewing the results very clear exertion of 'high' is expressed by the teachers and percentage computed ranged between 19% to 42% while a minority of the teachers chose 'very low' as their response where the percentage ranged from 3% to 23%.

Table 10. Distribution of Problems

Problems	Very low		Low		Average		High		Very high		Total
	F	P	F	P	F	P	F	P	F	P	
Lack of adequate content/material	3	10	6	19	8	26	11	36	3	10	100
Unavailability of design of course syllabi	6	19	4	13	10	32	11	36	0	0	100
Inadequate continuing professional development (CPD) programs	4	13	5	16	5	16	11	36	6	19	100
Lack of assessment design	4	13	7	23	6	19	9	29	5	16	100
Insufficient funds to carry out social projects	1	3	11	36	2	7	6	19	11	36	100
Insufficient funds for ICT material	1	3	7	23	1	3	12	39	10	32	100
Lack of supportive classroom environment	3	10	2	7	13	42	7	23	6	19	100
Inappropriate physical structure of classroom	5	16	7	23	4	13	11	36	4	13	100
Lack of opportunities for practicing social skills	3	10	5	16	9	29	9	29	5	16	100
Lack of well-planned daily schedules	5	16	5	16	6	19	11	36	4	13	100
Inadequate funds for Educational tours etc. Lack of audio visual aids	7	23	5	16	6	19	8	26	5	16	100
	6	19	6	19	3	10	13	42	3	10	100
Lack of computer based resources	7	23	8	26	2	7	9	29	5	16	100

As per responses of the table above, it can be concluded that the highest rated problem was ‘lack of audio-visual aids’ 13(42%) because teachers face difficulty in accessing audio-visual

aids for preparing lectures and activities and there are such topics in the curriculum which cannot be taught effectively without AV aids while the second highest rated problem is 'Insufficient funds for ICT material' because 12(39%) teachers not getting sufficient AV aids for classrooms so responded it as high. The lowest rated problem is 'Insufficient funds to carry out social projects' because teachers find do not find enough opportunities to involve students socially which is necessary to develop communication and social competence.

Table 11 presents the results of the measures that can be taken to incorporate communication and social competence in teacher educator program.

Table 11. Distribution of Measures

Themes	No of occurrences	Percentages
Regular upgradation of curriculum	9	29%
Continuous professional development of teachers	13	42%
Collaborative ventures between universities	17	55%
Focus on teaching practice of students	5	16%
Assessment of individual and collaborative tasks	4	13%
Availability of guides' of B.Ed. program	3	10%
Instructional funds by governments	12	39%
Open access to E-books and journals	8	26%
Self-generated funds	2	6%
Internships in educational institutions	3	10%
Systematic peer interaction	9	29%
Use of student-oriented approaches	15	48%
Process-oriented approaches	1	3%
Sufficient time for student-teacher interaction	7	23%
Teachers' engagement in research	2	6%
Photocopying facility for students	1	3%
Increase use of timetables	1	3%

The highest response remained for 'collaborative ventures between universities' as 55%

because teachers it will enhance student-student and student-teacher interaction. The high the interaction the higher is the chance of communication and social competence development. The second most recommended measure computed as 48% and is 'Use of student-oriented approaches' because it gives students a chance to interact more to peers consequently enhance their communication skills, improve their teamwork capability, increases their responsibility, brings management skill and advances social relations. The third measure suitable to incorporate communication and social competence is computed as 42% and is 'Continuous professional development of teachers' because teachers play a significant role in the development of students.

Summary of Findings

The concept of communication and social competence was explained and the characteristics of communication and social competence were found out as follows: Communication skills (CS), Cooperation and teamwork (CT), Solution finding and Resolving Interpersonal Conflicts, Management and social responsibility(SM), Monitoring (M), Effective usage of Information communication skills (ICTS). The curriculum encompasses all the categories of communication and social competence but two of them are embedded in the curriculum with a major proportion 'communication skills' as 27% and 'teamwork' as 23% whereas the category 'solution finding and resolving interpersonal conflicts' with the least ratio of 10%.

The overall response for the use of learning and teaching approaches remained high. The teachers rated 'integrative approach' as the best teaching approach for the incorporation of communication and social competence with 71% rating whereas the second most employed approach was 'communicative approach' calculated as 48%. Moreover, the overall response for the effectiveness of learning and teaching approaches remained high. 68% of the teachers rated 'cooperative learning approach' as the most effective approach for communication and social competence integration. Additional, the overall response for the teaching methodologies/ strategies remained high. The teachers who rated 'group work' and 'lecture/teacher talk' as the most employed teaching method for communication and social competence were 58%. Likewise, the overall response for the improvement of categories of communication and social competence remained high. 74% of the teachers claimed the improvement of category 'relationship building' the highest by using these methodologies.

Equally, the overall response for the improvement of teaching techniques and aids remained high. The activity 'construction of summaries by students' was ranked number 1 by teachers with 61%.

In the sameway, the overall response for the use of assessment techniques remained high. The majority 55% of the teachers rated for the assessment technique "peer assessment' as the highly employed technique for communication and social competence. On the other hand, the overall response to the use of activities to supplement teaching remained moderate. 45% of the teachers agreed using 'Portfolio tasks' the most for the incorporation of communication and social competence. Field trips were rated as 26%.

The overall response for the problems teachers face to inculcate communication and social competence remained high. The majority (42%) of the teachers rated 'lack of audio-visual aids' as the main problem while 39% of the teachers rated 'insufficient funds for ICT material' ranking it the second main problem for the incorporation of communication and social competence. Measures that can be taken to incorporate communication and social competence were found out the following: 'Collaborative ventures between universities' as 55%, 'Use of student-oriented approaches' as 48%, 'Continuous professional development of teachers' as 42%.

Conclusions

The concept of communication and social competence was explained and it was revealed as a combination of six characteristics which are communication skill, cooperation and teamwork, solution finding and resolving interpersonal conflicts, management and responsibility, monitoring, and effective usage of ICT skill. The curriculum of education (revised 2012) has the capability to develop communication and social competence as it encompassed all the categories of it. Against six categories of communication and social competence, curriculum focused on two components majorly which are 'communication skill' and 'cooperation and teamwork' whereas it gave less attention to rest of the four components (monitoring, management and responsibility, solution finding and resolving interpersonal conflicts) which creates a gap.

In addition, results of the study show that for the effective implementation of communication and social competence, teachers showed familiarity towards all six approaches and the response for the use of teaching approaches remained high for integrative approach and communicative approach. It has revealed that for the effectiveness of learning and teaching approaches 'cooperative learning approach' and 'integrative approach' been rated the highest. Moreover, It was found out that among teaching methodologies/ strategies 'group work' and 'lecture/teacher talk remained the most employed teaching methods for communication and social competence incorporation. Similarly, for the improvement of categories of communication and social competence 'relationship building' was rated the highest among all components whereas 'be responsible was rated second highest.

Further, the results about the teaching techniques and aids for the inculcation of communication and social competence remained highest for 'construction of summaries by students'. Additional, it was revealed that among assessment techniques remained "peer assessment' is the highly used technique for communication and social competence integration. Last, the results showed a low response to the use of activities to supplement teaching for communication and social competence incorporation.

Besides, another major finding includes the problems which teachers are facing to inculcate communication and social competence. The responses of the teachers for all the problems remained very high which depicts a major implementation gap. The two highly rated problems are related to ICT which shows that curriculum has not been developed with respect to the demands of the 21st century. As all the sects of life have been advanced, social relationships have also been through transition and ICT is one main component of social competence presently and cannot be ignored. Majority of the teachers suggested three measures as most effective for the incorporation of communication and social competence which are 'collaborative ventures between universities', 'use of student-oriented approaches', and 'continuous professional development of teachers'.

Recommendations

The study recommends that curriculum developers may revisit and revise curriculum for the integration of 'solution finding and resolving interpersonal conflicts' with more topics, themes, and activities because it is least reflected in the curriculum. The greater the content,

the higher will be the chance of its improvement. Curriculum developers may outline social projects in the curriculum to be carried out in each semester and teacher educators may ask students to conduct these projects especially in collaboration with students of other universities. It can be proved great venture to enhance 'solution finding and resolving interpersonal conflicts' if carried out.

Policy makers may add 'solution finding and resolving interpersonal conflicts' content in the education policy. Results reveal that the activities that supplement the incorporation of communication and social competence are employed to a very low level. Continuous monitoring and evaluation of B.Ed. (Hons.) Elementary program teaching should be carried out by NEAS and regular monitoring by department head for the usage of activities. HEC may also play role to monitor B.Ed. (Hons.) elementary program teachers for quality teaching. The government of Pakistan may release adequate funds in the budget for the effective integration of ICT in the curriculum because lack of audio-visual aids' and 'insufficient funds for ICT material' have been rated two major problems in the study. The coding agenda designed by the researcher in this study may be used by other researchers in their 'communication and social competence theme' related studies to conduct content analysis. Researchers carrying studies related to social competence theme may take advantage by referring to this study and can add up to their literature.

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Chapter 4 - Exploring the Nature and Effects of Cross – Age Peer Tutoring on Primary School Pupils' Reading Competence and Self-esteem

Ebrahim Talaee, Azad Mohammadi, Golrokh Bararpour

Chapter Highlights

- This chapter explored the nature and effects of cross – age peer tutoring on primary school students' reading competence and self-esteem.
- This chapter outlined the nature and theoretical foundations of peer tutoring.
- This chapter discussed the challenges of peer tutoring in primary school settings.
- This chapter used a quasi-experimental research design with t-test analysis.
- This chapter provided insights into the impacts of peer tutoring on primary school students' academic achievement, reading competence, and self-esteem.
- The results showed that peer tutoring program improves primary school students' reading fluency and comprehension, and self-esteem.

Introduction

This chapter discusses various aspects of cross-age peer tutoring, drawing on data from two sources: a) a conceptual analysis of the nature of peer tutoring and its theoretical foundations including psychological, social and neuroscientific perspectives and b) an empirical study of fourth graders who do the tutoring for the second graders in reading. Although the research literature contains studies which reinforce use of peer tutoring by teachers (Arco-Tirado et al., 2020; Topping et al., 2017; Tenhovirta et al., 2021; Robinson et al., 2005, Greenwood., 1997), it has faced criticisms too. The counter findings includes superficial self-reflection (Tenhovirta et al., 2021), personalizing feedback and creating a sense of jealousy and inferiority (Topping et al., 2017; Banihashem et al., 2018; 2021), resistance to peer learning (Lippitt, 1976; Noroozi, 2022), lack of awareness of an effective teaching framework (Topping et al., 2017). Nearly all studies which show a positive impact of peer tutoring confirm that this teaching strategy works well for two groups of children: the disadvantaged groups of pupils i.e., lower socio-economic status and those who scored lower in their emotional development such as lower self-esteem and self-confidence. These groups of children, need "learning opportunities" to be able to engage in learning activities commensurate with their learning speed and level of development, so that for them to have significant academic progress (Greenwood, 1997; Arco-Tirado et al., 2020; Noroozi et al., 2016).

However, due to limited resources (time, class size etc.) it is hard for teachers to provide an individualized or personalized instruction for this group. On the other hand, they cannot hold back the whole class to the rhythm of the pupils who need extra time for learning. Peer tutoring, we argue here in this chapter, can be used as a complementary approach to prevent academic failure and its social consequences. The present study aims to uncover the potentialities of cross- age peer tutoring for classroom instructional events as a main teaching strategy. The chapter has the following outline: First the concept of peer tutoring is analysed within the familial network of educational concepts to map out how it is related to other members of the family. In this endeavor, we have drawn upon main theories which support the use of peer tutoring in classroom teaching. Next, the mixed impacts of peer tutoring on children's academic achievement and social development are reviewed and discussed. Finally, based on an empirical study, we argue that, under certain conditions, peer tutoring

have positive impacts on children's reading competence, self-esteem and the wider context of teaching i.e. teachers, parents and school leadership team.

Nature and Theoretical Foundations of Peer Tutoring

Peer tutoring (PT) is a subset of cooperative learning and a structured form of peer learning (Thurston et al., 2021). Cooperative learning (CL) has been described as "structuring positive interdependence" in pursuit of a specific shared goal (Boz Yaman, 2019; Slavin, 1990; Topping, 2005; Noroozi et al., 2012, 2013; Ghasemi et al., 2016; Shahali Zadeh et al., 2016). While in peer learning, the goal is sought beyond a simple type of cooperation of students and can be applied between two groups of peers and non-peers and in accordance with Miller et al., 2010 cooperative learning also includes peer assisted learning.

Topping (2005) describes that peer learning originates from cooperative learning, and this type of learning is more than working together. In this regard peer learning involves people from similar social groupings who are not professional teachers helping each other to learn and learning themselves by doing so. Willis and colleagues (2012) considered tutoring as a platform for providing young people with social support, giving academic assistance. Peer tutoring is characterized by specific role-taking as tutor or tutee, with high focus on curriculum content and usually on clear procedures for interaction, in which participants receive generic and/or specific training (Topping, 2005). Peer tutoring entails adopting a new social role in a community and becoming a student expert who can provide relevant guidance for younger peers (Noroozi et al., 2016; Tenhovirta et al. 2021). Considering students' age, two types of peer tutoring are implemented: cross-age and same-age tutoring (Alegre et al., 2019b). Considering students' roles, two categories of tutoring are defined: reciprocal and fixed peer tutoring (Miravet, 2015) (see Figure 1).

Same age Peer tutoring means when tutor and tutee are in the same age and grade levels. In cross-age peer tutoring**,** students belong to different grade levels meaning that tutors from higher educational levels help tutees from lower educational levels (Kalkowski, 1995). Although researchers such as Topping et al. (2004), Hartup (1976), and Scruggs and Osguthorpe (1986) described those tutees improve the most when older tutors help them. Topping et al. (2004) recommend an age gap of at least two years between tutors and tutees.

Fixed tutoring is often regarded as the most frequently implemented tutoring type (Miravet et al., 2013). In fixed tutoring, students do not switch roles and keep being tutors or tutees from the beginning to the end of the program. For many researchers in the field, this type looks as it is logical that the most skilled students tutor their less skilled peers (Falchikov, 2001; Walker et al., 2009). On the contrary, during reciprocal peer tutoring students switch roles (Pigott et al., 1986; Latifi et al., 2021). Previous studies in the field state that, from a psychological perspective, reciprocal peer tutoring is better than fixed tutoring (Miravet et al., 2014; Latifi et al., 2020; Noroozi et al., 2012; 2016; 2022).

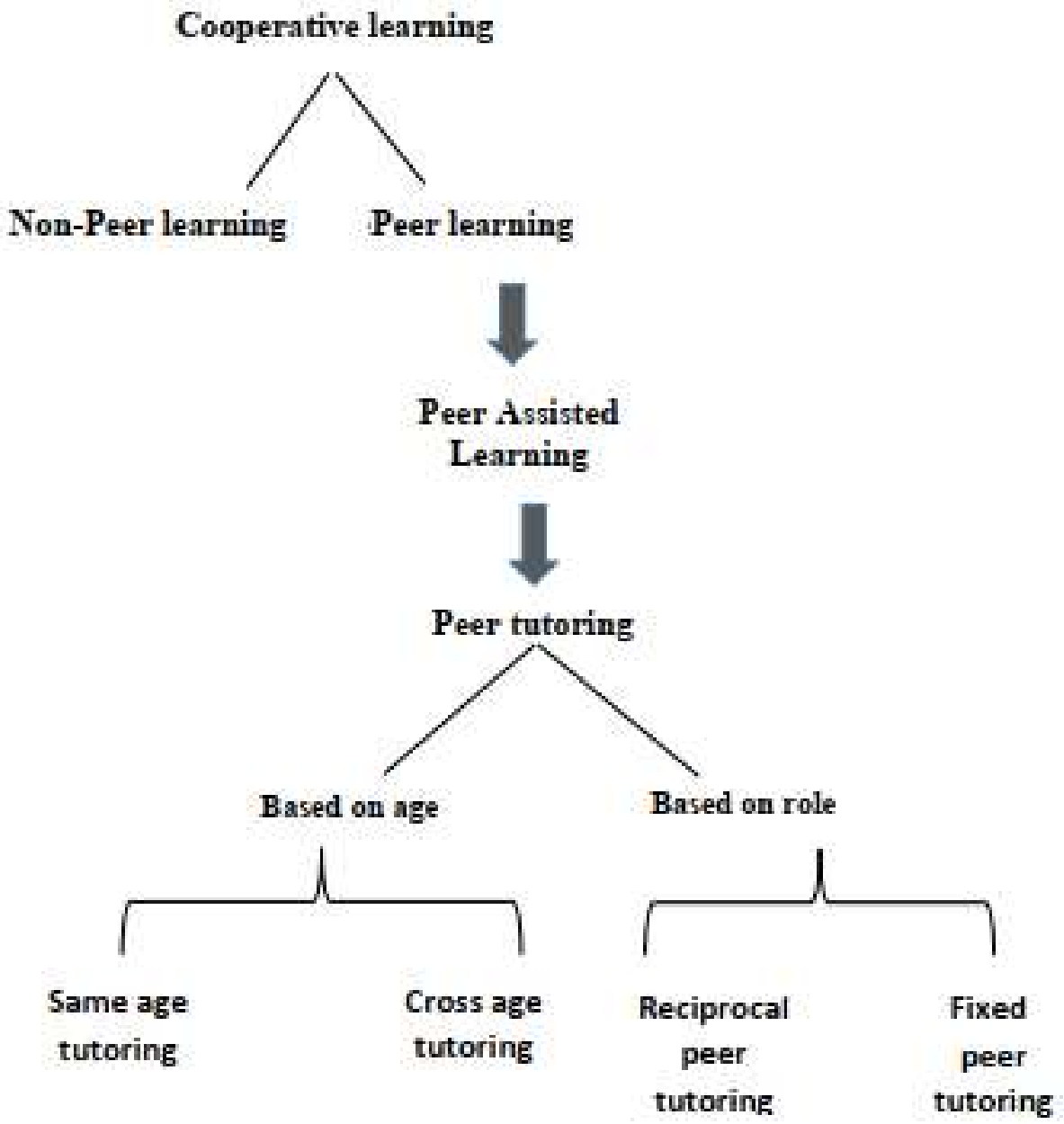

Figure 1. Familial Network of Peer Tutoring

In general, the theoretical foundations of peer tutoring are referring to theories that support cooperative learning and learning through teaching. Cooperative Learning provides foundation for other forms of active learning such as peer tutoring. Theoretical, empirical, and practical support has made cooperative learning a powerful model now (Johnson et al., 2000). In this section, the foundations of peer tutoring theories from three perspectives are investigated. From the psychological and educational perspective, Piaget's theory of constructivism, Vygotsky's theory of social constructivism, social interdependence theories of Johnson et al (2000) as well as role-taking theory of Sarbin (1982) are discussed; while from the neuroscience point of view executive functions; biopsychosocial; inter-subjectivity and reward systems models.

Constructivism

Piaget proposed that improved understanding in children is via the processes of assimilation and accommodation (Golbeck., 1999; Topping, 2005; Thurston et al., 2021). According to this theory, children create meaning through their interactions with each other and the environment. One of the effective factors in the cognitive development according to peer tutoring based on Piaget is their social interaction, which facilitate their cognitive development. As an example, it has been shown that students who were not active in traditional classrooms, became active in smaller groups (Gardner and Jouler, 2000) as shown in cross-age peer tutoring research in our research

Social Structuralism

Vygotsky's theory of social structuralism refers to the concept of Zone of Proximal Development (ZPD) and scaffolding (Thurston et al., 2021; Sanchez-Aguilar, 2021; Golbeck., 1999; Topping, 2005). The ZPD is the distance between the actual and potential growth level. There are ample evidences demonstrating that following Vygotsky's concept of ZPD in peer-tutoring a child develops ability to solve the problems with the help of a peer (Thurston et al., 2021; Sanchez-Aguilar, 2021; Topping, 2005). Similarly, applying the concept of scaffolding in a cross age peer-tutoring has shown that when a more skilled person (peer of the child) guides the child according to the child's knowledge the level of child's efficacy increases (see Figure 2).

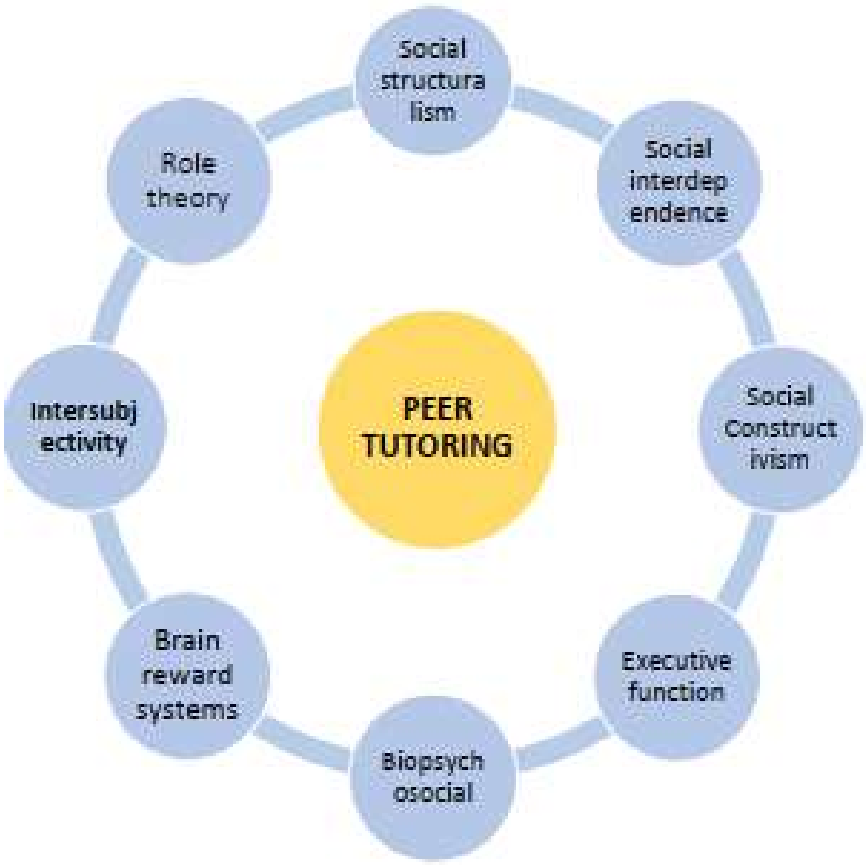

Figure 2. Theoretical Foundations of Peer Tutoring

Theory of Social Interdependence

The theory of social interdependence combines individual and group performance. This creates a social interdependence between tutor and tutee in the cross - age peer tutoring and is the base for cognitive developments. Success of tutors and tutees is linked through common goals, and mutual interdependence on (Johnson et al., 2010; Thurston et al., 2021; Fantuzzo et al., 1989).

The most important goal is cooperation. The power of cooperative learning via cross age - peer tutoring is in the interrelationship among social interdependence theory (Johnson et al., 2014). A researcher should educate appropriate social skills and accountability in tutor and tutee so that they promote each other's success. In addition cross - age peer tutoring creates positive interpersonal relationship support and promotes greater psychological and well-being (including self-esteem and social competencies). It also creates positive attitudes toward the academic experience.

Role Theory

Sarbin's role-taking theory (Fogarty et al., 1982; Thurston et al., 2021) proposes that individuals' behaviors are partially determined by the roles they play (Thomas & Biddle, 1966). According to this theory, role is a set of behaviors and attitudes that is associated with a particular identity (e.g., student, parent, doctor, teacher etc.) and recognized by the society (Turner, 2002). Role theory leads to the expectation that a student who takes on the role of a tutor may behave and feel differently as a tutor than he or she behaved prior to assuming that role (Robinson & Schofield, 2004). Based on Role theory when an individual assumes a role, that individual will be likely to behave in role-consistent ways and to develop self-perceptions in line with role expectations. It is through discussions in small groups that students acquire attitudes and values such as the need for continuous improvement. Success in a role depends on favorable motivation, a perception of the role, and role-taking aptitude. In the cross age peer tutoring role-perception is derived from interaction tutor and tutee the manner in which role-perception influences role-enactment is indicated.

Executive Function

Some research has shown that peer tutoring is more beneficial to tutors than tutees, as an example, learning outcomes have most often been attributed to the tutors' generation of instructional explanations and metacognitive self-monitoring in teaching (Roscoe & Chi, 2004). This indicates that self-monitoring is enhanced through teaching. This is consistent with neuroscience findings about the development of executive functions of the brain (Diamond, 2013, 2014; Miyake & Friedman, 2012; Mccloskey et al., 2012; Mccloskey & Harne, 2017). Self-regulation is, collection of multiple directive capacities that are primarily responsible for direction of day-to-day activities (Banihashem et al., 2021; McCloskey et al., 2008). Furthermore, Mccloskey and Harne (2017) also described that academic and social problems are directly or indirectly related to one or more executive function difficulties. Self-regulation is comprised of multiple executive functions responsible for directing, and coordinating moment-to-moment functioning within the domains of perception, emotion, cognition, and action (Mccloskey & Harne, 2017).Therefore, when a student is in the role of tutor, it is necessary to use these self-regulatory components (including attention, organization, time management, cognitive flexibility, inhibitory control) to perform his or her tasks, and as a result, his mental and cognitive abilities are improved.

It seems that learning through teaching (which is the result of peer tutoring) promotes the skills of tutors because performing teacher duties will enhance the executive functions of the tutors' brain. There are different definitions in relation to executive functions, which encompasses the skills that drive behavior regulation, such as inhibitory control, attention, and dealing with situations requiring cognitive flexibility, metacognitive skills, such as initiating tasks, sustaining attention, planning and organizing tasks, and monitoring behavior based on feedback from the environment or the reactions of others (Banihashem et al., 2018; 2019; Dawson, 2014; Guy, 2018; Mccloskey & Harne, 2017; Noroozi et al., 2019; Mccloskey et al., 2012; Miyake & Friedman, 2012).

Biopsychosocial Approach

In social-affective neuroscience, development of the mind and cognition is influenced by the society and culture in which the individual grows, and so the impact of social interaction cannot be ignored from education. Some studies demonstrated that human beings are social by nature and live in continuous interaction with each other. This approach emphasises that human brain development is inherently social (Immordino-Yang & Gotleib, 2017). In fact, it should be noted that cooperative learning and peer tutoring such as cross - age peer tutoring should be followed in order to maintain a social and cooperative state for cognitive and mental development. In this regard, some studies suggest that the functions of the human brain should be studied in social contexts. (Eid, & Diener, 2009, Hari, & Kujala, 2009; Immordino-Yang, 2016). Thus, development of students' minds and cognitions is inconceivable regardless of their social and cultural environment, and it is necessary to improve the learning environment.

In peer tutoring an atmosphere of cooperation and a sense of empathy should be created. In this regard, Immordino-Yang and Gotleib (2017) described about a framework for growth and learning that can be a good theoretical support for peer tutoring (in various forms). This approach, called the BIOPSYCHOSOCIAL that, provides a good framework for individual social development that creates both a body role (such as the positive emotions experienced by peers) and a social role (such as a cohesive classroom atmosphere). According to this approach, neurobiological aspects are intertwined with socio-cultural aspects that can provide a suitable framework for explaining the social and individual development of peers.

Especially in peer tutoring such as cross - age peer tutoring which emotional experiences and positive or negative emotions can change the path of mental and cognitive development of peers. This approach, along with other theories that believe brain is essentially social in nature and should take care of the social aspects of learning in mental development, can be a good basis for the intertwining of cognition, emotion, and community, all three of which are essential for promoting peer tutoring.

Intersubjectivity

However, the importance of intersubjective communication in discovering hidden ideas and values among peers can be realized and according to Schilbach et al., (2013). Intersubjectivity is the extent to which the "hidden" ideas, intentions, and values of one participant are accessible to, understood and reciprocated by the other. Therefore, to compensate for some of the shortcomings and challenges of peers tutoring, (especially in providing feedback to each other) it is necessary to help them to establish a successful interpersonal relationship and the teacher who guides the tutors to tell them the necessary points to establish an intersubjective and precise communication with the learner. The same hidden ideas that are probably the points that may challenge the peer tutoring and they may not be able to exchange it well. Recently data in social neuroscience reveals that differences in experiences with parents /caregivers and peers in early life emerge in neural sensitivities that influence how adolescents engage with peers (Guyer et al., 2018).

According to social neuroscience findings, the approach of learning through peers and creating interaction between them is another solution that prepares children to participate and learn from their peers at older ages. In this regard, neuroimaging research that focuses on past socializing experiences suggests that familial and peer influences may moderate neurobiological attunement to threat and reward cues in social contexts (Guyer et al., 2018). This indicates that if children have a good relationship with each other at an early age, they will have a good interaction with their peers in adulthood.

Reward Systems and Mentalizing

Some neuroscience evidence suggests that motivation is naturally a social emotion and activates the brain's reward system upon social interactions with others. Some studies

emphasized that "the powerful and pervasive drive" for humans to seek out social interactions and reiterated that contingent interactions with another person recruits the reward systems (Guionnet et al., 2012; Krill & Platek, 2012; Sakaiya et al., 2013; Schilbach et al., 2013). Neuroscience has also shown how "motivation can emerge from the social world" (Krach, 2010), motivation is social in nature (Walker, 2010) and "social and reward-processing neural structures relate to each other" (Ruff & Fehr, 2014).

In a socioconstructivist "two-body" or "second-person" perspective interactive learning requires an intricate negotiation between people which recruits the neural processes underlying reciprocal social interaction and involves both affective and cognitive aspects (Sakaiya et al., 2013). These cases show that peer tutoring is based on the cooperation and equal participation of tutor and tutee, which develops their empathy. Because some of the studies have shown that social interactions with another person with a similar cognitive framework employ reward and pleasure systems. This idea means that "learning together" activates brain reward systems, which helps deepen learning. Neuroscience studies have shown that motivation can arise from the social world, and neural-social structures and reward processing are interrelated.

Some of studies claim that peer tutoring increases the atmosphere of attachment and empathy among students, which results in motivation for academic achievement. further evidence of neuroscience indicate that function of mirror neuron systems can be interestingly attributed to peer tutoring's goals in which social interactions highlight tutors and tutees and it negates the isolation (without contact with others) of student action. Mentioned as an example, The posterior superior temporal sulcus (STSp) and the inferior parietal lobe (IPL) contribute to the human mirror-neuron system (MNS), although they do not have true mirroring properties: they are activated during observing others' movements but not during one's own actions (Iacoboni et al; 2006). These phrases indicate that this part of the brain, which is also important for learning social behaviors and empathy, is activated in the peer tutoring.

As mentioned, this part is activated during the movements and actions of others and is inactive during our own actions. In cooperative learning and peer tutoring, observing peer (or cross–age peer) child behavior can change the type of child exposure to goal pursuit, empathy, and imitation, because the role of the mirror neuron system (MNS) is in this direction. It is also mentioned in other places that social experiences at each stage of

development may impact social competence during subsequent phases of maturation (Guyer et al., 2018).

Given the evidence that peer tutoring leads to increased self-esteem and empathy, it can be said that this educational method can prepare people for collaborative learning and collaborative activities, and this is important in education and for different communities. One of the weaknesses exemplified for peer tutoring is that peers cannot (or do not know) give each other good feedback (Noroozi et al., 2012; 2016; 2020; Latifi et al., 2020; 2021). But the findings in the field of neuroscience suggest that such a shortcoming is that they are not properly emotionally aroused to establish proper intersubjectivity. So as, Schilbach et al. (2013) note that Intersubjectivity is a necessary condition for rewarding peer-tutoring to occur. Because when individuals are not emotionally engaged, they cannot be expected to gain intersubjectivity. It is also stated that peer relations and neural circuit interactions reciprocally influence one another (Guyer et al., 2018).

One of the weaknesses exemplified for peer tutoring is that peers cannot (or do not know) give each other good feedback. But the findings in the field of neuroscience suggest that such a shortcoming is that they are not properly emotionally aroused to establish proper intersubjectivity. So as, Schilbach et al. (2013) note that Intersubjectivity is a necessary condition for rewarding peer-tutoring to occur. Because when individuals are not emotionally engaged, they cannot be expected to gain intersubjectivity. It is also stated that peer relations and neural circuit interactions reciprocally influence one another (Guyer et al., 2018).

Impacts of Peer Tutoring

On Academic Achievement

Meta-analyses as well as research on peer tutoring show the positive impact of this educational approach on children's learning and academic achievement. For instance Meta-analyses of Peer Assisted Learning (e.g., Ginsburg-Block et al., 2006; Leung et al., 2005) have identified learning gains and academic achievement from a variety of types of PT interventions. Research on PT techniques suggests significant improvements in academic achievement in the targeted area and cognitive gains for both tutors and tutees (Duran, 2016; Falchikov, 2001; Nguyen, 2013; Topping, 2005). There is strong evidence that peer tutoring, as a form of cooperative learning, has a positive impact on tutor and tutee outcomes

(Thurston et al., 2021). Cross-age peer tutoring provides valuable support for teachers' and schools' for implementing innovative pedagogies (Tenhovirta et al., 2021) and have the potential to enhance both academic achievement and psychological adjustment (Jenkins & Jenkins, 1985). Some studies have reported the positive effects of peer tutoring on academic achievement in various subjects such as mathematics, reading, art and technology. For example Fuchs, Fuchs, and Karns (2001) show that for Mathematics. Recent literature reviews and meta-analyses state that Peer Tutoring in Mathematics is more effective in primary education (ages 7–12 years) than in secondary education or middle school (ages 13–18 years) (Alegre-Ansuategui et al., 2018; Alegre et al., 2020). Studies in the field conclude that students' interactions during peer tutoring have positive significant effects on students' mathematics learning (Alegre et al., 2019; Gamlem, 2019). Researches showed that Mathematics self-concept and mathematics attitude seem to benefit more from the role exchange that takes place during reciprocal tutoring (Cheng & Ku, 2009; Fantuzzo et al., 1989; Moliner & Alegre, 2020; Sutherland & Snyder, 2007). An effective way of raising reading attainment in primary school is shown to be peer tutoring (Duran et al., 2005). A number of research has shown that tutor shows significantly greater cognitive gains than the student being taught (Annis, 1982, 1983; Bargh & Schul, 1980; Lambiotte et al., 1987). Finally, Thurston et al. (2021) hold that for cooperative learning to be most effective during peer tutoring/paired reading, social interdependence must be present in the form of goal structure, positive interdependence, and individual accountability and interaction patterns.

On Self-esteem

There are studies which report improvement in self-esteem, social skills, attitude towards school, and school attendance (Topping, 2005) , gains in self-esteem and academic achievement in both cross-age and same-age peer tutoring conditions (Miller et al., 2009), peer tutoring both challenges and fosters the development of their self-esteem and social skills (Mete, 2021; Willis et al., 2012), peer tutoring also encourages students to engage in metacognitive self-monitoring, which helps learners to detect and repair missing knowledge and misconceptions (Roscoe & Chi, 2004). Gains of peer tutoring also has been reported in self-worth in the cross-age condition (Akyuz, & Erdemir, 2022; Haynes, & Brendle, 2019; Miller et al., 2010). In a study tutees and tutors showed positive behaviors and attitudes during the tutoring sessions and that those behaviors and attitudes significantly contributed to a favorable teaching–learning experience (Sanchez-Aguilar, 2021).It is characterized by

positive role modelling, positive reinforcement, and joint problem-solving and often targeted to disadvantaged groups (Topping., 2005; Slavin, 1990).

Some Reported Challenges of Peer Tutoring

One of the reported weaknesses of peer tutoring approach is the possibility of tutors not being able to provide appropriate feedback to tutees. This could depend on their friendly interactions in classroom experiences, also tutors are not professional and therefore their behavior may be influenced by this feature. Next, same-age students work together by teaching each other, despite neither of them being an expert (Madaio, Cassell, & Ogan, 2017: Palincsar & Brown, 1984; van Ginkel et al., 2019). Therefore, in response to this challenge, researchers argue that competence gap should not be too extreme between the tutor and the tutee, suggesting that the optimum age gap in cross-age peer tutoring should not be more than two or three years (Karcher, 2008). Moreover, some studies have called for more involvement from school authorities to capitalize on peer-to-peer social learning resources, such as cross-age peer tutoring, when initiating challenges in schools such as Science, Technology, Engineering, Arts, and Mathematic (STEAM) projects (Tenhovirta et al. 2021; Zwart et al., 2020). On in all social mechanisms appear to be central to the effectiveness of peer assisted learning (Ginsburg-Block et al., 2006; Laine et al., 2022).

Report of An Empirical Study of Peer Tutoring and its Impacts on Children's Reading Competence and Self-esteem

The main aim of this research was to determine the effects of cross - age peer tutoring on the progress of Persian reading fluency and comprehension and on self-esteem in primary education. To this purpose, two hypotheses were defined:

- Hypothesis 1: Second graders' reading fluency and comprehension will improve significantly as a result of cross - age peer tutoring
- Hypothesis 2: Second garders' self-esteem will improve significantly as a result of cross - age peer tutoring

The research population consisted of second and fourth graders in a district in south Tehran. The study sample included 34 second graders (randomly assigned to experimental and control groups; 17 students for each group) whose GPAs were below the class average and 34 fourth graders (17control and 17 experimental) who volunteered to act as substitute teachers. The

2nd grader experimental group received training in Reading by the 4th grader experimental group students in 24 sessions. Each session lasted for 45 minutes. The research instruments included Cooper Smith Self-Esteem Questionnaire (Cooper Smith, 1959) and researcher-constructed Reading Fluency and Comprehension Test. The reading assessment included both reading fluency and reading comprehension. The score of Monthly teacher-made test for pre-test before the Intervention (Persian reading and comprehension lesson) and post-test, was teacher-made monthly test after the Intervention. Performance of the two groups were compared on the reading ability and self-esteem score before and after the treatment. An experimental pretest posttest with control group design was used in this research. Results of the analysis showed that cross – age peer tutoring had significant positive effects on both reading capability and self-esteem of the experimental group. Analysis of variance (ANOVA) between the experimental and control groups (One Between and One within Subject Design) showed significant over performance of the experimental group (For the experimental group: M=17/23 as compared with the control group M=16); (P< 0/01). The design of this research is a quasi-experimental design of two groups that are dissimilar to pre-test and post-test. The methods used to describe the data of this study include mean and standard deviations and its inferential statistical method is through analysis of variance (ANOVA) that is between experimental and control groups, One Between and One within Subject Design was used to test the effectiveness of the intervention. To explore participants' behaviors, self-esteems, and performance in reading during and towards a cross – age peer tutoring experience, a mixed methods research approach was employed in this study. The experimental group benefited of the "peer -tutoring program "for 24 sessions, during which the control group was trained in the traditional and usual way. To dive deeper to research questions we employed both quantitative and qualitative methods of data collection and analysis.

Sample Access

Multi-stage cluster sampling method was used for sampling. Sampling was done in two stages (schools and classrooms). Thus, in the first stage, a list of girls' primary was listed, then the cluster school (according to the neighborhood) was selected, and one cluster was randomly selected from the seven clusters obtained, which included seven schools, one of which was randomly selected as a sample. In the second stage, from the fourth and second classes, one class was randomly selected as the experimental and one class as the control group. A total of 17 students from each class were selected to implement the project as

follows:

-Among the fourth-grade students, 17 teachers' volunteered (Out of 38 students in the class, 28 volunteered) were randomly selected (both in the experimental and in the control group)

-Among the second-grade students (tried to be the weakest student in Persian reading course) after performing the Persian reading pre-test, 17 people who obtained the lowest scores in the pre-test were selected compared to the average grade of the class (both in the experimental and in the control group).

The statistical population of this study is all female students in the second and fourth grades of elementary school in Tehran, and the sample group consists of 34 second grade female students and 34 fourth grade female students with an average age of 8 to 10 years and six months.

Research Instruments

The Cooper-Smith (1967) scale, revised by the Roger-Diamond scale (1954), was used for this study. Content-dependent method was used to assess the validity of the questions in the research questionnaire. This questionnaire has been revised and modified several times by respected supervisors, advisors, and researchers, after a preliminary implementation and has been approved by supervisors and advisors. The reliability coefficient through Cronbach's alpha is 74%. Academic achievement index in this study is the score of Persian reading fluency and comprehension at the end of the first semester as a pre-test for post - test is the score after the Intervention (after 24 sessions of 45 minutes of training). The score of Monthly teacher-made test for pre-test before the Intervention (Persian reading and comprehension lesson) and post-test, was teacher-made monthly test after the Intervention.

Procedure

Coordination with the Education Authority was done to select an education district which is considered to be socially and economically deprived area. The girls only were divided into seven clusters according to their place of residence, and one of them was randomly selected as cluster. This cluster included seven schools, which were again selected by chance, finally a school was chosen. Some modifications were needed to make in school timetable of the second and fourth grades. By mentioning the research topic, the researcher informed the

principal and teachers about the purpose of the research and invited them to participate. And it was decided that they would understand each other's situation and rush to each other's aid as much as possible. Randomly, one class was selected as the control group and one class as the experimental group, and both groups underwent a pre-test and post-test. The pre-test included the reading score of the Persian course at the end of the first semester, the post-test included the reading score after intervention. Also, two classes from the fourth grade were randomly assigned one class to the control and one to the experimental group.

A pre and post-test were performed for both groups. The pre-test included the score obtained from the Coopersmith self-esteem test before the intervention and the post-test included the score obtained from the Coopersmith self-esteem test after the intervention. From the fourth grade, which was selected as the experimental group, among the student volunteer teachers, 17 were randomly selected as "tutors". Three times a week, each time for about forty-five minutes to an hour, they helped 17 second-grade students in the experimental group who were poor at reading Persian. In this way, the tutors leave the classroom at the times specified in the weekly program, and each, together with a second-grade student who was poor in reading (is supervised by researcher) were teaching, in a school location designated for this purpose. Of course, at the beginning of each program, for seven minutes, there were discussions between researcher and tutors about the characteristics of a teacher and the moral characteristics of the community and cooperation. The last five minutes of each session were devoted to summarizing the results of the session (due to lack of time, they preferred to write the report in writing) who usually talked about their problems with their students and all cases were reviewed by the researcher. It should be noted that one of the factors affecting “Cross - age peer tutoring “is the cooperation of teachers. Therefore, before starting the program, it is necessary for schoolteachers to become familiar with the method and believe in its usefulness. Acceptance and approval of the program by teachers allows them to facilitate communication between students and at the same time to adjust their class schedule so that no new lessons are taught at the scheduled hours**.**

Data Analysis

The methods used to describe the data of this study include mean and standard deviations. Mean bar graphs were used for clarity of descriptive results. The precondition for an experiment or intervention is that the two groups are the same before the intervention .

Therefore, independent t-test was used to detect significant differences between the pretest and the posttest in two groups. The result of t-test also showed that there is no significant difference between the two groups.

Results

Means and standard deviations of experimental and control group scores in pre-test and post-test reading are given in Chart 1 and Chart 2 and Table 1 and Table 2.

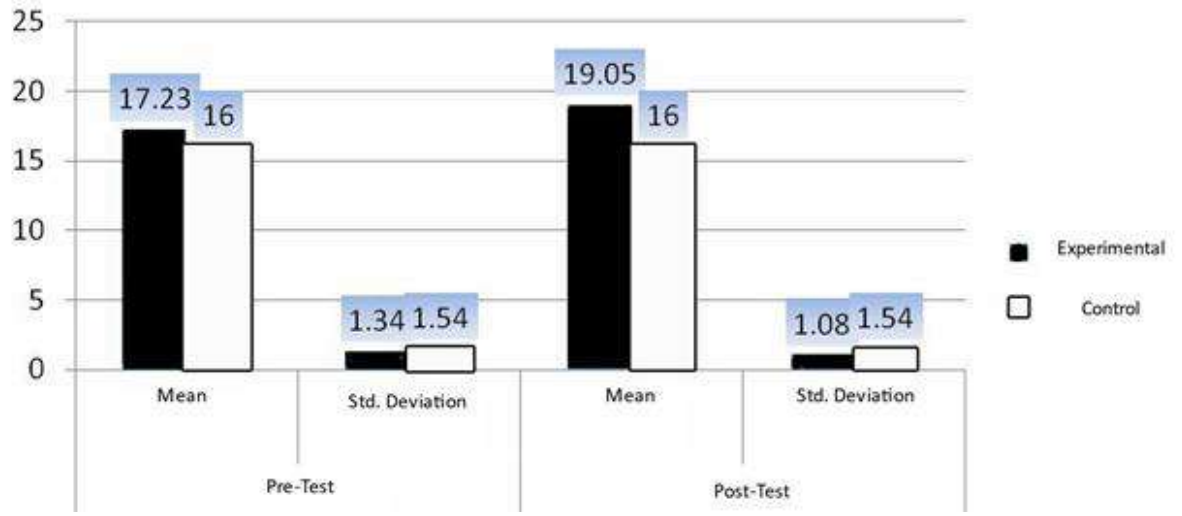

Chart 1. Comparison of the Mean Scores of Students in the Experimental and Control Groups in Pre-test and Post-test Reading

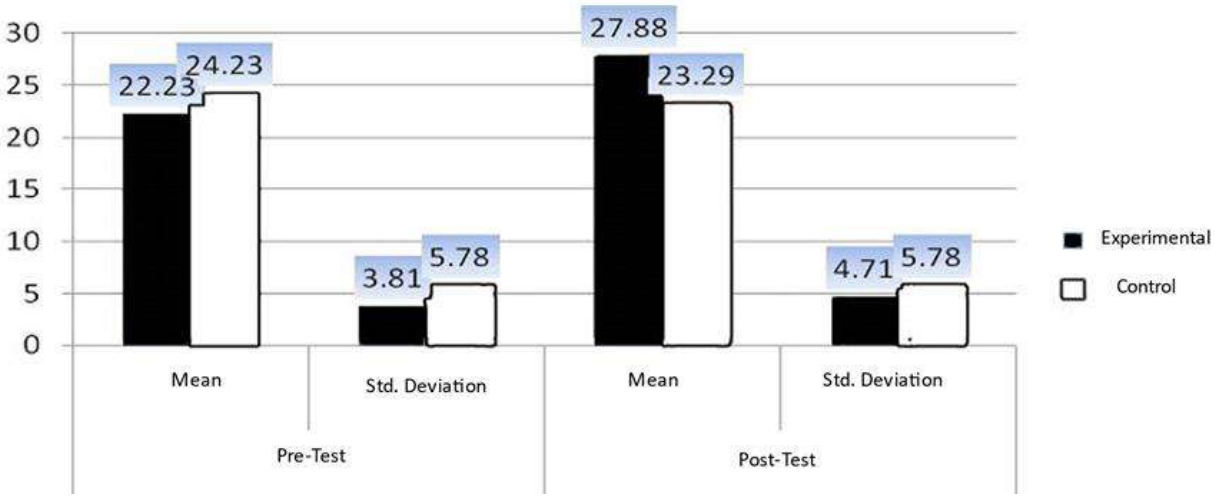

Chart 2. Mean and Standard Deviation of Experimental and Control Group Scores in Pre-test and Post-test Self-esteem

Table 1. Test Results: the In-subject Effects for Reading Score and its Interaction with the Group

Group	N	Pre - Test		Post - Test	
		Mean	Std. Deviation	Mean	Std. Deviation
Experimental	17	17.23	1.34	19.5	1.8
Control	17	16	1.54	16	1.54

Table 2. Mean and Standard Deviation of Experimental and Control Group Scores in Pre-test and Post-test Self-esteem

Group	N	Pre - Test		Post - Test	
		Mean	Std. Deviation	Mean	Std. Deviation
Experimental	17	22.23	3.81	27.88	4.71
Control	17	24.23	5.87	23.29	5.78

Table 3 shows the difference between pretest and post-test scores of Persian reading course with a value of F = 7.50 at the level of p <0.01 is significant. Also, the group's interaction with Persian reading course is significant with F = 14.97 at the level of p <0.01. The findings means that the students in the experimental group have improved their Persian reading lesson after the implementation of the "peer tutoring program.

Table 3. Test Results: In-subject Effects for Reading Score and its Interaction with the Group

Source of variations	Sum of squares	df	Mean squares	F	sig
Reading	14.13	1	14.13	7.50	0.01
Reading* Group	28.14	1	28.14	14.97	0.01
Error	60.23	32	1.88		

Table 4 shows the intergroup effect. The group scores with F = 39.32 at the level of p <0.01 are significant.it means that, there is a difference between the experimental and control groups in terms of grades, which is due to the positive effect of the " peer-tutoring program " on students who have benefited from this .strategy

Table 4. Test of Intergroup Effects for Group Effect on Reading Score

Source of variations	Sum of squares	df	Mean squares	F	sig
Group	78.36	1	78.36	39.32	0.01
Error	63.76	32	1.99		

The interaction of the groups on reading comprehension performance is provided in Figure 3.

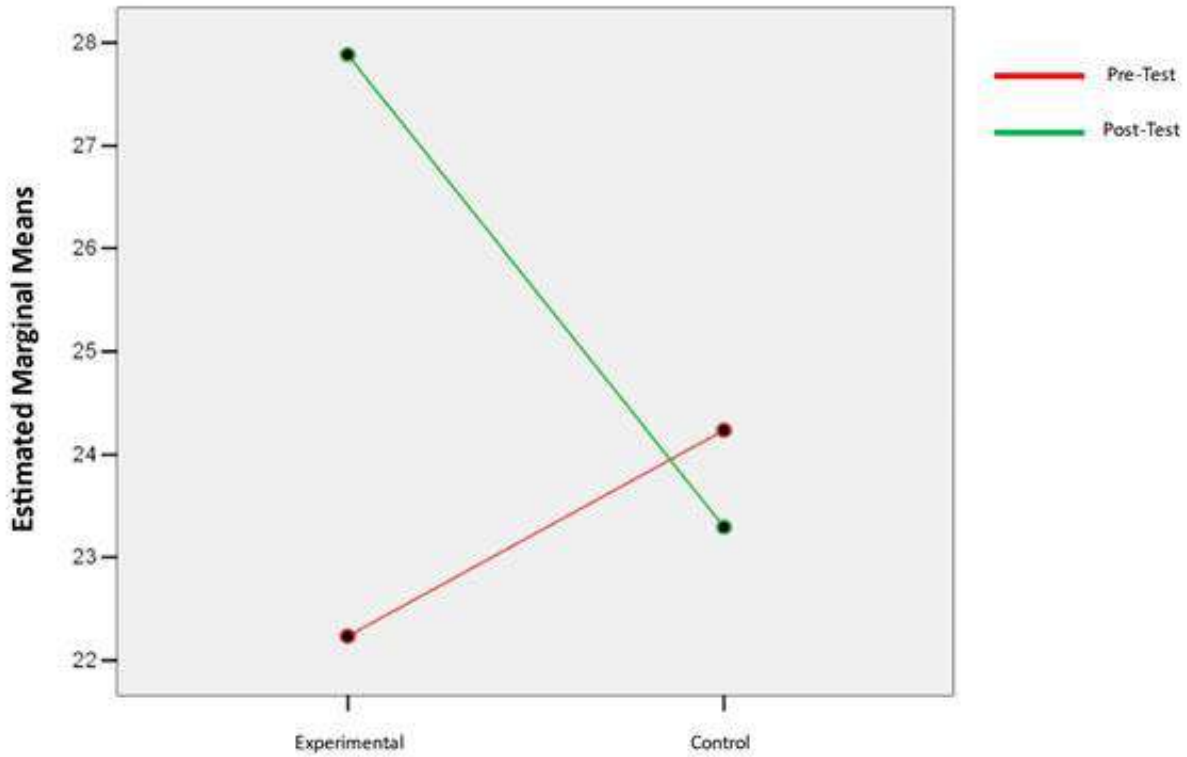

Figure 3. The Interaction of group and the Test on Reading Comprehension Performance

Table 5 shows that the difference between pre and post-test self-esteem scores with a value of F = 13.91 at the level of p <0.01 is significant. Also, the group's interaction with self-esteem was significant with F = 27.27 at the level of p <0.01. That is, the subjects in the experimental group improved or increased their score in the self-esteem test after the "peer-tutoring program "compared to before the performance, which was due to the positive effect of the experimental action. According to our observation lack of self-esteem but not the student's ability to comprehend was one of the causes of academic failure. Strengthening their self-esteem has increased their sense of responsibility towards tutees and subsequent academic achievement. One of the important factors for the success of "cross age peer

tutoring" program is the cooperation of teachers. Therefore, before starting the program, it is necessary for schoolteachers to become familiar with the above method and believe in its usefulness. Acceptance and approval of the program by teachers allows them to facilitate communication between students and at the same time to adjust their class schedule so that no new lessons are taught at the scheduled hours. "Cross age peer tutoring" program was able to provide an opportunity to encourage students with low performance to engage in activities that are appropriate to their abilities. Importantly, an enhanced emotional security was also observed in the tutees. Tutees have benefited from obtaining individual training as well as direct feedbacks.

Table 5. The Test of Inside the Subject Effects for Self-esteem Score and its Interaction with the Group

Source of variations	Sum of squares	df	Mean squares	F	sig
Self -steam	94.11	1	94.11	13.91	0.01
Self-steam* Group	184.47	1	184.47	27.27	0.01
Error	216.41	32	6.77		

According to the principal's point of view, next to academic achievement, both tutors (fourth-grade students) and tutees (second-grade students) have improved their self-esteem and obtained more qualified characters than other students. According to a fourth-grade teacher, the excitement of tutors was enjoyable. Tutors improved in classroom activities, moral behaviors, and their self-confidence. The teacher believed that applying educational theories is interesting and popular, but there are practical barriers.

Interestingly, tutors, like real teachers, enjoyed the academic progress of their students (tutees). According to a second-grade teacher, after a few sessions, the tutors would question the academic progress of their students'(tutees) from her. The remarkable point is that the tutors would evaluate their tutee's progress by their own teaching methods indicating their conscientiousness and responsibility. The tutees imitated tutors' behavior and attitudes, while imitating the main teacher is more difficult due to greater communication barriers. The tutors and tutees better understand each other's language and therefore can easier solve each other's problem.

Qualitative observation of the process of peer tutoring and interviews with both children and their teachers provided rich data to disentangle the micro-processes of peer tutoring. It deals with how in fact teaching and learning are conceptualized by students when they act as teachers and what it means to learn and teach an object to peers and how it differs from an adult perspective. What drivers facilitates the process and what hinders it. The findings will be presented and discussed in this chapter.

Conclusions and Implications

To explain the results, these empirical findings are explained using the theoretical inputs from "social- affective neuroscience" and especially the "biopsychosocial" approach to the development of emotional and social development of children. Studies in this field have shown human beings are deeply social (Immordino-yang & Gotlieb, 2017; Guyer et al., 2018). Therefore, it has been argued that peer communication, due to the proximity of their intellectual and emotional horizons to each other and similar cognitive-emotional frameworks, motivates care and cooperation between them, which in a way provides social success for their current stage of development. Also, studies in this area have shown that different levels of social competence can be related to brain function resulting from the processing of social information during the experiences of rejection and acceptance of peers - which in turn depicts real-world experiences related to social relationships (Immordino-yang et al., 2016; Immordino-yang et al., 2019; Taghizadeh Kerman et al., 2022).

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Chapter 5 - Combining Teaching for and through Entrepreneurship and Interaction between Developed Skills

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Chapter Highlights

- This chapter analyses the effect of combining two entrepreneurship teaching methods on developing students' entrepreneurial skills in Tunisia.
- The developed model suggests that entrepreneurial intention is supposed to depend on students' creativity.
- The latter in turn depends on three variables, specifically: teaching methods, managing ambiguity, and core self-evaluation.
- The latter develops entrepreneurial attitude. We are using structural equation modeling (SEM-PLS) to test the proposed model.
- There are statistically significant relationships between all the variables composing our structural model.
- As a result, universities are invited to vary the methods used to teach entrepreneurship and to combine theoretical and practical methods to develop students' entrepreneurial skills and to improve their entrepreneurial intention.

Introduction

Since the goal of entrepreneurship education is to give people the knowledge, skills, and attitudes to act in an entrepreneurial way, it is important to determine the degree to which this goal has been reached. This requires the use of suitable assessment tools. These tools should reflect that entrepreneurship is a key competence for life and is not uniquely aimed at setting up a business (Farrokhnia et al., 2022; Moberg et al., 2014). In fact, entrepreneurial skills are not only used for launching a new business, but they are also required for developing an existing enterprise. Neck and Corbett (2018) consider them as a life skill for the 21st century. As a result, to cope with the constant change characterizing the economy, the labor markets, societies and social structures, students must develop their skills to act entrepreneurially in many different situations. The educational system plays a key role in reaching this goal by focusing on developing students' entrepreneurial skills and abilities. In fact, ASTEE (Moberg et al., 2014, p.7) considers that "the role of entrepreneurship education is to foster a mindset of entrepreneurial spirit in pupils and students by providing them with skill sets, knowledge and behavioral patterns that allow them to be entrepreneurial in their own lives".

Being aware of the importance of developing students' entrepreneurial skills, many ways of teaching entrepreneurship at university have been developed. Each one has its own tools and its specific goals. Jamieson (1984) gathered them in a three-category framework composed by "teaching about entrepreneurship", "teaching for entrepreneurship", and "teaching through entrepreneurship".

The goal of the first category is to develop the students' general understanding of entrepreneurship as a phenomenon (Mwasalwiba, 2010) to increase their awareness of entrepreneurship, incite them to consider self-employment (Klapper and Tegtmeier, 2010) and encourage them to choose entrepreneurship as a potential career (Fayolle and Gailly, 2013). Teachers in this case mainly use theoretical content (Honig, 2004; Kuratko, 2005; Piperopoulos and Dimov, 2015; Solomon, 2007). Their goal is to develop, among students, skills such as entrepreneurial intention, financial literacy, and entrepreneurial knowledge.

For the second and third categories, although they do not make use of the same tools, but both are practice-oriented approaches (Piperopoulos and Dimov, 2015). Both educate students about the mechanisms for running a business (Bennett, 2006) and provide them with

techniques to develop their entrepreneurial skills such as creativity, managing ambiguity and entrepreneurial mindset. They enhance even the student's core self-evaluation and the way he/she perceives entrepreneurship education. Even if there are some studies that pay attention to evaluate the development of students' entrepreneurial skills because of entrepreneurship education (Chaker and Jarraya, 2021; Moberg et al., 2014; Kermani et al., 2020), they did not take into consideration the interaction between these skills and the good effect it has on developing them.

Starting from a teaching experience lived by our students at the Faculty of Economics and Management of Tunis where teachers combine teaching about and through entrepreneurship, the aim of this paper is to demonstrate that entrepreneurship education certainly develops the entrepreneurial skills of students, but these skills are not without effect on each other, and they interact together. This is important as it will enlighten us on how to proceed when we look for develop a specific entrepreneurial skill through education and to improve the readiness of young entrepreneurs from the formal education path.

Entrepreneurship Education and Skills Development

Expecting a myriad of effects going from reaching economic growth, creating jobs, increasing societal resilience, and allowing individual growth, many universities have been offering courses in entrepreneurship for students to develop their entrepreneurial skills. Therefore, when it was about going into practice, many challenges have been faced by teachers in concern with a clear definition of entrepreneurship education, the best way to do it, the set of skills to be developed to enhance the students' preparedness to the labor market, and the resources needed to reach the educational goals. Realizing the importance of meeting these challenges, several works have been carried out in order, on the one hand, to define the entrepreneurship education, to explain its importance and to present the different teaching methods and, on the other hand, to present the different skills developed by this teaching. We present these different elements in what follows.

Entrepreneurship Education: Value Creation and Skills Development

The definition of entrepreneurship education is profoundly affected by the definition of entrepreneurship. Lackéus (2015) distinguishes two main definition of entrepreneurship, one

termed “wide” and one termed “narrow” and thinks that the conception used largely determine educational objectives, target audiences, course content design, teaching methods and student assessment procedures. According to the author, the narrow definition of entrepreneurship is about opportunity identification, business development, self-employment, venture creation and growth. In this case, individuals learn how to become entrepreneurs (Fayolle and Gailly, 2008; Mahieu, 2006). Lackéus (2015) present the wide definition of entrepreneurship as personal development, creativity, self-reliance, initiative taking, and action orientation. He specifies that, in this case, individuals learn how to become entrepreneurial, which is much wider and goes beyond business creation to consider value creation (Bruyat and Julien, 2001). Seen in this way, entrepreneurship is rather presented as a generic method for human action that comprises principles and techniques that anyone can learn through basic education (Sarasvathy and Venkataraman, 2011). The learning should not be done in isolation, but by interacting with the environment where change occurs constantly (Bruyat and Julien, 2001: Öztürk et al., 2021; Shelley et al., 2021; Türe & Ozturk, 2021). Lackéus (2015) considers that learning and value creation are two main aspects of entrepreneurship and thinks that “this view aligns better with the learning focused aims of educational institutions than many other definitions of entrepreneurship” (Lackéus, 2015, p.10). Thus, the definition of entrepreneurship education is based on developing the students’ capacities to create values for different stakeholders because this will help them to develop their entrepreneurial skills. In this context, Lackéus et al. (2013) talk about "learning-by-creating value" and the entrepreneurship education is defined by Moberg et al. (2012, p.14) as “content, methods and activities supporting the creation of knowledge, competencies and experiences that make it possible for students to initiate and participate in entrepreneurial value creating processes”.

Entrepreneurship Education: Three Main Approaches to Teach Entrepreneurship

The different way to define entrepreneurship led to a wide diversity of approaches to teach it (Mwasalwiba, 2010). Scholars classified pedagogical approaches in three themes: educating or teaching about, for and in or through entrepreneurship (Mwasalwiba, 2010; Sirelkhatim and Gangi, 2015). The teaching about entrepreneurship is called by Jamieson (1984) as teacher-centered programs. It is the most common approach in higher education institutions, and it is mainly made up of theoretical content (Mwasalwiba, 2010).

Teaching for entrepreneurship aims to provide to aspiring entrepreneurs the practical skills and knowledge required to set-up and run small business (Piperopoulos and Dimov, 2015) by simulating the entrepreneurial process (Mwasalwiba, 2010) and making students typically role-play as entrepreneurs (Sirelkhatim and Gangi, 2015). Teaching in or through entrepreneurship is a practice-oriented approach (Piperopoulos and Dimov, 2015). It pushes students to become actual entrepreneurs (Vincett and Farlow, 2008). This approach conducts them to carry out projects in which they deal with real businesspeople, have real experiences, face real problems, and take real risks (Chang and Rieple, 2013). It is a way of learning with and through real-life entrepreneurship (Sirelkhatim and Gangi, 2015). As this learning-by-doing approach is considered as the best way to develop entrepreneurial competencies (Piperopoulos and Dimov, 2015) and corresponds to "entrepreneurial learning suggestions for EE programmes' best practice" (Sirelkhatim and Gangi, 2015: 7), we are going on the following to focus on the teaching in or through entrepreneurship in the same way as on the theoretical one.

Entrepreneurial Skills Developed by Entrepreneurship Education

The ASTEE (Moberg et al., 2014) created a set of tools in response to the need of entrepreneurship educators to measure the learning outcomes of their students. The measurement tools were created to assess entrepreneurial mindsets, attitudes and perceived skills acquired by students in entrepreneurship education which are complicated to observe directly that makes them difficult to measure. The evaluation of entrepreneurship education in the ASTEE program is based on the evaluation of skills developed because of the education.

According to the ASTEE (Moberg et al., 2014, p.15), skills are defined as "a combination of the knowledge, the knowhow and the experiences that have been acquired and that are necessary / useful in order to carry out an activity in a professional way". Authors argue their choice by the fact that Kuratko and Hodgetts (2004) consider that entrepreneurial activities require many different types of skills and abilities, both cognitively oriented and non-cognitive skills (Moberg et al., 2014). They organized the skills under six inclusive skill sets which cover both levels. It is about creativity, planning, financial literacy, resource marshalling, managing uncertainty, and teamwork. They add that these skills are required in the different phases of an entrepreneurial venture, going from exploration to evaluation and

exploitation, and relevant in self-employment or within established organizations. Among the set of skills identified by the ASTEE (Moberg et al., 2014), we are going to focus on the ones we consider are developed by the teaching about and through entrepreneurship.

Entrepreneurial Skills Developed by the Teaching about and through Entrepreneurship

The aim of the teaching about entrepreneurship theme is to increase students' awareness of entrepreneurship, push them to consider self-employment (Klapper and Tegtmeier, 2010) and encourage them to choose entrepreneurship as a potential career (Fayolle and Gailly, 2013). This leads us to consider that teaching about entrepreneurship develops students' entrepreneurial intention. In fact, the entrepreneurial intention is defined by the ASTEE as the student's intention to start up a company soon (Moberg et al., 2014). Anjum et al. (2021) describe entrepreneurial intention as the process of seeking knowledge that can be used to attain a business drive and according to Auzoult et al. (2016), it concerns the degree to which an individual has an intention of starting a business soon.

Furthermore, in teaching about entrepreneurship, courses contents include entrepreneurial traits, personality characteristics, economic success, how people think entrepreneurially and entrepreneurial awareness (Piperopoulos and Dimov, 2015), business plans (Honig, 2004), conventional management-related subjects such as marketing and financial management (Kuratko, 2005) and small business management courses (Solomon, 2007). This is likely to enhance the students' financial literacy which is considered by the ASTEE as the individual's ability to understand financial statements and budgets (Moberg et al., 2014). It is one's ability to use knowledge and skills to manage financial resources effectively for a lifetime of financial well-being (PACFL, 2008).

Teaching about entrepreneurship develops entrepreneurial knowledge too which is defined by the ASTEE as the knowledge about how to identify opportunities, the context in which people live and work, how the economy functions and ethical positions of enterprises (Moberg et al., 2014). Pihie and Arivayagan (2016, p.3) present entrepreneurial knowledge as "the ability to understand the role of entrepreneurs, which focuses on 1) assessing the students' perceived knowledge on how to gauge business opportunities, 2) the role and function of entrepreneurs play in society, as well as 3) the various prospective of entrepreneurial career options that exist".

In teaching in or through entrepreneurship, the activities conducted push students to be entrepreneurs (Vincett and Farlow, 2008) and allows them to carry out projects in which they deal with real businesspeople, have real experiences, face real problems, and take real risks (Chang and Rieple, 2013). It is a good exercise to enhance their entrepreneurial attitude defined by the ASTEE as individual's attitude toward his or her own capability to successfully perform various entrepreneurial activities (Moberg et al., 2014). Teaching in or through entrepreneurship also increases the students' entrepreneurial mindset considered by the ASTEE as the fact to focus on action and responsibility (Moberg et al., 2014). It is defined as the feelings and the belief of a particular ability to think out of the box (Lackéus, 2015; 2013). For Pihie and Arivayagan (2016, p.2), "entrepreneurial mindset is considered as a holistic perception of generating novel ideas, evaluating opportunities and risks, or starting and running a business, whereby an individual internally assesses his or her perceptions based on holistic rather than functional attributes".

This approach boosts students' core self-evaluation considered by the ASTEE as the individual's belief in his or her own capability to successfully perform challenging activities and tasks (Moberg et al., 2014). Core self-evaluation is defined as the fundamental assumptions individuals hold about themselves and their functioning in the world (Judge, Locke and Durham, 1997). It refers to people's fundamental evaluations of their own ability, competence, and values (Judge et al., 1998).

It is an overall and latent personality construct representing a positive baseline assessment in which they are self-potent, self-worthy, free from anxiety, and in control of their own lives (Harris, Harvey, and Kacmar, 2009; Johnson, Rosen, and Levy, 2008; Kim, Liden, Kim, and Lee, 2015). Many scholars consider core self-evaluation as an important personality construct (Chang et al., 2012; O'Neill, McLarnon, Xiu, and Law, 2016) to predict work-related outcomes better than other individual personality traits in both Eastern and Western contexts (Judge, 2009; Rode et al., 2012). For that purpose, it is considered as the best to develop the knowledge of student's personal fit with being an entrepreneur and/or being entrepreneurial (Kraiger et al., 1993).

During teaching in or through entrepreneurship, students develop practical skills to deal with the complexity of the entrepreneurial process (Gibb, 2002). Activities conducted develop in them the capabilities to make decisions in situations of high ambiguity (Arvanites et al.,

2006; Kailer, 2009). This approach engages students so that they can best learn how to deal with the complexities of new venture creation (Biggs, 2003). It raises their managing ambiguity defined by the ASTEE as the individual's ability to manage and cope with uncertainty and ambiguity in the process of implementing and exploiting a business idea (Moberg et al., 2014). The aim here is to feel comfortable with uncertainty and ambiguity, to be adaptable, and open to surprises by facing them through real-life entrepreneurs' activities (Sánchez, 2011, Murnieks, 2007).

Piperopoulos and Dimov (2015) explain that, in this way of teaching, many activities of generating ideas, team building, business planning, creativity, innovation, and inspiration are conducted. It conducts students to act, practice, experiment and make decision, solve problems, and recognize opportunities. It develops their creativity considered by the ASTEE as the individual's ability to think in new and imaginative ways (Moberg et al., 2014). And according to Sokolova (2015), creativity is the ability to produce new and unique ideas.

Teachers using it adopt self-directed and active learning as this approach is based on learning-by-doing. They make use of team teaching which consists of implying academics and practitioners. They help their students by mentoring them or giving them the opportunity of networking with real entrepreneurs. They invite them to pitch their business ideas to investors and teach them with and through real-life entrepreneurs (Piperopoulos and Dimov, 2015). By acting as such, they changed their teaching methods by adopting a more learning-by-doing approach and students-oriented methods. The ASTEE considers teaching methods in its measure tools and define it as measures according to the extent to which students find that they have been more encouraged by their teacher and that their education has focused to a larger extent on teaching them cognitively oriented and non-cognitive entrepreneurial skills and abilities (Moberg et al., 2014). This goal semms to be resched by combining this method with the theoretical one (Chaker and Jarraya, 2021).

Interaction between Skills Developed by Entrepreneurship Education

Although theoretically and practically oriented courses are used to teach entrepreneurship and authors consider they develop students' skills, many authors were focused on defining those skills (ex. Acharya and Chandra, 2019; Chaker et Jarraya, 2021; Messen and Saadaoui, 2020; Moberg et al., 2014; Lackéus, 2015; Pihie and Arivayagan, 2016) but fewer studies paid

attention to the interaction between them. These interactions are very important to be studied because they are going to enable teachers and practitioners in entrepreneurship education field understand how some specific skills can be enhanced and how should they act to improve them among students. This is a promising area where entrepreneurial education can aid the improvement of students' employability through its capacity to foster the development of entrepreneurial skills leading to increased students' entrepreneurial performance and their preparedness to the labor market in self-employment or within established organizations.

Teaching Methods, Financial Literacy, Managing Ambiguity and Creativity

According to the ASTEE, the student-teacher relationship is very important in developing students' entrepreneurial skills. And one of the main focuses of the measure they developed is to assess in what extent students feel that they have been more encouraged by their teacher and that their education has focused to a larger extent on teaching them cognitively oriented and non-cognitive entrepreneurial skills and abilities (Moberg et al., 2014). Claxton (2008) considers that experiential education is a step forward towards a more creative classroom. He adds that teachers have a crucial role in developing students' creativity and Cimermanová (2014) thinks that students' creativity depends on the creativity of the teacher, and the amount of creativity that he/she embraces. Thus, based on these arguments, we propose that:

> *Hypothesis 1 (H_1): teaching methods (TM) positively influence students' Creativity (Cr).*

According to Koh (1996), an ambiguous situation is said to exist when there is insufficient information to structure it. Ambiguity thus creates a tension that some individuals try to overcome. When they challenge ambiguous situations and strive to overcome unpredictable and unstable situations with the goal of performing well, they are qualified as persons who have a high tolerance of ambiguity (Samydevan et al., 2015). Koh (1996) considers that tolerance of ambiguity is a way persons perceive an ambiguous situation and with available information organize themselves to approach the situation. Thus, the more they have relevant information, the less the situation is ambiguous. Authors such as Castrogiovanni (1996), Delmar and Shane (2003) and Stevenson et al. (1985) think that financial literacy is an important ability to successfully engage in entrepreneurial activities and that it is important that the entrepreneur has at least a basic understanding of the financial concept to be

trustworthy to external and internal stakeholders. Consequently, we develop the following hypothesis:

Hypothesis 2 (H_2): Financial Literacy (FL) positively influences Managing Ambiguity (MA).

To show the effect of managing ambiguity, we refer to the research of Sætre and Brun (2012) in which they advocate that sustaining ambiguity stimulates creativity. In fact, in response to the ambigouis situation tension, individuals will use their creativity to reduce ambiguity by increasing the innovativeness of the solutions they offer (Lewis, 2000). Thus, based on these arguments, we posit the following hypothesis:

Hypothesis 3 (H_3): Managing Ambiguity (MA) positively influences Students' Creativity (Cr).

Financial Literacy, Entrepreneurial Knowledge, Entrepreneurial Mindset, Entrepreneurial Attitude, and Core-self Evaluation

Financial literacy is defined as the individual's ability to use knowledge and skills to manage financial resources effectively for a lifetime of financial well-being (PACFL, 2008). Many countries in the world are encouraging financial education as a tool of fighting poverty (UN, 2003). Furthermore, financial literacy is believed to be a key ingredient to entrepreneurship success (Njoroge, 2013). Entrepreneurship education provides the basic numeric and financial literacy skills and enhances the overall quality of the entrepreneur which increases the chance of survival (Carter and Jones-Evans, 2000). Consequently, we develop the following hypothesis:

Hypothesis 4 (H_4): Financial Literacy (FL) positively influences Entrepreneurial Knowledge (EK).

Ni and Ye (2018) advance that individuals who have entrepreneurial knowledge are likely to become entrepreneurs. It conducts them to seek out existing opportunities, challenges, and maximizing resources effectively (Saptono et al., 2020). Many scholars confirm that entrepreneurship knowledge influences entrepreneurial readiness, startups, and new business

development (Coduras et al., 2016; Ruiz et al., 2016; Tung et al., 2020). And as Nabi et al. (2017) and Solesvik et al. (2013) define entrepreneurial mindset as a feeling and belief with a unique way of seeking the opportunities and challenges, Saptono et al. (2020) show that entrepreneurial knowledge has a positive impact on entrepreneurial mindset. Consequently, we develop the following hypothesis:

Hypothesis 5 (H_5): Entrepreneurial Knowledge (EK) positively influences Entrepreneurial Mindset (EM).

Kraiger et al. (1993) consider that the core self-evaluation is the best to develop the knowledge of student's personal fit with being an entrepreneur and/or being entrepreneurial. Developing entrepreneurial knowledge is a key component for this purpose because people need to understand entrepreneurship well first so that they could organize and explain the knowledge about it in a clear way to ensure that they can take the best decision (Wang and Noe, 2010). This way, individuals can deepen their understanding of entrepreneurial knowledge and enhance their core self-evaluation. In summary, we propose:

Hypothesis 6 (H_6): Entrepreneurial Knowledge (EK) positively influences Core Self-Evaluation (CSE).

According to Keat et al. (2011), the main objective of entrepreneurship education is to change the students' views, behavior, and interests to understand entrepreneurship. This helps them to develop an entrepreneurial mindset that conducts them later to become successful entrepreneurs and build new businesses as well as promote new job opportunities. Thus, entrepreneurship education significantly affects a person's attitude to entrepreneurship by developing his entrepreneurial mindset (Wu and Wu, 2008). Accordingly, we propose:

Hypothesis 7 (H_7): Entrepreneurial Mindset (EM) positively influences Entrepreneurial Attitude (EA).

Abun et al. (2018) consider that entrepreneurial attitude matters because it influences a person to behave in a certain way and it reflects the attitude of the person and who the person is. Robinson et al. (1991) consider that attitude influences confidence, enthusiasm, inclination, and aspiration. Thus, we propose:

Hypothesis 8 (H_8): Entrepreneurial Attitude (EA) positively influences Core Self-Evaluation (CSE).

Creativity, Core Self-evaluation, and Entrepreneurial Intention

Many scholars consider that core self-evaluation enables individuals to approach the positive aspect of their work (Judge and Hurst 2007; Kammeyer-Mueller et al., 2009) and thus to seek positive outcomes (Judge et al., 2005). Chang et al. (2012) explain that the process includes cognitions and perceptions of one's job, and judgments or estimations of how other things relate to the self. It involves the development of the person's ways of carrying out job-related tasks too. As such, people with high core self-evaluation can effectively carry out self-assessment and quickly focus on important issues as they can trigger self-regulatory processes and maintain their external focus on performance, by paying attention to people who evaluate them positively (Zhang et al. 2014; Wang et al., 2018). As a result, high-CSE individuals are more likely to engage in creative activities (Wang et al., 2018). Chang and al. (2013) also consider that core self-evaluation positively affects individuals' creativity. Consequently, we develop the following hypothesis:

Hypothesis 9 (H_9): Students' Core Self-Evaluation (CSE) positively influences their Creativity (Cr).

Many scholars combine creativity to study entrepreneurial intention. Hamidi et al. (2008) were the first to introduce creativity into the theoretical model of entrepreneurship education and entrepreneurial intention. The results of their study showed that creativity exercises could improve students' entrepreneurial intentions. Zampetakis et al. (2011) also studied the connection between young people's creativity and entrepreneurial intentions and found that the more creative young people thought they were, the higher their entrepreneurial intentions were. Many other scholars found a positive relationship between creativity and entrepreneurial intention among students such as Chia and Liang (2016), Miranda et al. (2017), Hu et al. (2018) and Shi et al. (2020). On this basis, it is possible to put forward our last hypothesis:

Hypothesis 10 (H_{10}): Students' Creativity (Cr) positively influences Entrepreneurial Intention (EI).

Study Framework

Based on the above discussion and hypothesis development, our conceptual framework is thus constructed and can be presented as follow (see Figure 1):

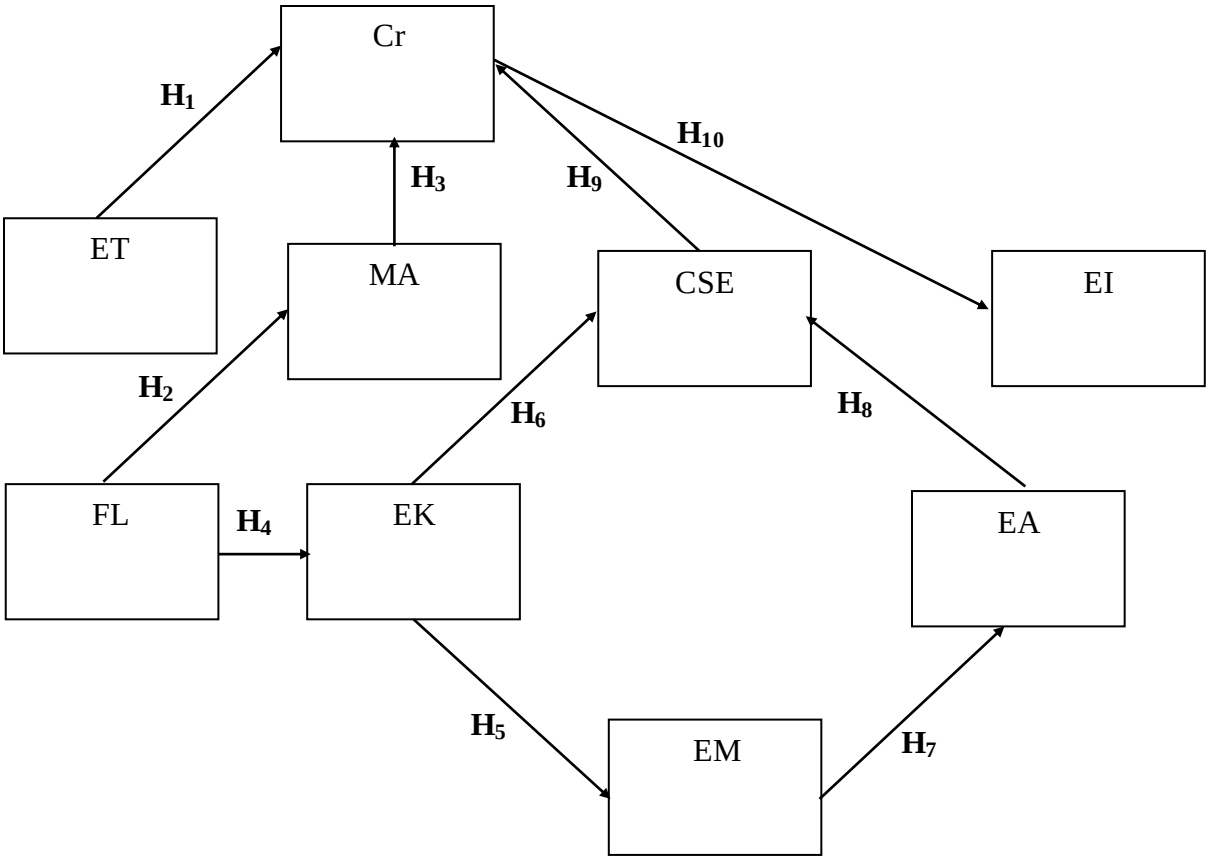

Figure 1. Conceptual Framework

Research Method

This section describes the method used to evaluate the measurement and structural model.

Questionnaire Development and Measurement Instruments

To measure the model variables, we used the scales created by Moberg et al. (2014) for the ASTEE project. These scales present the advantage of showing high reliability levels and being created for entrepreneurship skills developed evaluation purpose. They are seven-point Likert scales, where "1" means "completely disagree," and "7" means "completely agree". We present the measurement instruments (34 items) in Table 1:

Table 1. Measurement Instruments (34 items)

Variable	No. of items	Adopted from	Scale
Teaching methods	6 items	Moberg et al. (2014)	Likert-type seven-point scale
Creativity	4 items		
Financial Literacy	3 items		
Managing Ambiguity	4 items		
Entrepreneurial Knowledge	3 items		
Entrepreneurial Mindset	3 items		
Core Self-Evaluation	5 items		
Entrepreneurial Attitude	3 items		
Entrepreneurial Intention	3 items		

Data Collection Method and Sample

A questionnaire survey was carried out among students of the Faculty of Economics and Management of Tunis (FEMT). We focused on undergraduate management students. These students on their university course were taught through an approach combining teaching about and teaching through entrepreneurship in a pilot experience carried out for the first time at this university for a duration of 63 h in entrepreneurship. The theory-oriented course is taught three hours a week (42h a semester). The module focuses on the conceptual aspects of entrepreneurship and the course is taught by a single lecturer who adopted a stand-and-deliver approach.

The practice-oriented course is taught in a workshop format for one and a half hours per week (21h a semester). This was the first time that students experienced teaching through entrepreneurship. In the workshops, students worked in teams, ran their own real-life business, and took responsibility for their enterprises. This gave them the opportunity to experience professional responsibility within their companies, to take risks, and to manage conflicts so as to overcome the challenges of keeping the team working together. These activities developed students' entrepreneurial mindset, entrepreneurial attitude, and creativity. Students also had to develop their financial literacy so that they learn where to look for financial resources and how to manage them to launch their projects. For that purpose, the

teacher distributed a share issue of 80 shares among students where each share was worth five dinars (almost $1.82).

The shares were divided equally between the students in the team and each student could not buy more than one share. The goal is to teach them how to convince external investors to buy the remaining shares. For that purpose, they had to convince different economic actors of the feasibility of their project so that they buy shares to help the team move forward in the preparation of the prototype. This activity developed the students' financial literacy and taught them how to manage ambiguity.

Moreover, in this module, emphasis is placed on the development of business skills, occupational awareness of new venture start-ups, self-employment, and entrepreneurial competencies such as core self-evaluation, entrepreneurial attitude, and entrepreneurial intention. To develop students' entrepreneurial skills, a team of academics and practitioners worked together with students in a self-directed, learning-by-doing environment. Practitioners were implied to support teaching team by helping student teams from idea generation to the actual launch of their real-life businesses. They shared with them their learning and gave them access to their networks. Implementing these activities as part of the course or workshops required the mobilization of a wide range of educational tools as well as the adoption of an entrepreneurial mindset by the teachers responsible for the module. This conducted them to vary their teaching methods.

Sampling Method

We have chosen an empirical sampling method because of the lack of a sampling frame. Consequently, we constituted the sample of our study by using a reasoned choice (Royer and Zarlowski, 2014). The questionnaire was administered on-line, at the end of the entrepreneurship module, related to the academic year 2019–2020. A total of 92 undergraduate management students from FEMT who validated this module agreed to take part in this survey. They are part of the 125 students who followed the pilot program at the faculty.

Referring to the study sample, 71.7% of the respondents were women while 28.3% were men, 91.3% were Tunisian, and 8.7% were foreigners. The age of most respondents (84.8%) is

between 20 and 22 years old. Among the students surveyed, 33.7% have already worked in associative activities, while 66.3% have never participated in such activities. 83.7% of the students questioned declare that they have a family background in entrepreneurship activities (see Table 2).

Table 2. Profile and Characteristics of Respondents

Variables		Frequency	%
Gender	F	66	71.7
	M	26	28.3
Age	19	7	7.6
	20-22	78	84.8
	23	7	7.6
Associative experience	Yes	31	33.7
	No	61	66.3
Family background in entrepreneurship activities	Yes	67	83.7
	No	15	16.3
Total		92	100

Given the sample size, we have used the Partial Least Squares Path Modeling Method (Hair et al., 2019), to test the research model and hypothesis, using SmartPLS 3.

Results

We will present and discuss the structural model testing results.

Assessing Measurement Models

Three indices are commonly used to verify the convergent validity: factor loadings, average variance extracted (AVE) and composite reliability (CR). The results of convergent validity appear in Table 3. To ensure the discriminant validity, we check three criteria: Root Square of AVE (Fornell and Larcker, 1981), Cross Loadings (Hair et al., 2011), and HTMT (Kline, 2011).

Table 3. Convergent Validity Results

Construct	Items	Outer loading (>0.7)	Cronbach's Alpha (>0.7)	Rho-A (>0.7)	Composite reliability (>0.7)	Ave (>0.5)
Core Self-evaluation	CSE1	0.917	0.932	0.935	0.949	0.788
	CSE2	0.882				
	CSE3	0.847				
	CSE4	0.867				
	CSE5	0.921				
Creativity	Cr1	0.927	0.954	0.954	0.966	0.878
	Cr2	0.945				
	Cr3	0.942				
	Cr4	0.934				
Entrepreneurial Attitude	EA1	0.879	0.922	0.942	0.951	0.866
	EA2	0.955				
	EA3	0.955				
Entrepreneurial Intention	EI1	0.924	0.877	0.877	0.924	0.803
	EI2	0.850				
	EI3	0.914				
Entrepreneurial Knowledge	EK1	0.804	0.782	0.792	0.872	0.694
	EK2	0.881				
	EK3	0.813				
Entrepreneurial Mindset	EM1	0.866	0.847	0.894	0.906	0.763
	EM2	0.920				
	EM3	0.832				
Financial Literacy	FL1	0.905	0.925	0.926	0.953	0.871
	FL2	0.946				
	FL3	0.948				
Managing Ambiguity	MA1	0.868	0.906	0.939	0.933	0.778
	MA2	0.800				
	MA3	0.909				
	MA4	0.946				
Teaching Methods	TM1	0.903	0.943	0.965	0.954	0.776
	TM2	0.913				
	TM3	0.937				
	TM4	0.845				
	TM5	0.804				
	TM6	0.877				

As seen in Table 4, it's possible to verify the discriminant validity of the nine latent variables, in terms of the Fornell and Larcker criterion. In fact, the diagonals, which are the square root

of the AVE of the latent variables, indicate the highest in any column or row.

Table 4. Discriminant Validity Results (Fornell and Larcker Criterion)

Item	CSE	EA	EI	EM	EK	FL	MA	TM	Cr
CSE	0.888								
EA	0.582	0.930							
EI	0.494	0.358	0.896						
EM	0.764	0.523	0.599	0.874					
EK	0.589	0.513	0.525	0.527	0.833				
FL	0.410	0.194	0.431	0.428	0.373	0.933			
MA	0.542	0.347	0.541	0.641	0.447	0.472	0.882		
TM	0.472	0.057	0.307	0.342	0.451	0.424	0.203	0.881	
Cr	0.643	0.407	0.657	0.673	0.669	0.536	0.643	0.488	0.937

Concerning the second criteria, as indicated in the table (see Table 5), the variance shared between constructs measured by the correlations between constructs is lower than the variance shared by a construct with its indicators.

Table 5. Indicator Item Cross Loading

Item	CSE	EK	EA	EI	EM	FL	MA	TM	Cr
CSE1	**0.917**	0.525	0.577	0.452	0.730	0.306	0.471	0.323	0.559
CSE2	**0.882**	0.564	0.602	0.391	0.662	0.349	0.533	0.391	0.572
CSE3	**0.847**	0.505	0.440	0.430	0.618	0.295	0.567	0.423	0.498
CSE4	**0.867**	0.501	0.447	0.445	0.660	0.422	0.370	0.506	0.592
CSE5	**0.921**	0.515	0.502	0.478	0.717	0.440	0.469	0.460	0.626
Cr1	0.580	0.595	0.341	0.660	0.646	0.510	0.642	0.458	**0.927**
Cr2	0.634	0.695	0.393	0.605	0.604	0.527	0.583	0.486	**0.945**
Cr3	0.567	0.610	0.399	0.593	0.609	0.482	0.591	0.467	**0.942**
Cr4	0.629	0.607	0.431	0.601	0.661	0.487	0.592	0.418	**0.934**
EA1	0.455	0.479	**0.879**	0.341	0.416	0.210	0.303	0.014	0.395
EA2	0.558	0.514	**0.955**	0.304	0.475	0.158	0.312	0.047	0.345
EA3	0.597	0.448	**0.955**	0.356	0.556	0.180	0.349	0.087	0.399
EI1	0.424	0.502	0.345	**0.924**	0.547	0.375	0.551	0.221	0.571
EI2	0.394	0.442	0.229	**0.850**	0.450	0.404	0.384	0.354	0.593
EI3	0.508	0.468	0.387	**0.914**	0.612	0.378	0.520	0.247	0.599
EK1	0.367	**0.804**	0.224	0.494	0.391	0.291	0.339	0.466	0.554
EK2	0.466	**0.881**	0.461	0.416	0.461	0.307	0.403	0.390	0.582

Item	CSE	EK	EA	EI	EM	FL	MA	TM	Cr
EK3	0.604	**0.813**	0.549	0.415	0.455	0.328	0.370	0.297	0.537
EM1	0.643	0.383	0.432	0.509	**0.866**	0.399	0.489	0.310	0.541
EM2	0.750	0.594	0.527	0.540	**0.920**	0.449	0.590	0.420	0.722
EM3	0.587	0.354	0.390	0.526	**0.832**	0.243	0.606	0.112	0.450
FL1	0.433	0.385	0.206	0.387	0.382	**0.905**	0.431	0.445	0.545
FL2	0.351	0.358	0.154	0.443	0.422	**0.946**	0.446	0.373	0.478
FL3	0.360	0.296	0.182	0.372	0.392	**0.948**	0.444	0.366	0.473
MA1	0.425	0.412	0.322	0.471	0.528	0.508	**0.868**	0.241	0.548
MA2	0.324	0.278	0.178	0.341	0.419	0.243	**0.800**	0.009	0.371
MA3	0.496	0.409	0.284	0.506	0.597	0.385	**0.909**	0.117	0.586
MA4	0.608	0.441	0.387	0.546	0.670	0.467	**0.946**	0.273	0.693
TM1	0.464	0.389	0.044	0.268	0.302	0.402	0.232	**0.903**	0.489
TM2	0.489	0.377	0.017	0.234	0.318	0.373	0.178	**0.913**	0.459
TM3	0.443	0.443	0.070	0.292	0.328	0.441	0.185	**0.937**	0.513
TM4	0.388	0.386	0.054	0.326	0.298	0.368	0.150	**0.845**	0.320
TM5	0.288	0.368	0.014	0.208	0.203	0.247	0.113	**0.804**	0.257
TM6	0.374	0.422	0.088	0.295	0.331	0.363	0.183	**0.877**	0.443

Note: Items with high significance are bolded.

For the third criteria, the following table (see Table 6) shows that all the values are not equal or near 1, which shows a low discriminant validity between variables.

Table 6. Discriminant Validity (HTMT)

Item	CSE	EK	EA	EI	EM	FL	MA	TM	Cr
CSE									
EK	0.672								
EA	0.619	0.584							
EI	0.547	0.640	0.399						
EM	0.848	0.618	0.576	0.696					
FL	0.439	0.433	0.212	0.477	0.469				
MA	0.572	0.516	0.362	0.593	0.717	0.496			
TM	0.495	0.537	0.063	0.337	0.353	0.443	0.195		
Cr	0.681	0.775	0.435	0.717	0.726	0.569	0.669	0.494	

In sum, we can confirm the measurement model's validity. The overall model of this research is composed of nine measurement models, showing the links between items and latent

variables, and a structural model representing the supposed relationships between the five latent constructs (see Figure 2).

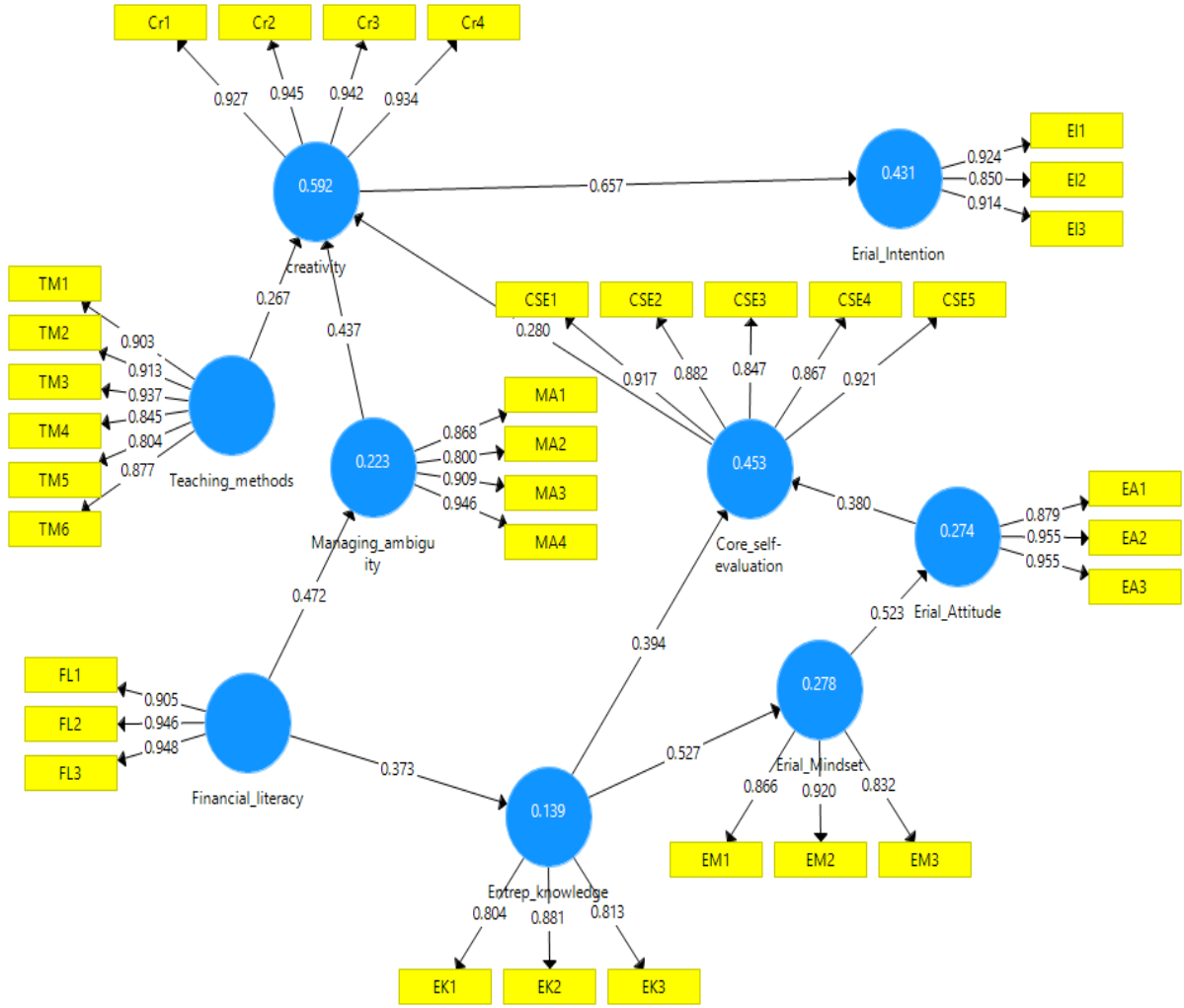

Figure 2. Measurement and Structural Model Results- Output SmartPLS

Assessing Structural Model

Our model is composed of 7 endogenous variables which are: core-self-evaluation, entrepreneurial knowledge, entrepreneurial attitude, entrepreneurial intention, entrepreneurial mindset, managing ambiguity, and creativity. As shown in the following table (see Table 7), the coefficients of determination of entrepreneurial knowledge, entrepreneurial attitude, entrepreneurial mindset, and managing ambiguity are weak (≈0.25). The ones of entrepreneeurial intention, core self-evaluation, and creativity are moderate (≈0.5) (Chin, 1998).

Table 7. The R^2 and Q^2 Results

	R^2	Q^2 (≠0)
CSE	0.453	0.344
EK	0.139	0.087
EA	0.274	0.226
EI	0.431	0.337
EM	0.278	0.182
MA	0.223	0.153
Cr	0.592	0.509

The values of the effect size (f^2) are acceptable for six exogenous variables: entrepreneurial knowledge, entrepreneurial attitude, entrepreneurial mindset, financial literacy, managing ambiguity, and creativity because they are higher than 1.5 but they are low for only two exogenous variables, namely core self-evaluation and teaching method in their relationships with creativity (Cohen, 1988).

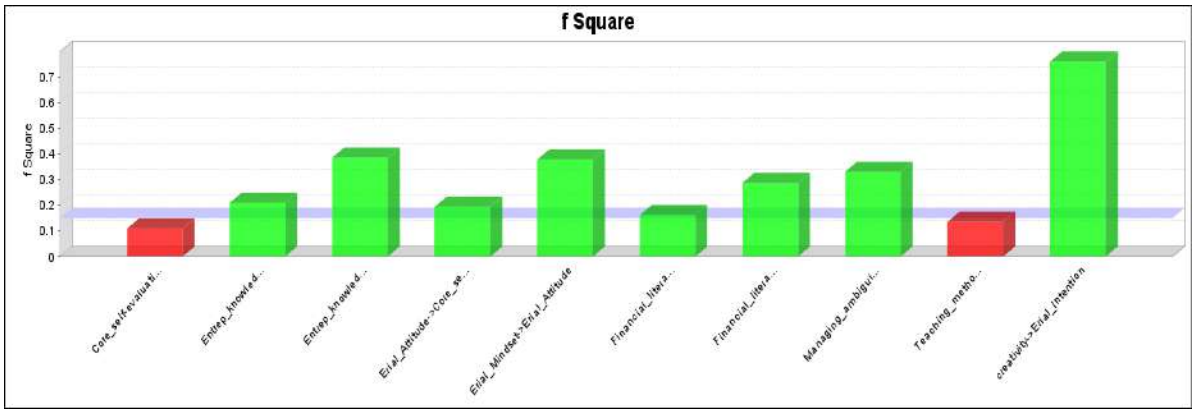

Figure 3. The Effect Size Results f^2

The value of the Goodness of Fit of the Model of this study (GoF = 0.521 > 0.36) is large enough to consider sufficient global PLS model validity (Wetzels et al., 2009). Finally, the predictive powers of the model Q^2 are acceptable (see Table 7).

According to the empirical finding, the students' entrepreneurial intention mainly depends on their creativity. The creativity depends in turn on teaching methods, managing ambiguity and core self-evaluation. The core self-evaluation depends on entrepreneurial knowledge and entrepreneurial attitude. The latter depends on entrepreneurial mindset which depends on

entrepreneurial knowledge. Finally, financial literacy has an effect on managing ambiguity and entrepreneurial knowledge (see Table 8).

Table 8. Result of Hypothesis Testing

Hypothesis	β-value	t-value	p-value	Decision
H_1: TM ---->Cr	0.267	3.296	0.001***	Supported
H_2: FL ---->MA	0.472	4.770	0.000***	Supported
H_3: MA ---->Cr	0.437	4.062	0.000***	Supported
H_4: FL ---->EK	0.373	3.487	0.001***	Supported
H_5: EK ---->EM	0.527	5.540	0.000***	Supported
H_6: EK ---->CSE	0.394	3.488	0.001***	Supported
H_7: EM ---->EA	0.523	5.317	0.000***	Supported
H_8: EA ---->CSE	0.380	3.511	0.000***	Supported
H_9: CSE ---->Cr	0.280	2.385	0.017*	Supported
H_{10}: Cr ---->EI	0.657	9.009	0.000***	Supported

* 1.96 (sig. level= 5%); **2.58 (sig. level= 1%); ***3.29 (sig. level= 1‰)

The first hypothesis that states a direct positive and significant effect of teaching methods on students' creativity has been accepted according to the finding (H_1. β =. 267; t-value = 3.296; p = .001), with a risk threshold equal to 0.001 (p = .001). Thus, teaching methods contribute with 13.5% of students' creativity explanation. Even if the effect is low, but we consider that if we work more on teaching method to make them more convenient to the course content and the students' expectations, they can become a better predictor of students' creativity.

According to the second hypothesis, there is a direct positive and significant effect of financial literacy on managing ambiguity by students. The finding allowed this hypothesis to be accepted (H_2. β =. 472; t-value = 4.770; p = .000), with a risk threshold below 0.001 (p < .001). As is seen, financial literacy contributes with 28.7% of managing ambiguity, meaning that this variable can be considered as a predictor of managing ambiguity.

The third hypothesis states a direct positive and significant effect of managing ambiguity on students' creativity. The relationship between these two variables is positive and significant

(H_3. β =.437; t-value = 4.062; p = .000). Managing ambiguity contributes with 32.9% of students' creativity and can be considered as its predictor.

The fourth hypothesis that states a direct positive and significant effect of financial literacy on students' entrepreneurial knowledge has been accepted according to the finding (H_4. β =. 373; t-value = 3.487; p = .001), with a risk threshold equal to 0.001 (p = .001). Accordingly, financial literacy contributes with 32.9% of entrepreneurial knowledge and can be considered as a predictor of this variable.

According to the fifth hypothesis, there is a direct positive and significant effect of entrepreneurial knowledge on students' entrepreneurial mindset. The finding allowed this hypothesis to be accepted (H_5. β =. 527; t-value = 5.540; p = .000), with a risk threshold below 0.001 (p < .001). Consequently, entrepreneurial knowledge contributes with 38.4% of students' entrepreneurial mindset, meaning that this variable can be considered as a predictor of it.

The sixth hypothesis states a direct positive and significant effect of entrepreneurial knowledge on students' core self-evaluation. The relationship between these two variables is positive and significant (H_6. β =.394; t-value = 3.488; p = .001). As a result, entrepreneurial knowledge contributes with 20.9% of students' core self-evaluation and can be considered as one of its predictors.

The seventh hypothesis which predicts that entrepreneurial mindset has a direct positive and significant effect on students' entrepreneurial attitude has been accepted according to the finding (H_7. β =. 523; t-value = 5.317; p =.000). Hence, entrepreneurial mindset contributes with 37.7% of students' entrepreneurial attitude and can be considered as a predictor of this variable.

According to the eighth hypothesis, there is a direct positive and significant effect of entrepreneurial attitude on students' core self-evaluation. The finding allowed this hypothesis to be accepted (H_8. β =. 380; t-value = 3.511; p = .000). As is seen, entrepreneurial attitude contributes with 19.4% of students' core self-evaluation, meaning that this variable can be considered as the other predictor of students' core self-evaluation.

The ninth hypothesis that states a direct positive and significant effect of core self-evaluation on students' creativity has been accepted according to the finding (H_9. β =. 280; t-value = 3.511; p = .017). In consequence, core self-evaluation contributes with 10.9% of students' creativity explanation, even if the effect is low, but core self-evaluation can be considered as one predictor of students' creativity.

As for the tenth and last hypothesis which predicts that creativity has a direct positive and significant effect on students' entrepreneurial intention, it has been accepted according to the finding (H_{10}. β =. 657; t-value = 9.009; p =.000). Therefore, creativity contributes with 75.9% of students' entrepreneurial intention and can be considered as a good predictor of this variable.

Discussion and Conclusions

The objective of this research was to identify the developed entrepreneurial skills following the teaching of entrepreneurship and the interactions they have with each other. The finding enlightens us on the various skills developed due to the combination of a theoretical method and a practical one and on the variables that affect Tunisian students' entrepreneurial intentions.

Discussion

This study provides evidence that combining a practical and theoretical method in teaching entrepreneurship develop students' entrepreneurial skills and affect students in preparing for entrepreneurs in Tunisia. From the analysis, this study confirmed that the ten hypotheses proposed were accepted. Many scholars offered valuable insights into how entrepreneurship education can make a difference and considered that the teaching method adopted in entrepreneurship education is very important and that the one selected depends on the course objectives and the skills to develop (Gibb 2002; Gorman, Hanlon, and King 1997; Kuratko 2005; Mitra and Matlay, 2004; Neck and Greene, 2011). And even if entrepreneurial education is often categorized into three main approaches, authors such as Chaker and Jarraya (2021) suggest combining a theoretical method with a practical one to develop a bigger set of students' entrepreneurial skills. Our finding gave the proof that teaching method consisting in combining teaching about and teaching through entrepreneurship influenced students'

creativity. And even if the direct effect is low (f^2=13.5), the indirect effect is considerable as it was this combining method which enabled the development of this set of cognitive and non-cognitive skills.

This result is more important since creativity is considered by several authors as a factor influencing the students' entrepreneurial intention. In fact, Zhao et al. (2005) explained the impact of creativity on entrepreneurial intentions by the fact that people with high creativity could maintain a positive attitude and high self-confidence in entrepreneurial activities. Many other researchers found through empirical studies that creativity has a direct positive and significant effect on students' entrepreneurial intention. It is the case of Zampetakis et al. (2011) who, through a survey of 180 undergraduate business school students, found that the more creative young people thought they were, the higher their entrepreneurial intentions were. Chia and Liang (2016) also conducted a survey at a university in Taiwan and showed that students with higher creativity reflected greater entrepreneurial intention. Miranda et al. (2017) conducted a survey of 1,178 Spanish university scholars from different institutions, professions, and qualifications. They found that entrepreneurial intention was influenced, among other things, by creativity. Hu et al. (2018) demonstrated, through field surveys of 735 undergraduates at 26 Chinese universities, that entrepreneurial alertness had an absolute mediating effect between creativity, proactive personality, and entrepreneurial intention. Finally, Shi et al. (2020) found, through a survey of 523 students from different universities in China's Zhejiang province, that creativity has a significant moderating effect on the roles of perceived behavioral control and subjective norms on entrepreneurial intention. In sum, even in the Tunisian context, developing students' creativity is a crucial element on which authorities and universities can play to improve the level of intention among university students. And as we already explained, choosing the appropriate method to teach can be a way to develop creativity.

Enhancing students' core self-evaluation is another way to do it. In fact, core self-evaluation (CSE) is a good way enabling individuals to approach the positive aspect of what they do (Judge and Hurst 2007; Kammeyer-Mueller et al., 2009). This conducts them to seek positive outcomes (Judge et al., 2005) and to effectively carry out self-assessment and quickly focus on important issues as they can trigger self-regulatory processes and maintain their external focus on performance, by paying attention to people who evaluate them positively (Zhang et al. 2014; Wang et al., 2018; Noroozi et al., 2019; Verstege et al., 2019; Banihashem et al.,

2021). In their study, Chang et al. (2013) argued that CSE can stimulate creative ideas via enhanced intrinsic motivation and domain knowledge. Wang et al. (2018) found that high-CSE individuals are more likely to engage in creative activities. In our study, the CSE has a low effect on creativity. Judge et al. (1998) present CSE as a latent construct consisting of four manifest components: (a) self-esteem (worthy of respect and regard), (b) self-efficacy (belief in one's capability of solving problems), (c) locus of control (responsible for what happens to oneself), and (d) emotional stability or low neuroticism (optimistic and free from doubts and worries). One good way to enhance this skill is to make activities for students either in entrepreneurship course or in softskills developmment course to develop these four components.

Managing ambiguity is another determinant of students' creativity. Although its theoretical importance and practical usefulness, the relationship between managing ambiguity and creativity is not developed in the literature and few scholars studied it. Wang et al. (2011) made a laboratory experiment where two hundred and forty-two graduate students in a business-related field on a Midwestern university campus and a Southwestern university campus participated. They found an interactive effect of role ambiguity and tolerance of ambiguity on creativity. In fact, according to their study, they noticed that people who are tolerant of ambiguity exhibit higher creativity when faced with an intermediately ambiguous situation than those who are intolerant of ambiguity. Saeter and Brun (2012) advanced that sustaining ambiguity increases the innovativeness through creativity stimulation.

The results of this study have implications for teachers interested in creating the right environment to enhance students' creativity. This study found that managing ambiguity has a direct impact on how creative students can be under entrepreneurs' activity practice. A direct implication for practicing teachers could be that they should consider assigning students who are more tolerant of ambiguity to more ambiguous and open-ended tasks to facilitate better creative results. In the absence of a measure of tolerance of ambiguity, teachers can still be sensitive to the influence of tolerance of ambiguity and effectively use his or her knowledge of students' tolerance of ambiguity to the teaching methods' advantage.

Our study showed that having financial literacy enhances students' ambiguity management. In fact, as explained Saeter and Brun (2012), faced with ambiguity and desiring clarity, individuals in a situation will discuss and test out alternative interpretations to arrive at some

commonly accepted interpretation. These discussions need the possession of relevant information to hold assumptions that later may be tested and strengthened or rejected. Finance is one of the most important fields to master in entrepreneurship and Castrogiovanni (1996), Delmar and Shane (2003) and Stevenson et al. (1985) think that financial literacy is an important ability to successfully engage in entrepreneurial activities and that it is important that the entrepreneur has at least a basic understanding of the financial concept to be trustworthy to external and internal stakeholders. Our study gave evidence that the more students have financial literacy, the better they manage ambiguity. And here again teachers who want to enhance students' managing ambiguity abilities should give them relevant knowledge in finance. This way, they are also going to develop their entrepreneurial knowledge. In fact, financial literacy is the individual's ability to use knowledge and skills to manage financial resources effectively for a lifetime of financial well-being (PACFL, 2008). Financial literacy is believed to be a key ingredient to entrepreneurship success (Njoroge, 2013) and entrepreneurship education provides the basic numeric and financial literacy skills and enhances the overall quality of the entrepreneur which increases the chance of survival (Carter and Jones-Evans, 2000).

The importance of entrepreneurial knowledge is that, in one hand, it develops students' core self-evaluation, and, in the other hand, it enhances their entrepreneurial mindset. Teachers who look for developing students' core self-evaluation must provide them with relevant entrepreneurial knowledge to develop their knowledge of the fit they have with being an entrepreneur and/or being entrepreneurial (Kraiger et al., 1993) and to ensure that they can take the best decision (Wang and Noe, 2010). Theoretical method plays a key role for this purpose and teachers must develop students' ability to understand the role of entrepreneurs by focusing on assessing their perceived knowledge on how to gauge business opportunities, the role and function of entrepreneurs in society, and the various prospective of entrepreneurial career options that exist (Arivayagan, 2016). The developed knowledge will help students in seeking out existing opportunities, challenges, and maximizing resources effectively (Saptono et al., 2020). It will influence their entrepreneurial readiness, startups, and new business development (Coduras et al., 2016; Ruiz et al., 2016; Tung et al., 2020) and develop their entrepreneurial mindset (Saptono et al., 2020) that conducts them later to become successful entrepreneurs and build new businesses as well as promote new job opportunities. Hence, entrepreneurship education significantly affects a person's attitude to entrepreneurship by developing his entrepreneurial mindset (Wu and Wu, 2008). Developing

entrepreneurial attitude matters because it influences a person to behave in a certain way and it reflects the attitude of the person and who the person is (Abun et al., 2018) as it influences confidence, enthusiasm, inclination, and aspiration (Robinson et al., 1991).

Conclusion

This study examines the constellation between variables with ten hypotheses, where all are accepted. Based on the results of hypothesis testing, we found that creativity is a good predictor of students' entrepreneurial intention (Shi et al., 2020). We also found that students' creativity can be developed by combining teaching about and through entrepreneurship (Chaker and Jarraya, 2021), by enhancing students' ambiguity management (Sætre and Brun, 2012), and by improving their core self-evaluation (Wang et al., 2018). We also found that financial literacy positively influences entrepreneurial knowledge (Njoroge, 2013) and managing ambiguity (Delmar and Shane, 2003). This finding also showed that entrepreneurial knowledge positively influences the entrepreneurial mindset (Saptono et al., 2020), and prepares for a high core self-evaluation (Wang and Noe, 2010). The latest finding is that students' entrepreneurial mindset positively influences their entrepreneurial attitude (Wu and Wu, 2008) which develops their core self-evaluation (Abun et al., 2018).

Based on these results, entrepreneurship education should be further improved due to the significant role in the readiness of young entrepreneurs while they are still studying at university. The primary goal for combining a theoretical method that develops financial literacy and entrepreneurial knowledge and a practical one by making students living the real life of entrepreneurs and implying businesses, industries, and startups around the faculty that develops students' attitude and mindset, their core self-evaluation, their ambiguity management, and their creativity is a to better develop students' entrepreneurial skills because skills interact with each-other. Hence, teachers are solicited to provide a learning-by-doing approach based on action learning in academic entrepreneurship education, with integrating theory to better master entrepreneurship (Brook and Pedler, 2020, Chaker and Jarraya, 2021; Boubker et al., 2021; Banihashem et al., 2014). Entrepreneurship education must be evaluated by referring to the skills to develop and the chosen method must enable the development of these skills.

Our study also offers practical suggestions for public policy in developing countries like Tunisia. In fact, they must consider entrepreneurship education and training programs as a veritable strategic tool for regional development to enhance entrepreneurial activity, to create new businesses opportunities and consequently new jobs (Bischoff et al., 2018; Galvão et al., 2018). Although data were collected from 92 students in FEM of Tunis, the finding cannot be generalized to represent real conditions in all Faculties in Tunisia because the way to teach entrepreneurship changes from one university to the other. So future research needs to involve other institutions so that research results are more diverse and generalizable. Additionally, in this study, we solely used quantitative method, which can be elaborated using a mixed-method and longitudinal model to provide a better understanding of entrepreneurial skills development to enhance students' readiness to entrepreneurship.

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SECTION II - STUDIES ON SCIENCE

Chapter 6 - Trends in Calculus-Based Mathematics in the New Senior Secondary Queensland Certificate of Education

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Chapter Highlights

- The new Queensland Certificate of Education (QCE) curricula was introduced in 2019, offering senior secondary students four mathematics options to study: Essential Mathematics, General Mathematics, Mathematical Methods and Specialist Mathematics. Methods and Specialist are calculus-based options, and provide broader and diverse career opportunities post-secondary.
- This chapter investigated senior secondary students' enrolment in calculus-based mathematics options between 2019 and 2020 in Queensland state schools from different districts.
- Results show a high dropout rate in calculus-based options as students progressed into their initial course/s of study.
- The study argues for resources to be made available to promote continued students' participation and achievement.

Introduction

Mathematics plays a central role in innovation, scientific, technological, economic and social knowledge development (Watt et al., 2017). The sciences, digital technologies and innovation, in particular, are regarded as the economic drivers and main jobs of the future (Black et al., 2021; PwC, 2013), and mathematics is regarded as a significant enabler of these fields (Australian Academy of Science, 2016). In Australia, "innovation and digital technologies have the potential to increase Australia's productivity and raise GDP by $136 billion in 2034, and create close to 540,000 jobs" (PwC, 2013, p13), hence mathematics is pivotal in reshaping the future (Chubb, 2012). Australia, and especially Queensland needs graduates with advanced mathematics skills to promote innovation, data synthesis and technology if it is to remain competitive in the global scenario.

Indeed, enhancing participation and achievement in advanced mathematics in schools is a focus of most governments all over the world (Noyes & Adkins, 2016; Treacy et al., 2020; Zwart et al., 2020), because mathematics drives STEM (Shaughnessy, 2013). Similar to other countries such as the United Kingdom, Australia also offers bonus points at university entry for students who pass advanced mathematics as an incentive to motivate uptake (Prendergast et al., 2020; Treacy et al., 2020). The distinct advantage of studying advanced mathematics in high school is not only important to achieve individual goals but is recognised as being of value to society.

Developing advanced mathematics skills results in high economic value, since "strong mathematical skills are critically important for a thriving and competitive knowledge-based economy" (Adkins & Noyes, 2016, p. 94). Studies have shown that students who pursue advanced mathematics are interested in pursuing high impact jobs (Gijsbers et al., 2020). Indeed, people with advanced mathematics skills progress to earn about 11% more than those without by the time they reach 34 years of age (Adkins & Noyes, 2016). Similarly, choosing advanced mathematics is generally regarded as a pathway to high paying jobs (Light & Rama, 2019). The link between economic development, prosperity and advanced mathematics makes it a key transformational focus for governments, hence understanding trends in students' participation in advanced mathematics can inform policy makers.

The purpose of this research is to determine trends in enrolment and participation in calculus-based mathematics under the new curriculum introduced in Queensland in 2019. In addition, the relationship between the participation trends, school location, area's socio-economic status and schools' transfer ratings are explored. The study builds on prior research on students' participation in calculus-based mathematics in Queensland (Chinofunga et al., 2022). This study further expands the focus to the relationship between participation, dropout rates, SES, school location and teacher mobility and transfer ratings. The study will contribute to limited literature available on the impact of social and economic factors and school location on participation in calculus-based mathematics.

Importance of Calculus-based Mathematics

Calculus is built on the foundations of the analysis of changing phenomenon. Therefore, "calculus is essential for developing an understanding of the physical world" (Queensland Curriculum and Assessment Authority (QCAA), 2018 p.1). Calculus-based mathematics introduces differentiation and integration at high school which provides students with the opportunity to model quantities that undergo change and a portal for deeper theoretical growth (Maltas & Prescott, 2014). In Queensland, graduates with either Specialist Mathematics and or Mathematical Methods have a pathway to pursue tertiary courses that are mathematics intensive such as natural sciences, health sciences and engineering (QCAA, 2018). However, students who opt for Specialist Mathematics also have to study Mathematical Methods but have a distinct advantage at tertiary levels as it is regarded as more advanced. Thus, studying these subjects is critical as students prepare for careers in a competitive world.

Several scholars have highlighted the importance of advanced mathematics that include providing better and diverse career opportunities, (Chinnappan et al., 2008; Chinofunga et al., 2022; Maltas & Prescott, 2014; Noyes & Adkins, 2017) and facilitate skills for STEM workforce (Kennedy et al., 2014). Moreover, calculus-based mathematics is critical in "developing students' logical thinking and reasoning abilities" (Prendergast et al., 2020, p. 753). A country's economic status and social wellbeing is enhanced by having a workforce that possess advanced mathematics skills as they are critical for research, industry and business to thrive (Black et al., 2021). A projected increase of school enrolments of 20.4% by 2026 in Queensland must prompt policy makers to also find ways of boosting calculus-based

graduates by the same margin (O'Connor & Oam, 2019). Calculus based mathematics offers distinct advantages for graduates as it enhances critical thinking and decision making, thus prepares them for individual growth and flexible but critical career options.

High school calculus-based mathematics increases the chances of entry into highly sought-after courses in higher education (Cogan et al., 2019). Hence,

> "students need a good measure of rigorous, formal mathematics in order to be literate, prepared for whatever career path students choose upon completion of their secondary education whether they choose to enter immediately the work force; to enter a technical, trade or vocational career path, or to continue their formal education at a college or university" (Cogan et al., 2019, p. 531).

Furthermore, calculus-based mathematics enhances the chances of success in STEM courses at tertiary level (Cohen & Kelly, 2020; Gottfried, 2015; Nicholas et al., 2015; Redmond-Sanogo et al., 2016). Research also indicates that students who graduate from high school with advanced mathematics subjects do well in health sciences at university with a high-grade point average (Ryan et al., 2017). High school graduates with non-calculus options who want to pursue tertiary courses where calculus-based mathematics is a pre-requisite are required to take up bridging or remediation courses (Nicholas et al., 2015; Redmond-Sanogo et al., 2016; Varsavsky, 2010). Undoubtably, the role that calculus-based mathematics plays in STEM tertiary courses cannot be underestimated.

Socio-economic Background and Participation in Calculus-based Mathematics

Social and economic background largely determines access to resources. Students from high SES families or schools have access to better resources that can provide opportunities for success compared to those from lower socio-economic backgrounds (Bornstein & Bradley, 2014). Consequently, students' participation and achievement are significantly influenced by "school characteristics such as location and socio-economic background of the students it serves." (ACARA, 2013 p.1). Additionally, differences in students' achievement are often influenced by students' SES (Broer et al., 2019). "In Australia, the magnitude of the socio-economic gap in mathematics achievement at age 10 is about 65% as large as the gap observed among 15-year-olds, and about 58% as large as the gap in numeracy proficiency among 25-29-year-olds" (OECD, 2018, p. 2). Consequently, the limited educational opportunities and experiences students from low SES are more likely to encounter do not

promote social equality and better educational outcomes (Peggy, 2018). Moreover, financial and human capital complemented by resources accessed through networking play an important role in shaping students' choices and beliefs (Bradley & Corwyn, 2002). Better and diverse opportunities calculus-based mathematics offer are skewed towards students from high SES families or who go to high SES schools.

Socio-economic factors also influence students' mathematics subject choices and achievement (Valero et al., 2015). Consequently, students from high SES background have better chances of participating in and achieving well in mathematics, especially in advanced options compared to those from low SES background (Valero et al., 2015). Moreover, parents of students from high SES background have high expectations and encourage their children to take advanced mathematics (Hascoët et al., 2021). In contrast, students from lower SES communities may not interact much with knowledgeable and experienced adults who can act as role models and provide stimulating and motivating experiences, thus limiting opportunities and options for such students (Bradley & Corwyn, 2002). This is because, the immediate social network around students that include parents, teachers, siblings and friends plays a key role in influencing students' mathematics choices (Kirkham et al., 2019). The critical role parents, and the social background plays in influencing students' mathematics choices emphasise the importance of school location, school choice and the social network a student is exposed to. On average, a student who attends a higher SES school enjoys higher educational outcomes compared to a student from a similar social background who attends a lower SES school (Perry & McConney, 2013, p. 125). This is because, high status peers are significantly influential to other peers within a social group (Choukas-Bradley et al., 2015; Noroozi et al., 2012; 2013; 2016). Schools with high SES are strongly associated with high academic expectations, competition and achievements (Perry & McConney, 2013), hence students' mathematics choices are influenced by the school environment, which is expected to be highly stimulative, productive and positive (Willms, 2010). Clearly, the interaction between students from different levels of SES in high SES schools provides an opportunity for networking among peers that will boost mathematics achievement, especially to those from low SES (Perry & McConney, 2013). Hence, school SES plays a critical role in students' mathematics choices regardless of the students' family SES.

A school reflects the demography of the community within its catchment area and those located in communities with low SES have students who are in some way disadvantaged

(Hernández, 2014). In fact, "schools that are in the same district, but located in neighbourhoods of differing SES display a large disparity in opportunities and quality of education offered to students" (Hernández, 2014, p1). Students who attend schools in high SES neighbourhoods have access to relevant information and experiences that help them set high expectations and above all better educational resources (Ireneusz, 2020; Pritchett, 2001). Schools in affluent areas have better physical and material resources that differentiate them from other schools. In fact, differences in educational opportunities are influenced by accessibility to well-resourced schools (Broer et al., 2019). "It is not just the relative wealth of parents that holds large numbers of bright kids back: it is postcode inequality too. What part of the country a child grows up in has a real impact on their life chances" (Nick Clegg (UK former leader of the Liberal Democrats), 2016). In contrast, students from low SES who attend high SES schools score 86 points higher than their counterparts in low SES schools (OECD, 2018). Students from low SES families and communities have limited options to pursue because of the social and financial capital which is needed to enter reputable and well-resourced schools.

Student participation and achievement in advanced mathematics is linked to school resources that include discipline trained teachers and family social economic status (Chiu, 2010). Importantly, mathematics teachers' expertise in teaching the subject and making it more engaging and understandable to students plays a critical role in student participation in calculus-based mathematics (Kirkham et al., 2019). In fact, "the likelihood of a student pursuing further studies in mathematics would be influenced by their experiences in mathematics classes at secondary school" (Chinnappan, 2008). For example, past mathematics achievement directly influences students' attitude towards mathematics (Birgin et al., 2010; Hascoët et al., 2021; Sikora et al., 2019). Clearly, "attitudes concerning mathematics show significant impact on one's decisions about the amount and nature of mathematics one will study in the future" (Recber et al., 2017). As a result, students' choices of schools influence the mathematics options they select (Sikora et al., 2019). Students from low SES families have limited options in terms of school choices as they are more likely to enrol in schools within their communities.

Location of a school is a major contributor of resources and opportunities a school offer as it contributes to teacher mobility and transfer rate. Queensland state schools are allocated transfer ratings from 1 to 7 depending on remoteness, access and level of amenities in the

area, complexity of school environment and staffing requirements (Department of Education [DoE], 2019). Remoteness is determined by distance from Brisbane or Toowoomba or any coastal city of more than 8000 people (DoE, 2019). In fact, school transfer ratings are the bases of the transfer points teachers accrue (Department of Education, 2020). Therefore, "teachers who elect to work for longer periods in schools of rating 3 to 7 increase their prospects of securing a transfer to a preferred location where they choose to return, while schools benefit from the greater stability and stronger community integration." (DoE, 2020, p. 5). Teachers who are attached to a school for a longer period perform better than those who have a short stint at the school and this pattern is more apparent in disadvantaged schools (Hanushek & Rivkin, 2010). Teachers at a school with rating 7 are due for transfer after 2 years while others are expected to serve 3 years at a school to qualify (DoE, 2020). However, any other personal, social, professional circumstances and transfers from a school with a lower rating to one with a higher rating may also lead to approved transfers (DoE, 2020). The higher the school transfer rating, the more transfer points teachers accrue which may result in unintended consequences of high teacher turnovers in such schools.

High teacher turnover in schools is also a key factor in hindering quality education and better options for students in disadvantaged communities (Barbieri et al., 2011). Teachers may target schools with high transfer ratings because they "are simply waiting to move on to a desired location, putting low effort into their current work duties and disregarding any longer-term plans for their students" (Barbieri et al., 2011, p. 1430). Therefore, a substantial number of teachers tend to be more effective and more focused on delivery after a voluntary transfer (Jackson, 2013). Contrastingly, teachers who teach students who are keen to engage or are high achievers are less likely to transfer (Boyd et al., 2011). This means that teachers in low transfer rated schools may serve longer in a school which will provide stability, consistency, and confidence for students to participate in calculus-based mathematics if other factors like socio-economic disadvantages are minimised.

Socio-economic Measures in the Study

A significant number of researchers (Anastasiou et al., 2020; Avan & Kirkwood, 2010; Broer et al., 2019) have linked family and neighbourhood socio-economic status (SES) with educational outcomes. SES differences mainly involve accessing material (financial, assets) and social (community networking, neighbourhood) resources that impact wellbeing and

development of individuals, families and neighbourhoods (Bornstein & Bradley, 2014; Bradley & Corwyn, 2002). However, obtaining family SES is very difficult considering the sensitivity of the subject to society (Broer et al., 2019). Nevertheless, SES of an area can be determined using the socio-economic Index for areas (SEIFA) which indicates the relative advantage and disadvantage of a neighbourhood (Australian Bureau of Statistics [ABS], 2018b). This study seeks to determine the correlation between the school districts' SEIFA Indexes, schools' ICSEA Indexes, teacher mobility and transfer ratings with students' dropout in the calculus-based mathematics subjects in Queensland state schools.

The Australian Bureau of Statistics census data can be used to infer important school information such as relative advantage and disadvantage of a neighbourhood (Gibson & Asthana, 2000). The SEIFA index is developed after a census and the current index is from 2016. The data includes SES index in percentiles and name of area. This data was corelated with school data, obtained from QCAA, which included name of district, postcode, and enrolment per unit. The period under study is of particular interest because Queensland changed to a new senior curriculum in 2019 and the first external examination was in 2020. Importantly, the analysis will help to determine the impact of school postcodes and SES on participation in calculus-based mathematics.

The SEIFA value is used to better understand the relationship between socio-economic advantage and disadvantage to social and educational outcomes (ABS, 2018a). ABS broadly define "relative socio-economic advantage and disadvantage in terms of people's access to material and social resources, and their ability to participate in society" (2018a, p6). The percentile value on the SEIFA index is meant to indicate where the area sits in terms of SES within the whole nation (ABS, 2018a), but this study is only focused on Queensland. Importantly, socio-economic status of an area is mainly attributed to collective income, education, employment, and occupation of people in a neighbourhood (ABS, 2018a). Thus, a low score on the index indicates a high proportion of relatively disadvantaged people in an area (ABS, 2018a, p. 6). This index is used comparatively in the trend analyses.

To better understand the impact of socio-economic factors in relation to different schools and their location, the Australian Curriculum, Assessment and Reporting Authority (ACARA) developed an Index of Community Socio-educational Advantage (ICSEA). ICSEA values are developed using students' family background data, location of school and demography of

indigenous and non-indigenous students (ACARA, 2013). It enables "comparisons between schools based on the level of educational advantage or disadvantage that students bring to their academic studies." (ACARA, 2013, p.1). Similarly, it can be used as a measure of social economic advantage in education (Callingham, 2017). The ICSEA values range from 500 representing schools with students from hugely underprivileged educational backgrounds to 1300 for schools with students from very highly privileged educational backgrounds and a benchmark average of 1000 (ACARA, 2013). This study analyses trends in participation in calculus-based mathematics using ICSEA values of all Queensland government secondary schools to investigate if school location and socio-economic background plays a role in students' participation in the subjects.

Study Methods and Results

The study used data from a range of institutions (ABS, ACARA, DoE, QCAA) to investigate the impact of social and economic factors on participation in calculus-based mathematics. Quantitative methods were used to analyse trends from within and across data sets to establish a comprehensive picture of how socioeconomic status and school location affect participation. QCAA provided consent for the use of its data which included school name, subject name, postal code and enrolment per unit. Each school and district were matched to SEIFA index (ABS), ICSEA value (ACARA) and transfer points (DoE).

Descriptive quantitative methods were applied to analyse trends using Microsoft Excel suite of functions because it "provides a comprehensive approach to quantitative data analysis" (Johri, 2020, p. 4). It is especially ideal for descriptive quantitative statistical analysis and data management through its use of functions and data organisation tools (Rubin & Abrams, 2015). Measures of central tendency such as mean (average) and mode together with Excel in-built functions were used to determine trends in students' participation. Specifically, data analysis explored (i) students' participation and dropout rates per district (ii) school location SEIFA index and students' participation (iii) school ICSEA value and students' participation (iv) transfer ratings and students' participation. The next section reports the data analysis using the SEIFA index, ICSEA value, school transfer rating and student enrolment to determine trends in students' participation in calculus-based mathematics.

Students' Participation and Dropout Rates per QCAA District

Firstly, an analysis of the average percentage of student enrolment in Mathematical Methods and Specialist Mathematics in state schools per QCAA district between 2019 and 2020 was carried out. Distance education schools were considered separately because their catchment area can span more than one district. In both Tables 1 and 2, enrolment in Unit 1, was considered for 2019 because it is the first unit students engage with in Year 11. Similarly, Unit 4 enrolment was considered in 2020 because it is the last unit before students sit for the external examination. Hence students' enrolments in Unit 4 indicates the number of students who completed Year 12 calculus-based mathematics.

Mathematical Methods Enrolment per QCAA district

Table 1 shows raw data on enrolment and dropout rates in Mathematical Methods in state schools per district at the beginning of Year 11.

Table 1. Enrolment in Mathematical Methods in State Schools per District

QCAA District	Unit 1 Enrolment	Unit 4 Enrolment	Dropout	% dropout
Brisbane-Ipswich	563	405	158	28.1
Brisbane Central	950	718	232	24.4
Brisbane East	619	405	214	34.6
Brisbane North	829	513	316	38.1
Brisbane South	625	334	291	46.6
Cairns	451	267	184	40.8
Gold Coast	731	457	274	37.5
Mackay	247	134	113	45.7
Rockhampton	337	179	158	46.9
Sunshine Coast	661	390	271	41.0
Toowoomba	388	223	165	42.5
Townsville	364	209	155	42.6
Wide Bay	354	208	146	41.2
Distance education	88	53	35	39.8
Totals	7207	4495	2712	

The data shows that 7207 state schools students opted for Mathematical Methods. However, state school students who were still enrolled for Unit 4 in Year 12 were 4495 representing a percentage drop out of 37.6%. This means that the total number of students in state secondary schools who opted out of Mathematical Methods from the start of Year 11 to the end of Year 12 was 2712. That is, for every 14 students who chose this subject 5 did not complete it. Brisbane Central and Ipswich are the only districts with less than 30% dropout rate while Brisbane South, Mackay and Rockhampton are over 45%. Due to the high dropout in Brisbane South, Mackay and Rockhampton districts, for every 20 students who choose Mathematical Methods in Year 11, about 9 of the students dropped out by the end of Year 12.

Specialist Mathematics Enrolment per QCAA District

Table 2 shows raw data on enrolment and dropout rate in Specialist Mathematics in state schools per district.

Table 2. Enrolment in Specialist Mathematics in State Schools per District

QCAA District	Unit 1 Enrolment	Unit 4 Enrolment	Dropout	% Dropout
Brisbane-Ipswich	113	88	25	22.1
Brisbane Central	330	280	50	15.2
Brisbane East	168	131	37	22.0
Brisbane North	225	170	55	24.4
Brisbane South	196	139	57	29.1
Cairns	101	67	34	33.7
Gold Coast	191	147	44	23.0
Mackay	33	23	10	30.3
Rockhampton	91	59	32	35.2
Sunshine Coast	191	141	50	26.2
Toowoomba	99	60	39	39.4
Townsville	68	49	19	27.9
Wide Bay	100	77	23	23.0
Distance education	55	34	21	38.2
Totals	1961	1465	496	

The total number of students who opted to study Specialist Mathematics in Year 11 at the beginning of 2019 was 1961 (see Table 2). Nonetheless, only 1465 enrolled for Unit 4; hence, 496 students opted out. The dropout rate of participation or enrolment was 25.3% from Unit 1 (beginning of Year 11 in 2019) to Unit 4 (end of Year 12 in 2020). That is, for every 20 students who opted for Specialist Mathematics 15 continued until end of year 12. Cairns, Mackay, Rockhampton and Toowoomba districts have greater than 30% dropout rates. Similarly, distance education schools have a 38% dropout rate which is the highest of all the jurisdictions under consideration. Brisbane Central remains the district with the lowest percentage dropout rate of 15.2% followed by Brisbane East and Brisbane- Ipswich at 22%. Similarly, Mackay contributes the smallest number of students studying calculus-based mathematics among all districts.

An analysis of the number of schools offering calculus-based mathematics in each district was also done. Figure 1 shows the distribution and number of schools offering Mathematical Methods and Specialist Mathematics in the thirteen districts.

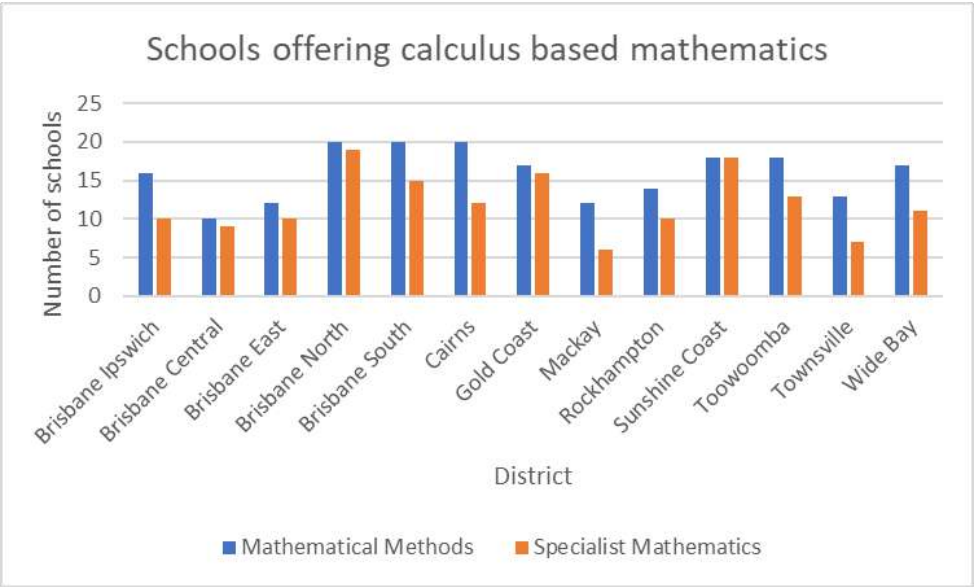

Figure 1. Schools offering Calculus-based Mathematics per District

An analysis of Figure 1 and Tables 1 and 2 gives a deeper understanding of enrolment and the number of schools offering the options per district. Figure 1 show Brisbane Central having only 10 and 9 schools offering Mathematical Methods and Specialist Mathematics respectively, but the enrolment in this district is the highest in Queensland. Furthermore, it has the lowest percentage dropout rate compared to any other district at 24.4%. Contrastingly,

Brisbane East and Mackay districts have 12 schools each offering Mathematical Methods, but Brisbane East has almost three times the enrolment of Mackay and the dropout rate is significantly different. This is also true if a comparison is made between Sunshine Coast and Toowoomba, Brisbane North and Cairns districts in Mathematical Methods. There is also a bigger difference in number of schools offering Mathematical Methods and Specialist Mathematics in Mackay, Brisbane Ipswich, Brisbane South, Cairns, Mackay, Rockhampton, Toowoomba, Townsville and Wide Bay.

School Location SEIFA Index and Students' Participation

An analysis of student enrolment in Mathematical Methods and Specialist Mathematics and school location based on their SEIFA index was done. In total, the SEIFA indexes of 203 schools was considered. This excluded 4 distance education schools because their location has no influence on students' enrolment. Since the SEIFA data was in presented as percentiles, 50% and upwards was considered as upper half and thus designated as areas with economic advantage while below 50% was considered as areas that were economically disadvantaged. Although there were 115 schools, with students enrolled in Mathematical Methods in the lower half they only contributed 39.8% of the Unit 1 Mathematical Methods cohort. Schools below the 50% have an average percentage dropout rate of 42%, while those above the 50% economic advantage have a dropout rate of 34.7%. Similarly, in Specialist Mathematics, the group with the 50% economic advantage has a dropout rate of 24% compared to 26.6% with the economic disadvantage. Although, there are 76 schools out of 153 considered to have economic advantage, they contribute 63.1% of all students who studied Specialist Mathematics in Unit 1.

School ICSEA Value and Students' Participation

An analysis of student enrolment in Mathematical Methods and Specialist Mathematics and school ICSEA index was completed. The results indicate that dropout rates are influenced by the school ICSEA index. Schools with an ICSEA value of more than 1100 have a dropout rate of 27%, while those between 1000 and 1100 have a dropout rate of 29.2% and lastly those less with than 1000 have a dropout rate of 43.4% in Mathematical Methods. The trend was the same in Mathematical Methods with schools with ICSEA value of 1000 and above having a dropout rate of 20.3% compared to 29.2% of those with a value less than 1000.

School Transfer Ratings and Students' Participation

Lastly, an analysis of the school transfer ratings and student enrolment in Mathematical Methods and Specialist Mathematics was also completed. In 2019 at the end of Unit 1, there were 106 state secondary schools with transfer ratings of 1 and these schools had an enrolment of 4919 students in Mathematical Methods. There were 101 schools with transfer ratings of 2 and above, but they only enrolled 2288 students in the same option. To be precise, only 31.7% of all students who studied Unit 1 of Mathematical Methods were enrolled in schools with transfer ratings of 2 and above. Hence, the total enrolment of all the other schools with a different transfer rating from 1 was less than half of those with rating 1. Despite enrolling 68.3% of all students studying Mathematical Methods, 1691 (34.4%) students dropped out of the subject from schools with ratings 1 compared to 1021 from schools with transfer rating of 2 and above. In fact, 54.5% of the enrolled students in schools with transfer ratings of 7 dropped out. Figure 2 shows the dropout rates in relation to the school transfer ratings.

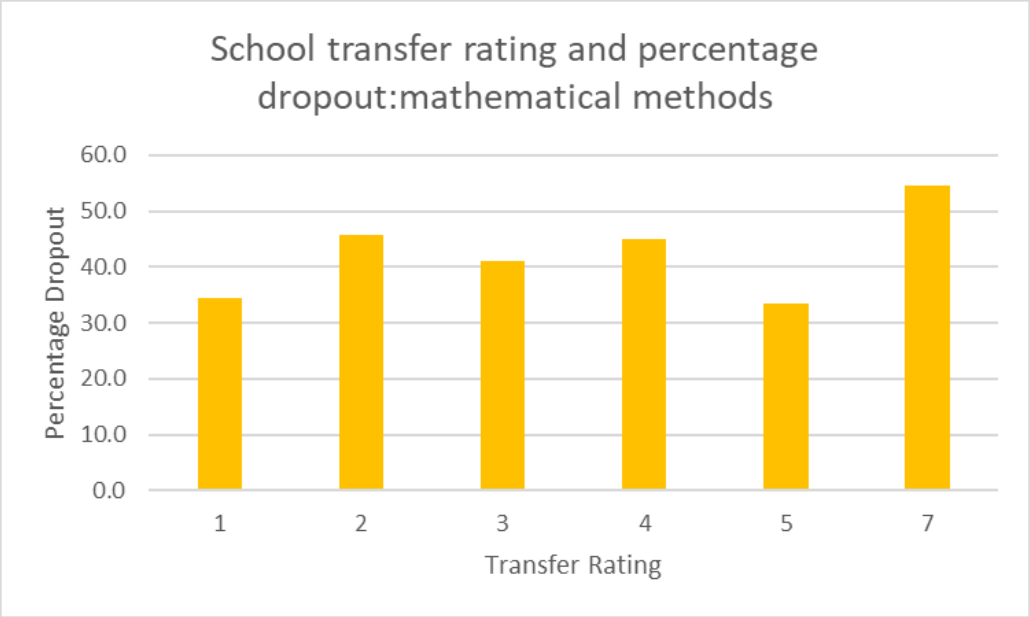

Figure 2. Dropout Rates and School Transfer Ratings

Fewer students in schools with transfer rating above 1 choose to do Specialist Mathematics. Out of 156 schools with students studying the subject, only 61 have a transfer rating of 2 and above. In addition, only some schools with transfer ratings from 1 to 5 have students who enrolled in Specialist Mathematics as shown in Figure 3.

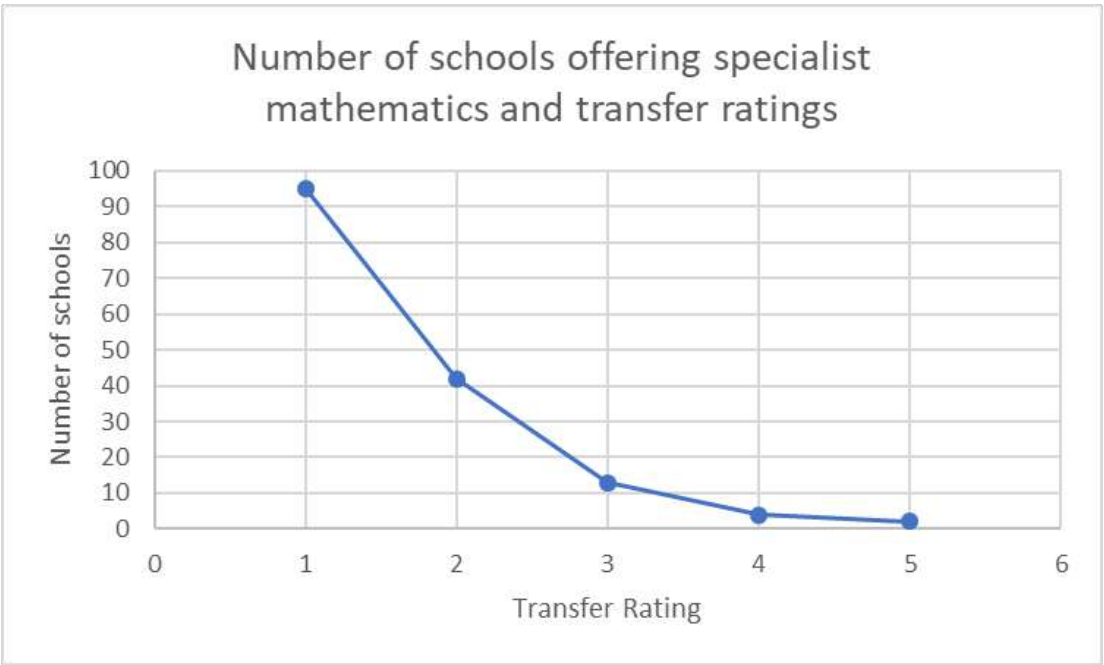

Figure 3. Schools offering Specialist Mathematics and School Transfer Ratings

Discussion

Education systems all over the world aim to support and nurture students to reach their goals when they have chosen a career path, hence minimising dropout rates in calculus-based mathematics is fundamental. Undoubtedly, dropping out has "considerable social and economic implications," (Goss & Andren, 2014), especially considering the importance of calculus-based mathematics as a key enabler of STEM courses at tertiary institutions (Maltas & Prescott, 2014). Participation in calculus-based mathematics in all districts showed a high dropout rate. In fact, for Mathematical Methods (about equivalent to Mathematics B previously offered), the dropout rate in state schools of 37.6% from 2019 to 2020 is 10 times the average dropout rate of 3.77% of all Queensland secondary schools from 2010 to 2019 (Chinofunga et al., 2022).

Similarly, in Specialist Mathematics (about equivalent to Mathematics C previously offered), the dropout rate of 25.3% from 2019 to 2020 is more than ten times the average dropout rate of 2.35% of all secondary schools in the state (Chinofunga et al., 2022). The substantial increase in student dropout rates from calculus-based mathematics from 2019 to 2020 is alarming for these students who initially showed interest and opted studying these subjects and found it hard to continue pursuing them.

Importantly, students who dropout from calculus-based mathematics options are not the same as students who choose to avoid the options at senior secondary school (Hine & Mathematics Education Research Group of Australasia, 2017). These are students with an initial genuine interest in calculus-based mathematics options as they think about and prepare for these options in Year 10 and then enrol in Year 11. If we are to increase the number of students participating in calculus-based mathematics, then the focus should be on retaining the students who dropout. Disrupting this trend would reverse the enrolment and participation numbers in these subjects which have been highlighted as tumbling across Australia (Kennedy et al., 2014; Maltas & Prescott, 2014). Teachers as facilitators of learning can help to retain these students through effective planning and teaching. Calculus-based mathematics teachers' planning must focus on enhancing students' confidence and relationship with their chosen subject options (Grundén, 2020), through providing a coherent and spiral sequencing of mathematical concepts that are anchored on student's prior knowledge and interest to enhance student participation and achievement (ACARA, 2015). Moreover, effective mathematics teaching must enhance the connection of prior knowledge to new knowledge, build, interconnect and expand knowledge and skills from familiar to unfamiliar contexts (Novak, 2010; Stoll et al., 2012). Such an approach is likely to arrest the dropping participation in calculus-based mathematics subjects. This approach might call for new and innovative research focused on enhancing mathematics content sequencing and ways of promoting mathematics knowledge development at all levels in the school curriculum to stop the decline in participation in calculus-based mathematics.

The economic advantage or disadvantage of a school location and students who attend a school can be determined by the SEIFA index and ICSEA value. Considering the initial uptake of Mathematical Methods, Brisbane Central district has the highest enrolment. Importantly, all 10 schools in this district have a SEIFA value of more than 92 and an ICSEA value of more than 1000, demonstrating a high economic advantage enjoyed by the student population. Although it is a district with the least number of schools, it has the highest number of students who participate in calculus-based mathematics in Queensland. Similarly, the Brisbane North district has 10 school locations out of 20 with a SEIFA value of more than 80 and 5 schools with ICSEA value of more than 1000 and it has the second highest enrolment. Contrastingly, from the Mackay district the highest SEIFA value of a school location is 74 and there are only 4 out of 12 schools in areas with values above 50. There are no schools with ICSEA value of more than 1000. Likewise, 6 school locations out of 13 in

the Rockhampton district have a SEIFA value of more than 50 but less than 72 and there are no schools with an ICSEA value of 1000 and above. The Wide Bay district has 17 schools offering Mathematical Methods and there is no school location with a SEIFA value above 50 and ICSEA of 1000 and above. In addition, Townsville and Toowoomba districts have only up to two schools in the top SEIFA index or ICSEA value band with the rest below average. It can be observed that all these districts have low enrolments and a substantial difference between the number of schools offering Mathematical Methods and Specialist Mathematics. This means that potential students who have the interest and capability to participate and achieve well in the calculus-based mathematics subject do not have the option of enrolling in these subjects.

A proactive research agenda that supports teachers who teach in low SES areas and less desired schools in relation to the teacher mobility and school transfer ratings must not be limited to financial rewards. The focus should be on planning and pedagogical resources that build a foundation that promotes knowledge and skills development and facilitates independent learning. As argued by some researchers, it is "more meaningful to study what educators can work with to improve students' participation and achievement" (Valero et al., 2015, p. 288). Thus, proactive research that focuses on planning and developing such pedagogical resources should be a priority. These pedagogical resources would need to include multiple representations including visuals as they are easy for students to follow and understand (Raiyn, 2016). This proactive approach may also assist in promoting self-directed learning in students. Importantly, a common framework that can be used by teachers in such schools will help to bring stability in students' learning because it would provide uniformity in concept development and critical delivery resources.

The economic advantage or disadvantage of a school location can be determined by the SEIFA value. Data analysis shows that schools in the top half of SEIFA indexes of 50 and above contribute more than 60% of all students who enrol in calculus-based mathematics despite being less than half of all state schools in Queensland. This is because, school location and the economic advantage significantly influences the knowledge, skills, experiences and other forms of capital students gain (Ireneusz, 2020). The experience may build high expectations from such schools and also parents and students the schools serve (Pritchett, 2001). Resources offered by schools differ mainly because of SES location (Broer et al., 2019). Considering schools in the top half of SEIFA indexes of 50 and above, data

analysis shows that the dropout rate is less than the lower half which reinforces the high expectations schools in such locations foster. It is particularly important to pay special attention to schools with lower ICSEA values. The ICSEA value of a school provides a clearer indication of the economic advantage and disadvantage of students enrolled in that school. The relationship between the average dropout rate and a school's ICSEA value supports Perry and McConney's (2013) findings that schools with highly economically advantaged students are strongly associated with high academic expectations and are competitive, compared to schools with economic disadvantage. Thus, the high expectations and competition in schools with high ICSEA values have a substantial influence on students to continue with the subjects.

One of the most critical resource in any school is teachers. Teachers are attracted to different schools based on a range of considerations. School location and resources are key in attracting and retaining teachers which is why schools' transfer ratings are mainly based on these factors. The majority of students, almost 70% of Mathematical Methods cohort, are in the schools that have a transfer rating of 1 and have minimal teacher turnover. This creates stable and predictable school environments. These schools with transfer ratings of 1 have a significantly less dropout rate than schools with transfer ratings above 1. Similarly, the trend is also witnessed in Specialist Mathematics where enrolment is also biased towards schools with ratings of 1, even if they are a smaller number of schools than those with transfer ratings above 1. Barbieri and colleagues (2011) concluded that teachers in schools with high transfer ratings might not have long term plans of teaching in those schools hence they might be less committed and wait for an opportunity to leave. This creates less stable and predictable school environments.

Similarly, the COVID-19 pandemic impacted education systems in different ways across the world. As a result, it might also have affected students physically and psychologically, and might have influenced to some extent the results obtained in this study. However, Queensland experienced minimum disruptions in 2019 and 2020 and the dropout rate is much higher in 2019 before COVID-19 than in 2020. A total of 3117 students had dropped out by the end of 2019, a year the state did not experience lockdowns or restrictions. Likewise, the introduction of external examinations, which contributed towards 50% of the overall calculus based subject result, might also have had an impact on students' confidence and thus their participation.

Conclusion

This paper investigated senior secondary students enrolled to participate in calculus-based mathematics subjects between 2019 and 2020 in Queensland state schools from different socio-economic districts. The QCAA data which included subjects, unit enrolments, school postcodes and districts was matched to SEIFA index (ABS), ICSEA value (ACARA) and transfer points (DoE). The overall high dropout rate in the new calculus-based mathematics subjects is a concern as students who initially choose to study calculus-based mathematics choose not to continue. Consequently, the state is losing a large number of students who could have pursued opportunities that are deemed to be jobs of the future. Socioeconomic factors, school location and transfer rating play a significant role in students' participation in calculus-based mathematics and dropout rates. Indeed, the results show that schools in low socioeconomic locations, enrol students from low SES backgrounds and have high transfer ratings have a low uptake in calculus-based options and high dropout rates. Further research is recommended to identify proactive strategies on how mathematics teachers can improve planning and delivery so as to promote participation and achievement and retain more students in calculus-based subjects. Importantly, there is urgent need for research that focuses on developing pedagogical resources that not only builds a foundation that promotes knowledge and skills development but facilitates more independent learning for the students. Thus, minimising the impact of school location, family SES and teacher turnover.

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Chapter 7 - Development and Validation of Academic Hardiness Questionnaire in Learning Chemistry during COVID-19 Pandemic using Rasch Model

Ifan Rivaldo, Hari Sutrisno, Alusti Cundo Manik

Chapter Highlights

- The existence of COVID-19 pandemic shifts the face-to-face chemistry learning process into long-distance learning which makes students need to have academic hardiness which is proven by their personality trait along with certain strategies to spare themselves from psychological stress and academic stress.
- An academic hardiness questionnaire in learning chemistry was developed, which consists of 12 items in Indonesian language.
- The Rasch model was implemented to determine the quality of psychometric scale, which includes reliability of measurements, item fit statistics, use of rating scale, and Differential Item Functioning (DIF).
- The result showed that the Rasch model conformed to the data (item-person reliability > 0.8). 10 items from the instruments have fulfilled statistical criteria indices in terms of infit and outfit mean square as all item-point measure correlation coefficient is above 0.3.
- The results indicate that the questionnaire is valid and could be used for further studies to measure academic chemistry hardiness in students.

Introduction

In the Indonesian 2013 curriculum, chemistry is part of a science subject in which students will learn what matters composed of, its characteristics, even how chemical reaction processes take place (Brady, 2009:23). At the same time, chemistry also became one of the subjects which perceived as abstract and hard to mastered, which led to "concern feeling" from students to learn it (Zammiluni, 2018). Moreover, there is a misleading stereotype toward chemistry in public and students, which makes them perceived it as something hard and dangerous to learn for (Salta et al., 2012; Ardura & Pe´rez-Bitria´n, 2018). Based on other studies, most students also shown their disinterest toward science subjects such as chemistry, due to a lot of topics priorly perceived as hard and abstract to learn to (Sitepu, 2016; Refriwati, 2015). This paradigm and difficulties also worsened by the implementation of long-distance-learning due to COVID-19 pandemic (Akerson & Carter, 2021; Altawalbeh & Al-Ajlouni, 2022; Atilgan & Tukel, 2021; Canese et al., 2022; Ghosh et al., 2022; Hebebci et al., 2020; Hebebci, 2021; Hu & Huang, 2022; Jackowicz & Sahin, 2021; Kara, 2021; Kibici & Sarıkaya, 2021; Kibici, 2021; Kilincer, 2021; Van der Spoel et al., 2020; Maksum & Purwanto, 2022; Paudel, 2021; Xhelili et al., 2021). As for 26 March 2020, UNESCO confirmed that up to 1.52 billion students from 165 countries, including Indonesia, implemented long-distance-learning (UNESCO, 2020). The implementation of long-distance-learning is identically related with online learning, which is carried out by utilising information technology tools (Aimiuwu, 2022; Atak et al., 2022; Dankers et al., 2022; El-aasar & Farghali, 2022; Sahin & Shelley, 2020; Sarikaya, 2021; Taghizade et al., 2020). To deliver information using technology smoothly, the Indonesian government has prepared virtual infrastructures to support this implementation (Churiyah et al., 2020). This fact confirmed by a statement from Hamid on the official page of Indonesian Ministry of Education and Culture, which stated that there are 23 webpages which could benefit students as source of learning, such as "Study House (*Rumah Belajar*)", "TV Education (*TV Education*)", and many others (Kemendikbud, 2020). However, due to the implementation of long-distance-learning, Indonesian Child Protection Commission (*Komisi Perlindungan Anak Indonesia*) saw an increase of reports received from parents that reported their children suffered stress due to excessive tasks administered by their teachers (CNN Indonesia, 2020).

Students need to have a persistent attitude in learning activities, whether at the school, or long-distance at the house, in order to achieve conducive and comfortable learning

circumstances, at the same time will be able to achieve designated objectives. As an attitude and a strategy, hardiness could ease individuals, by changing a stressful situation into a chance for students to grow, then turn it into an advantage (Maddi, 2013). A resistible individual has the capability to protect themselves from psychological stress, and could suppress it, even though it could serve as a disadvantage for themselves (Skomorovsky & Sudom, 2011). These research findings showed that the most common trigger for stressful situations for students are the fear of failure (Gibbons, 2015; Kamtsios & Karagiannopoulou, 2015). These findings were also strengthened by the PISA report back in 2018, which exposed that around 59% of students agreed or very agreed that the failure which they faced raises fears toward how others viewed them (OECD, 2019). Hence why, students need to have strong academic hardiness, thereby allowing them to grow their potential better, which will lead them to achieve fruitfulness in their study.

Sarafino and Smith (2012) expressed that hardiness is a personality trait which will give the person the ability to show a positive image toward unpleasant events, which will not cause stress in them. A study by Gardner (1999) showed that students who have hardiness as one of their characteristics, will be reflected through their balance of emotional, spiritual, physical, and interpersonal relationship, as well as their professional life. On the other hand, students who have low hardiness will tend to find it difficult to get out of stressful situations, feeling left out, powerless, even threatened (Benishek et al., 2005). Other studies also showed that students with high hardiness have commitment for their academic activities by controlling their performance and academic result, by using their tasks as a challenge as well as a chance to study more (Benishek & Lopez, 2001; Creed et al., 2013).

Dimatteo and Martin (2002), then Sarafino and Smith (2012) voiced out that academic hardiness consists of three aspects, which is Commitment, Control, and Challenge. Benishek & Lopez (2001), Maddi (2006), Kamtsios (2013), and Abdollahi et al., (2020) also agreed with that statement. However, previous studies have not been able to expose the academic hardiness during long-distance-learning, e.g., in the COVID-19 pandemic era. Aside, there were no studies yet that is focusing toward academic hardiness in chemistry learning activities, thus, there is need to develop an academic hardiness instrument which can be used to measure how far students' personalities or characteristics to commit, to control themselves, and to resist from various challenges during long-distance learning (online) in this pandemic era.

The Item Response Theory (IRT) concept was introduced for the first time by Frederic Lord (Lord, 1952). IRT includes mathematics modelling theory which is used to explore construct validity and reliability of the questionnaire. The Rasch model is the most common applied model by referring to relations of items' difficulties and respondents' abilities (Spinou et al., 2017). The Rasch model is considered as an effective and modern approach to measure validity and reliability with new scales to be used in various scientific fields (Assanovich, 2012). Analysis using Rasch model mostly has been used to find out psychometric properties of measurement instrument scale, e.g., "The Self-Efficacy Teaching and Knowledge Instrument for Science Teachers" (Pruski et al., 2017), "Quality of Teacher Success Questionnaire" (Tabatabaee-Yazdi, 2018), "Evaluating the Quality of Teaching for Students' Creativity" (Bui, 2020), and other relevant studies which indicate Rasch model implementation and its trend among the researchers.

Method

Measurement

Our study used qualitative and quantitative methods. Qualitative method includes synthesis of the instrument which was done by modifying instrument by developing previously developed instruments by Maddi (2016) and Kamtsios (2013). Our instrument was specifically used to measure students' academic hardiness in learning chemistry during long-distance learning. The developed instrument consists of 12 items with five-point likert scale (Strongly Disagree, Disagree, Neutral, Agree, Strongly Agree) with three dimensions or aspect, which is "Commitment" (4 item: KA53, KA54, KA55, & KA56), "Control" (4 item: KA57, KA58, KA59, & KA60), and "Challenge" (4 item: KA61, KA62, KA63, & KA64).

Furthermore, we also implemented a qualitative method to validate the instrument based on consultation with two experts regarding the developed instrument. In this step, we revised the questionnaire by changing three items into negative statements in each aspect, so the questionnaire consists of nine positive statements and three positive statements (KA54, KA58, and KA64). For example, item KA54 stated that "obtaining good grades in chemistry subject is not my highest priority for me to fight for". The existence of negative items meant to reduce bias in the measurement, due to the tendency of a person to quickly agree to an agreement without understanding the contents or filling it with a certain response pattern

(Podsakoff, MacKenzie, Lee, & Podsakoff, 2003). Also, these negative items could contribute toward the validity of the measurement by broadening how respondents think individually and setting up their mindset regarding the studied construct (Weijters & Baumgartner, 2012).

On the other hand, for the quantitative method, we implemented Rasch analysis to analyse the obtained data. Then, to analyse psychometric quality of the instrument, which consist of reliability of measurements, item fit statistics (Infit and Outfit values, and Point-Measure Correlation Coefficient (PTMEA Corr), use of response category, dan Differential Item Functioning (DIF), we used WINSTEPS® Rasch software (version 3.73) (Linacre, 2009).

Participants

To apprehend the respondents' perspective toward our developed instrument, we gathered 247 senior high school students from four schools in Padang. They consist of 78 male and 169 female, ranging from 10th until 12th grade, and their prospect after graduation which could be seen in Table 1.

Table 1. Demographic Profile of Respondents

	Category	Frequency	Percentage
School	Public	181	73
	Independent	66	27
Gender	Male	78	32
	Female	169	68
Grade	10th	145	59
	11th	20	8
	12th	82	33
Prospect After	Continue Study to College	228	92
Graduate	Work	19	8

We collected the responses via an online survey through Google Forms. We disseminated the link toward the online questionnaire through chemistry subject teachers in schools which then disseminated again to all respondents. Respondents then filled the forms voluntarily without any compulsion from us as researchers, nor the teachers.

Results

From the collected data, we determine psychometric quality of the instrument using the Rasch model, which consists of reliability, use of response category, item fit statistics, and Differential Item Functioning (DIF). Summary of overall instrument quality, and the correlation between person and item, can be seen on Table 2.

Table 2. Summary Statistics of Person and Items

	Quantity (N)	Logit Mean Score (Standard Deviation)	Separation	Reliability	Cronbach's α
Person	247	0.72 (0.90)	1.71	0.74	0.79
Item	12	0.00 (0.33)	4.24	0.95	

Based on Table 2, it could be inferred that logit mean score in person was positive (0.72), with standard deviation 0.90. This means that respondents have abilities above the average of the item's difficulties. On the other hand, the logit mean score for the item was 0.00, with standard deviation 0.33, which indicates that the item has standard difficulties. From the same table, we could see that the reliability in person was 0.78 which could be categorised as "fair", whereas in an item scored as 0.95 which could be categorised into excellent. In the Rasch model, reliability scores range from 0 until 1. There are various categories to interpret these scores, where below 0.5 as unacceptable reliability; 0.5 to 0.67 as poor; 0.67 to 0.80 as fair; 0.81 to 0.90 as good; 0.91 to 0.94 as very good; and the last one is more than 0.94 as excellent (Fisher, 2004). The reliability score also can be seen from Cronbach's α score, which scored as 0.79, and could be categorised as good.

Next, for separation score, we could see the score in person was 1.71 which could be categorised as poor, whereas in item was 4.24 which could be categorised as very good (Fisher, 2004). These scores indicated that the items in the instrument could differentiated or grouped our respondents based on their level of academic hardiness in learning chemistry. On the other hand, a 1.71 score in person (could be rounded as 2), means that respondents included in our study were heterogeneous (comes from two groups with different academic hardiness).

Then, the result for item fit statistics could be seen in Table 3. The table gives some overview regarding the estimation of difficulties (measure or logit value), the standard error of the item difficulty measures or the precise level (Standard Error Measurement), and the conformity of each item in the academic hardiness questionnaire. The result showed that item KA54 (logit 0.57) is the hardest one to be agreed by respondents, and KA64 (logit 0.35) is the easiest one. The accuracy level for each item was 0.07 (except KA53, which was 0.08).

Table 3. Item Fit Statistics

No	Item Code	Measure (Logit Value)	Standard Error Measurement	Infit MNSQ	Outfit MNSQ	Point Measure Correlation Coefficient
1	KA53	-0.41	0.08	0.63	0.61	0.66
2	KA54	**0.57**	0.07	**1.82**	**1.95**	**0.27**
3	KA55	-0.01	0.07	0.78	0.80	0.61
4	KA56	-0.15	0.07	1.14	1.18	0.49
5	KA57	-0.48	0.08	0.90	0.92	0.58
6	KA58	0.56	0.07	1.33	1.41	0.38
7	KA59	-0.18	0.07	0.73	0.74	0.60
8	KA60	-0.18	0.07	0.76	0.75	0.61
9	KA61	0.06	0.07	0.84	0.87	0.60
10	KA62	0.11	0.07	0.73	0.76	0.59
11	KA63	-0.26	0.07	0.71	0.74	0.63
12	KA64	**0.35**	0.07	**1.54**	**1.70**	0.36

For fit or misfit items, Infit and Outfit Mean Square (MNSQ) value is one of the most important statistical indicators which are able to identify the fit of the model accurately. An acceptable range for MSNQ score is from 0.5 to 1.5 (Meyer, 2014). Table 3 showed that two out of 10 items, which is KA54 and KA64 were in the unacceptable score range, with an infit MNSQ score 1.82 and 1.54 respectively, then the outfit one was 1.95 and 1.70. Another indicator which could be used to determine the conformity is Point Measure Correlation Coefficient which estimates the polarity of items, which ranges from 0.3 to 0.8 as acceptable score range. This is due to the availability of some items which could measure some items as a good indicator (Allen, 2001). The result showed that KA54 was in 0.27, which means it's in

the unacceptable score range. On the other hand, item KA53 is the one with the highest polarity, but still included in the acceptable range.

Next, the result from the usage of a five-scale rating response shown in Table 4. Category 5, 4, and 3, easily agreed by most respondents, with 26%, 28%, and 32%, respectively. On the other hand, for category 2 and 1, only a small percentage of respondents filled it, which was 8% and 5%. These results indicate that it's probably better to merge both categories into one, so in the end there is only a four-scale rating.

Table 4. Statistics from the Use of Five-scale Rating Response

Category	Data Category Count Used	Frequency (%)	Observed Average	Infit MNSQ	Outfit MNSQ	Andrich Threshold Measure	Category Measure
1: Strongly Disagree	148	5	**0.08**	1.46	**1.66**	**None**	-2.32
2: Disagree	228	8	0.06	1.07	1.10	-0.59	-1.09
3: Neutral	963	32	0.21	0.75	0.73	-1.26	-0.11
4: Agree	843	28	0.77	0.89	0.84	0.69	1.04
5: Strongly Agree	782	26	1.42	0.90	0.94	1.15	2.57

Infit MNSQ score is an indicator for use of response category, with acceptable score ranging from 0.75 to 1.46. Aside, for Outfit MNSQ, category 1 score was 1.66, which means it passed the threshold, which ideally should be 1.0, where score above 1.5 is considered as problematic (Linacre, 2009a). These results proved that all scale categories are acceptable or functionally well in terms of determining how respondents agreed based on their academic hardiness, except for category 1 (strongly disagree).

In the observed measure score, the result didn't increase consistently from category 1 to 5, which was 0.08, 0.06, 0.21, 0.77 and 1.42, respectively. The presence of inverted scores (up and down) showed that respondents felt confused in agreeing with the given questionnaire. This statement goes along with the result on the score in the Andrich Threshold Measure column. Andrich Threshold Measure portrayed the probability points between two categories

which previously closed on rating scale (such as 2 and 3, 3 and 4, and so on). Due to that, in category 1, the Andrich Threshold Measure score is unknown (none). The obtained score showed the inaccuracy of Andrich Threshold score, where the increasing of scores is inconsistent along with the increasing number of categories on the rating scale, respectively (-0.59, -1.26, 0.69, 1.15). This statement is also proved by an illustration on Figure 1, all categories have their peak, and each are placed apart from each other on the curve, even though category 2 have relatively low peaks.

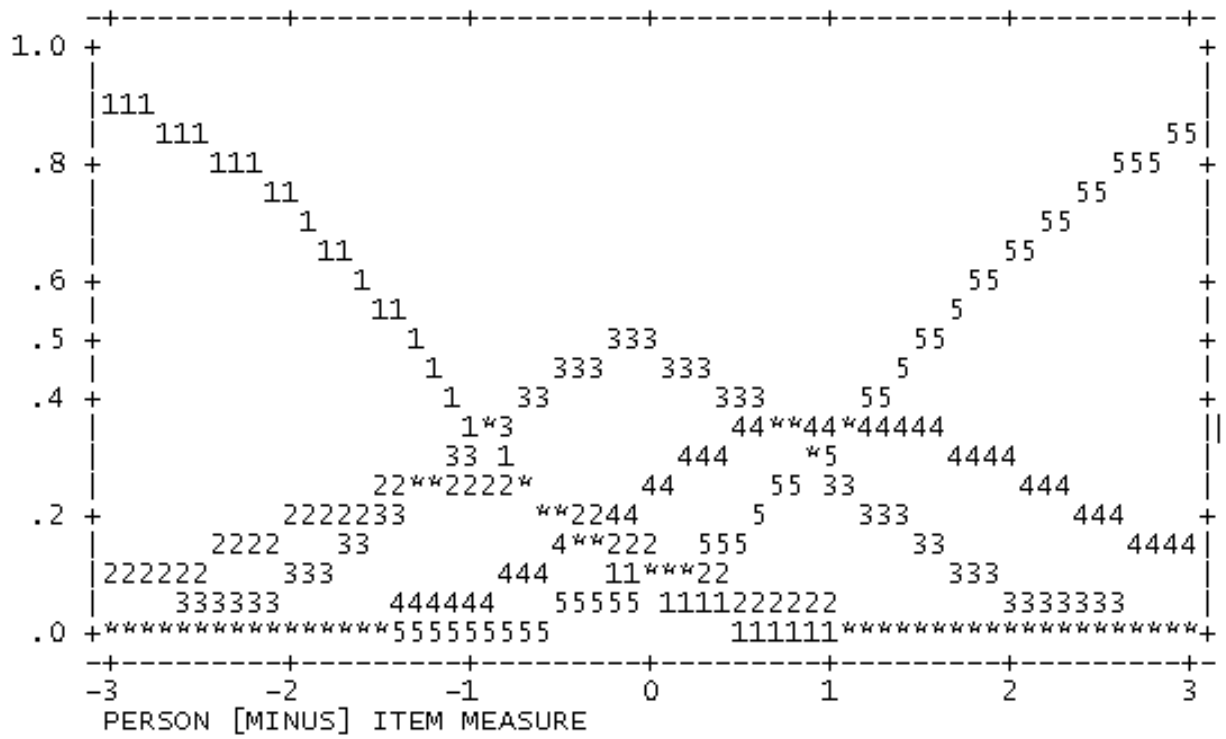

Figure 1. Probabilities Curve for Categories Used in the Instrument

Nevertheless, based on the measurement which proved by the "category measure" column, the rating scale category has functioned well to group our respondents based on their academic hardiness level. This score could be interpreted as the respondents with low academic hardiness (-2.32) will tend to choose category 1 (Strongly Disagree). Contrary, respondents with high academic hardiness (3.12) will choose category 5 (Strongly Agree).

Figure 2 showed wright map of items and people which portrayed the correlation between items' difficulty level to be agreed with the respondents' ability. Item number KA54 and KA58 (logit 0.57 and 0.56, respectively) was the most difficult item or hard to agree for. However, these items couldn't measure how respondents with academic hardiness level

above both items (from 162P, 198P) till some students with highest academic hardiness (which is 043P, 054P, and 230P) (with same logit, 4.90), which ended up causing separation person score (see Table 2) considered as "poor". Furthermore, item KA57 (logit -0.48) is considered as the item with the lowest difficulties or easiest to agree for. However, this item couldn't reach 8 students with lower academic hardiness level, such as 037P (logit -0.68), 166P (logit -0.85), till 089P (logit-1.21). All of these items could be interpreted as "good", because each is still inside the standard deviation limit (between two T symbols).

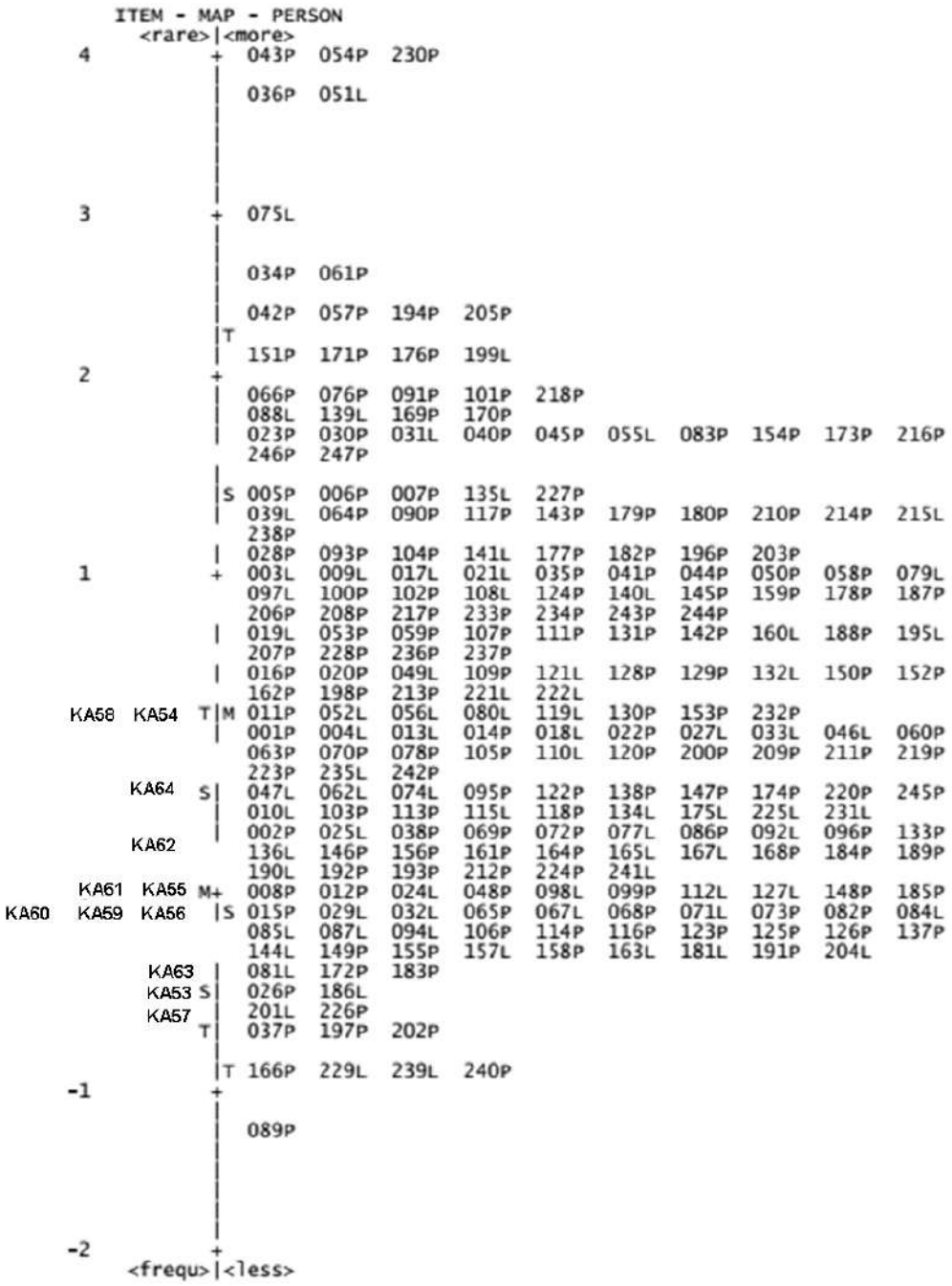

Figure 2. Wright Map of Academic Hardiness Measurement

Lastly, we also analysed Differential Item Functioning (DIF), to see whether there could be differences of responses between subgroups individually with certain similarity, such as gender (males and females), which will impact the end result (Holland & Weiner, 1993). DIF is an additional aspect from the conformity with Rasch model, which is probably going to affect the unidimensionality and validity by comparing data between subgroups through bias scale score (Andrich, 1988; Borsboom, 2006). DIF could be measured by comparing item responses function between groups of people in the sample inside the measured construct (Hagquist & Andrich, 2004). In our study, DIF analysis was done by grouping the respondents by their gender, which is males and females of senior high school students, which then later will be analysed whether there is bias of the items used in the academic hardiness instrument, based on their perception.

The DIF analysis result can be seen on Table 5.

Table 5. Differential Item Functioning (DIF) Analysis between Both Gender of Academic Hardiness Items

No	Item Code	Person Class	DIF Measure	Person Class	DIF Measure	DIF Contrast	Probability
1	KA53	L	-0.41	P	-0.41	0.00	1.000
2	KA54	L	0.71	P	0.51	0.20	0.1649
3	KA55	L	-0.06	P	0.02	-0.09	0.5734
4	KA56	L	-0.05	P	-0.20	0.15	0.3309
5	KA57	L	-0.51	P	-0.48	-0.03	0.8458
6	KA58	L	0.56	P	0.56	0.00	1.000
7	KA59	L	-0.24	P	-0.16	-0.08	0.6080
8	KA60	L	-0.14	P	-0.20	0.06	0.7168
9	KA61	L	0.06	P	0.06	0.00	1.000
10	KA62	L	-0.02	P	0.18	-0.20	0.1942
11	KA63	L	-0.29	P	-0.26	-0.02	0.8886
12	KA64	L	0.38	P	0.35	0.02	0.8761

The DIF measure column showed the difficulty levels in each group. For example, item KA53 is considered to have the same difficulty to be agreed by both groups (male and

female, each with similar score, -0.41), so both groups would not differ on the DIF contrast score. The index bias item categories include "Large" (logit > 0.64), "Moderate" (logit ranging from 0.43 – 0.64), and "Negligible" (logit < 0.43) (Zwick, 2012). This means that all items from KA53 to KA64 are not affected or could be interpreted as "Negligible" in index bias item categories, based on these two gender groups.

Item bias could also be seen through the probability score, whereas the items with score more than 0.05 means it would not have significant differences between male and female groups. Contrary, if the score is below 0.05, this means there are significant differences between both groups, which also means that there is item bias based on gender. Based on our obtained data, it could be inferred that there is item bias on the analysed item, as the lowest probabilities was 0.1649 on item KA54, and the highest was 1.0 on item KA53, KA58, and KA61.

Discussion

The developed questionnaire of academic hardiness in learning chemistry has 12 items based on three academic hardiness aspects, which is "Commitment", "Control", and "Challenges". All aspects are closely related with academic hardiness (Sarafino & Smith, 2012), so it was chosen as the component or basic aspect to develop items for the instrument.

"Commitment" could be interpreted as someone's mindset regarding their goals and involvement toward certain planned activities. Four items (KA53 to KA56) are items that were developed to describe students' commitment in learning chemistry. For instance, item KA53 stated that "I do my best in learning chemistry subject to obtain higher scores than my classmates". "Control" is someone's belief toward their own capabilities to control their activities. The next four items (KA57 to KA60) developed to describe how students' behaviour control themselves as a proof of their academic hardiness. For example, item KA59 stated that "I do my tasks/homeworks and study diligently to avoid shameful feelings when I obtained a low score in chemistry subject". Lastly, "Challenge" could be interpreted as how someone perceives change in something could mean as a chance which could benefit them instead. The last four items (KA61 to KA64) showed that Challenge, as in this aspect should be made as a chance to grow by students. For example, item KA63 stated that "Failure in chemistry subject test doesn't make me feel blue, instead it makes me study more diligently than before".

In terms of construct, items in the developed instrument assessed as “good”, which proven by the instrument’s reliability result (see Table 2) which could be interpreted into category “excellent” (scored 0.95), and Cronbach’s α which could be interpreted into category “good” (scored 0.79). These results indicated that there is similarity between this two-reliability measurement method toward Rasch analysis which generally portrayed the interaction between the person and the items of the academic hardiness instrument. Even though the person's reliability in the measurement result is not in the same category, both scores could be categorised into “fair” (scored 0.74) (Fisher, 2014). These differences could be anticipated by eliminating misfit respondents by observing the output person fit, which will increase the person's reliability, as the outlier data has been removed from the measurement.

Next, two out of 12 items based on the statistical item fit (see Table 3) must be removed or eliminated. Both items do not fulfil the acceptance threshold for infit and outfit of MNSQ, and one of the items (KA54) could not fulfil the acceptance threshold for item polarity (Bond, Yan, & Heene, 2020). These conditions make item KA54 could not measure the hardiness well of similar statements compared to other items (Allen, 2001). Both removed items were negative items, KA54 which stated “Obtaining good grades in chemistry subject is not my high priority to fight for”, and KA64 which stated “Obtained low scores in chemistry subject test will break my spirit to study for the upcoming test”. These probably happened due to the tendency of respondent who’s inconsistent when the instrument consists of negative and positive items (Colosi, 2005) and the respondents is not careful enough when trying to understanding the differences of meaning between both statement (Sonderen, Sanderman, & Coyne, 2013; Roszkowski & Soven, 2010).

To determine the use of response categories from our rating scale, two categories, which are Category 1 (Strongly Disagree) and Category 2 (Disagree), probably would be better if merged up into one category. Each category was only agreed by a small portion of respondents, which is 5% and 8%. Other than that, the outfit MNSQ score for Category 1 is above acceptance score range, which is 1.66 (Linacre, 2009a). To solve this problem, it’s possible to reduce the other option from the problematic category (Van Zile-Tamsen, 2017).

From DIF analysis of the instrument, it could be inferred that there was no item bias to measure the academic hardiness between male and female students. Even though male percentage (32%) and female (68%) less balance than how it should be (Table 1), but the

result showed a good item quality, hence the items did not seem to be bias into either gender, or at least there were no differences in the response between male and female students regarding the measurement of academic hardiness in learning chemistry.

Even though our study obtained good results, it still has few limitations which could be fixed in the future. The number of respondents is relatively small compared to others. Other than that, not-so-balance of the total respondents from each school (public and independent school).

Even if the DIF interpretation didn't see any item bias from the result, we think there is some need to have a balance or equality on including respondents with different genders. Based on Herrera and Gómez (2008), the imbalance of total sample between both groups will affect the DIF accuracy in determining item bias. Moreover, survey method which carried out online, quite limiting our observation and monitoring to control how serious the respondents, along with ensuring the given instruction has been understood by all respondents during the period of "filling the questionnaire", even if this method could have more flexibility to respondents as there were no pressure when the researchers were present near them.

Conclusion

In our study, we have developed an academic hardiness questionnaire in the chemistry learning process, in likert scale form with five categories. The instrument was valid in terms of contents based on expert's correction, also empirically through trials, which then analysed using Rasch model. The carried-out measurement was suitable with Rasch model theory, which includes reliability, separation, and strata statistics of questionnaire, use of response category from rating scale, polarity of item point-measure correlation coefficient, infit and outfit values, and Differential Item Functioning (DIF) of instrument. The result also showed that 10 out of 12 items from the instrument was really suitable with Rasch model requirements, and can be used to measure academic hardiness in the chemistry learning process of senior high school students.

Recommendations

This study has produced an academic hardiness questionnaire which is valid empirically.

Hopefully, the instrument could be useful for the upcoming studies to measure students' academic hardiness in the chemistry learning process during this pandemic era, by simplifying the previous scale categories from five into four categories. Also, it's possible that the upcoming studies could re-test our available instrument, using different methods, such as paper based with the same or different respondents.

Notes

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Chapter 8 - History of Mathematics and Students' Performance in Mathematics: The Mediating Effect of Mathematics Study Interest

Yarhands Dissou Arthur, Bright Asare

Chapter Highlights

- The research assessed the mediating effect of mathematics study interest in the relationship between history of mathematics and students' performance in mathematics.
- Findings revealed that the use of history of mathematics had a significant positive effect on students' performance in mathematics.
- Similarly, history of mathematics had a positive effect on mathematics study interest.
- Also, mathematics study interest had a significant positive effect on mathematics performance.
- Finally, the relationship between history of mathematics and mathematics performance was partially mediated by mathematics interest.
- Future studies on these concepts should adopt action research, as this will be a practical way of determining the impact of history of mathematics on the performance of students in mathematics.

Introduction

Mathematics is an essential tool for success in the modern world, but most Ghanaian students see mathematics as a difficult subject (Mills & Mereku, 2016). Are their difficulties with mathematics caused by the teacher who presents the lesson to them, or is it caused by their level of interest in learning mathematics in their various schools? Substantial percentage of students in senior high school perform poorly in mathematics during the West African Senior School Certificate Examination (WASSCE). In Ghana, as in many other countries, mathematics is made compulsory from basic to tertiary education, irrespective of course or program offered (Arthur et al., 2021). The ability of a student to perform well in mathematics determines the student's success in career advancement (Chine, 2022; Fletcher, 2007; Georgieva & Goranov, 2021; Marpa, 2021; Serhan & Almeqdadi, 2021; Young & Young, 2022).

In 2020, a total of 65.71% of the students who sat for school WASSCE in mathematics had the minimum pass for tertiary education (A1 to C6) (WAEC, 2021). Statistics from the 2021 WASSCE however indicated that only 54.11% of graduates had from A1 to C6 in mathematics when they sat for the examination (WAEC, 2021). This percentage was less than the pass rate during 2019 and 2020 WASSCE, which makes it a worrying situation. So, does it mean that the student's level of understanding is too poor, or that they do not have an interest in studying mathematics as a subject? The results are not encouraging to those who brag about Ghana's academic prowess. The present research looked at how the adoption of history of mathematics as a teaching pedagogy, could help salvage the situation of poor performance in mathematics.

Integrating the history of mathematics as a pedagogy tool is an interesting challenge to the teachers' creativity and knowledge (Butuner & Baki, 2020). Jankvist et al. (2020) indicated that the use historical accounts in classroom enhances students' comprehension of mathematics subject, as students get to appreciate the evolutions that have taken place, with respect to the concepts being studied. Students are able to better appreciate mathematical thinking and its dynamic nature, when presented with the history behind mathematics concepts. History of mathematics as a pedagogy tool, provides an active learning experience in the mathematics class, thereby enhancing students' engagement with the subject.

Literature Review

History of Mathematics and Students' Performance

History of mathematics is found to influence students' performance in teaching and learning mathematics at all levels of education. The use of the history of mathematics improves students' understanding of mathematics concepts, problems, and solutions (Tzanakis et al., 2002). Other studies have also suggested that when the history of mathematics is used in teaching students, it has a significant impact on students' cognition, which will result in their performance (Bütüner, 2016; Lim & Chapman, 2015) and affective development in mathematics class (Bütüner, 2015; Haverhals & Roscoe, 2010). According to Bütüner (2018), when history anecdotes, mathematics life stories, and historical problems are used in teaching of mathematics, it will improve the level of performance of the students. Such activities give the student's in-depth knowledge of learning mathematics. When the history of mathematics is adopted in teaching and learning it will enhance student's mathematics thinking ability which will result in better performance of the students in the classroom. According to Jankvist (2010), when the history of mathematics is used in the teaching and learning of mathematics in the classroom, it improves students' academic success. It was proposed that;

> *H1: History of mathematics has a direct positive effect on senior high school students' mathematics performance.*

History of Mathematics and Students' Interest

Interest in academia is largely regarded as the preference to do some basic academic tasks, willingness in learning new things in a particular subject, the feeling when students pick up their academic books to study, and how they enjoy taking a particular subject like mathematics (Lin & Huang, 2016). Mathematics learning interest is very crucial because mathematics is particular challenging subject for many students, and the interest is what will propel them commit to learning it (Landerl & Wimmer, 2008). Mathematics learning interest is essential in developing students' arithmetic skills, and mathematics performance in general (Rotgans & Schmidt, 2014).

History of mathematics is suggested to have effect on students' interests in learning mathematics. Mogari and Lupahla (2013) indicated that, when the history of mathematics is adopted in the teaching mathematics, it improves students' level of interest in mathematics.

That is, to improve learners' attitudes toward mathematics, teachers could deliver new concepts by providing students with the relevant historical background (Ding, 2019). This will enable the student to understand the new concept being introduced by the teacher. For instance, sharing the life story of the Pythagoras theorem could enable students to develop a positive interest in the Pythagoras theorem (Agarwal, 2020). It was thus proposed that;

H2: History of mathematics has a direct positive effect on senior high school students' interest mathematics.

Interest in Mathematics and Students' Performance

Students' interest in studying mathematics as a subject is one of the major factors that determine their performance (Arthur et al., 2022). Students' interest in mathematics is very necessary because student learning interest has a greater effect on student's performance (Gilbert, 2016). Learning interest influences students' willingness to commit time and effort in learning a particular subject (Yu & Singh, 2016). Laksono (2016) identified significant effect of learning interest on mathematics study achievements. Sause et al. (2016) points out that students' interest in mathematics is one of the main contributing factors towards their mathematics performance.

Student interest has also been established to be a crucial element for cognitive development and learning (Kim et al., 2015). Mathematics learning interest is therefore found to be an antecedent of students' mathematics achievement (Viljaranta et al., 2009). Students with high mathematics learning interest are able to expand knowledge by scrutinizing the mathematics course content deeper (Reeve et al., 2015). Köller et al. (2001) identified that interest has a significant effect on achievement, as high level of interest is found among high achieving students. To achieve high mathematics performance, it is thus expected that the student's interest in mathematics is awakened. It was thus proposed that;

H3: Mathematics study interest has a direct positive effect on senior high school students' mathematics performance.

Mediating Role of Students' Interest in Mathematics

Studies have suggested the potential influence of mathematics history on performance of students (Bütüner, 2016; Lim & Chapman, 2015). This effect could however be potentially

intervened by other variables such as student learning interest. For example, literature suggest that the adoption of history of mathematics as a pedagogical tool in teaching mathematics, has a significant influence on students' interest in learning mathematics (Arthur et al., 2018). Mathematics study interest on the other hand is found to influence students' performance in mathematics (Ganley & Lubienski, 2016). These suggest that the relationship between history of mathematics and mathematics performance could potentially be mediated by students' mathematics learning interest. Interest in the subject serves as an important role in learning and academic achievements (Leyva et al., 2022; Banihashem et al., 2015; Soltanizadeh et al., 2022). Interest in a subject makes students become active participants in the cause of teaching and learning mathematics (Rajkumar & Hema, 2021). It was thus proposed that;

H4: Mathematics study interest mediates the relationship between history of mathematics mathematic performance of senior high school students.

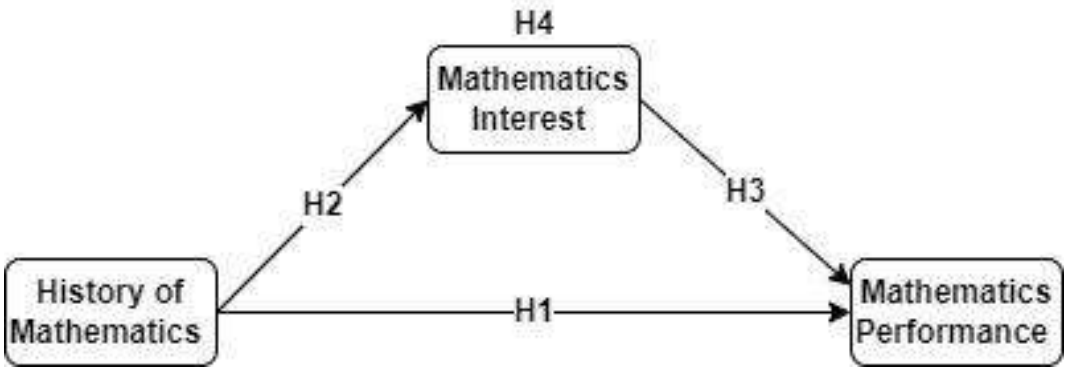

Figure 1. Conceptual Framework

Methodology

Sample and Data Collection

The study sampled 388 final year (3rd year) students from 4 selected senior high schools in Ashanti region of Ghana. The study assigned 100 questionnaires to each school, so 400 dataset was expected. After the 2 weeks of data collection however, 388 questionnaires were realized to be valid for data analysis. The rejected 12 questionnaires were either incompletely filled or selection of multiple responses for some measurement items. The response rate was 97% [(388/400)*100], which was considered as representative enough for the study.

The research instrument used was structured questionnaire, which was printed and distributed among the targeted students. The students were selected using convenience sampling

technique, that is, final year students who were in class during the data collection period were given a questionnaire to complete. Students were selected during class hours, after permissions were granted by the teachers in charge during the period of the data collection. Prior to the administration of the questionnaire, approvals were obtained from the various heads of selected senior high schools. The selected students offered programs such as Science, Business, and General Arts. Seventy-six percent (76%) of the students were aged 16 to 19 years, 14.2% aged below 16 years, while 9.8% were also aged above 19 years. There were 60.8% of the respondents who were males, while the remaining were females.

Questionnaire and Measures

The research had three main variables, which were history of mathematics, mathematics interest and mathematics performance. The three variables were measured on a Likert scale of 1=Strongly Disagree, to 5=Strongly Agree.

The three measurement scales for history of mathematics were developed from Butuner and Baki (2020). The items were "My mathematics teacher introduces new concepts by providing the history behind the concept", "I enjoy the history behind the mathematics concepts we study", and "It is easier to understand mathematics concepts, when the history is provided".

The five measurement scales for mathematics interest were developed from Arthur et al. (2022). The items were "I have interest in learning mathematics as part of my course", "Mathematics is one of the courses I enjoy learning most", "The time I use learning mathematics is the time I enjoy most in my private studies", "Learning mathematics is interesting", and "I love mathematics as a subject".

The four measurement scales for mathematics study performance were developed from Arthur et al. (2021). The items were "I perform well in mathematics examinations", "I make contributions and answer questions in mathematic class", "I am an active player during mathematics group studies", and "I am able to learn and understand mathematics concepts on my own".

Although the measurement items under all the constructs were developed from previous empirical researches, they were edited to conform with the current study. Hyman et al. (2006)

suggested that using validated measurement scale from past empirical researches, reduced the burden of developing and validating one's own measurement items.

Validity and Reliability Analysis

The research assessed validity and reliability by running Confirmatory Factor Analysis (CFA) using Amos (v.23) software. Table 1 presents the CFA results. As a procedural practice when conducting CFA process, measurement scales with factor loadings of less than 0.5 were deleted, as recommended by Dogbe et al. (2020). By this procedure, two measurement scales were removed from mathematics study interest.

Table 1. Confirmatory Factor Analysis

Model Fit Indices: *CMIN=246.945; DF=84; CMIN/DF=2.940; CFI=0.903; TLI=0.955; RMR=0.056; RMSEA=0.079*	**Std. Factor Loading**
History of Mathematics (HIST): CA=0.746; CR=0.765; AVE=0.529	
HIS1	0.568
HIS2	0.802
HIS3	0.789
Mathematics Study Interest (INTI): CA=0.840; CR=0.851; AVE=0.535	
INT1	0.677
INT2	0.692
INT3	0.846
INT4	0.661
INT5	0.766
Mathematics Performance (PERF): CA=0.805; CR=0.820; AVE=0.545	
MP1	0.580
MP2	0.532
MP3	0.835
MP4	0.929

CFI=Comparative Fit Index; CMIN/DF=Chi-Square/ Degree of Freedom; TLI=Tukey-Lewis Index; RMR=Root Mean Square Residual; RMSEA=Root Mean Square Error of Approximation

The internal reliability of the measurement scales were ascertained by running Cronbach's Alpha (CA) analysis, with the help of SPSS (v.23) software. Internal consistency is achieved when the Cronbach's alpha score is at least 0.7. Results in Table 1 pointed out that history of mathematics had an alpha score of 0.746, mathematics study interest had an alpha score of 0.840, while mathematics performance had an alpha score of 0.805.

In checking for convergent validity, Average Variance Extracted (AVE) was computed using the factor loadings of the measurement items. Fornell and Larcker (1981) recommended an AVE score of at least 0.5 and composite reliability (CR) score of at least 0.7, in achieving convergent validity. The results indicated in Table 1 showed that the least AVE was 0.529 for history of mathematics, and the least CR was 0.765 also for history of mathematics.

The model fitness was assessed using Hair et al. (2010) recommended fit indices criteria. According to Hair et al. (2010), CMIN/DF should be less than 3, TLI and CFI should be greater than 0.9, while RMSEA and RMR should be less than 0.08. Results shown in Table 1 demonstrates that the dataset fits the model very well, as all the model fit indices were met.

The Table 2 presets the descriptive and discriminant validity of the study. Results presented showed that all mean scores were above 3, with mathematics study interest having the highest mean score. The highest possible mean score was 5, since the three variables studied were measured on a 5-point Likert scale (1=strongly disagree, to 5=strongly agree). Respondents therefore agreed to the various statements under the three constructs.

Table 2. Descriptive and Discriminant Validity Analysis

Variables	**Mean**	**Std. Dev.**	**Course**	**Gender**	**Age**	**HIST**	**INTI**	**PERF**
Course	-	-						
Gender	-	-	0.449**					
Age	-	-	0.204**	0.079				
HIST	3.650	0.632	0.286**	0.279**	0.137*	**0.727**		
INTI	3.818	0.736	0.436**	0.341**	0.300**	0.609**	**0.731**	
PERF	3.673	0.859	0.475**	0.319**	0.095	0.646**	0.560**	**0.738**

*√AVE are bold and underlined; * ~ P-value significant at 5% (0.05); ** ~ P-value significant at 1% (0.01)*

There are a number of ways of analyzing discriminant validity, but this present research adopted the approach of Bamfo et al. (2018), by measuring the square-root of the AVEs (√AVEs) against the correlation coefficients. To conclude that discriminant validity was achieved, the least √AVE is greater than the largest correlation score. Results presented showed that the least √AVEs was 0.727, while the largest correlation score was 0.649. This suggests that the measurement scales were uncorrelated with other measurement scales on other constructs, and as such, discriminant validity was achieved. Multicollinearity was also not a challenge, as correlation scores were all less than 0.7, suggesting there was no high correlation among any two constructs.

Results

The path analysis was run using a Structural Equation Modelling (SEM), using Amos (v.23) software. SEM in Amos is covariance-based. Since the estimation had mediating effect, Bias-Corrected (BC) percentile method of bootstrapping was used, with 5000 bootstrap sample, and 95% confidence level. Table 3 presents the results of the analysis, while Figure 2 also presents the diagram of the structural model. Course pursued by students were coded as 1=science and 0=others. Results showed that course studied had a significant positive effect on the performance of students in mathematics ($\beta = 0.359; p < 0.01$). This suggests that science students were about 35.9% more likely to perform in mathematics than students pursuing other courses. This meets priori assumption, as in Ghana, best students are admitted into science programs. Age had a significant negative effect on mathematics performance ($\beta = -0.147; p < 0.01$). Younger students therefore were seen to perform better than older students. Good students are usually able to complete school at a younger age, because they are less likely to get repeated in a class, which might delay them in school. Gender on the hand, had no significant effect mathematics performance ($\beta = 0.029; p > 0.05$).

Results presented on the hypothesized paths indicated that, history of mathematics had a significant positive effect on performance of students in mathematics ($\beta = 0.498; p < 0.01$). That is, when mathematics teachers introduced mathematics concepts by giving the history behind those concepts, senior high school students' performance in mathematics is increased by 49.8%. Hypothesis H1: "*History of mathematics has a direct positive effect on senior high school students' mathematics performance*", was therefore accepted by this study.

Results showed that history of mathematics had a direct positive effect on mathematics study interest ($\beta = 0.729; p < 0.01$). That is, when mathematics teachers introduced mathematics concepts by giving the history behind those concepts, senior high school students' interest in mathematics is increased by 72.9%. Hypothesis H2: "*History of mathematics has a direct positive effect on senior high school students' interest mathematics*", was therefore accepted by this study.

It was further identified that mathematics study interest had a direct positive effect on the performance of students in mathematics ($\beta = 0.259; p < 0.01$). That is, an increase in mathematics study interest has a corresponding 25.9% increase in mathematics performance. Hypothesis H3: "*Mathematics study interest has a direct positive effect on senior high school students' mathematics performance*", was therefore accepted by this study.

Finally, the indirect effect or mediating effect of mathematics study interest was assessed. The coefficient of 0.189 for the indirect effect was found to be significant, as both the Lower and Upper BCs were all positive. Since the direct effect of history of mathematics on performance of mathematics was significant, mathematics study interest is said to only partially mediate this relationship. Hypothesis H4: "*Mathematics study interest mediates the relationship between history of mathematics mathematic performance of senior high school students*", was therefore accepted by this study.

Table 3. Path Estimates

Direct Paths	**UnStd. Estimate**	**Std. Error**	**C.R.**
HIST → INTI	0.729	0.098	7.413**
HIST → PERF	0.498	0.109	4.592**
INTI → PERF	0.259	0.077	3.378**
Course → PERF	0.359	0.065	5.480**
Gender → PERF	0.029	0.039	0.759
Age → PERF	-0.147	0.057	-2.571**
Indirect Paths	**UnStd. Estimate**	**Lower BC**	**Upper BC**
HIST → INTI → PERF	0.189	0.006	0.404

Bias-Corrected (BC) Percentile Method; 5000 Bootstrap sample; 95% Confidence level

** *~ P-value significant at 1% (0.01)*

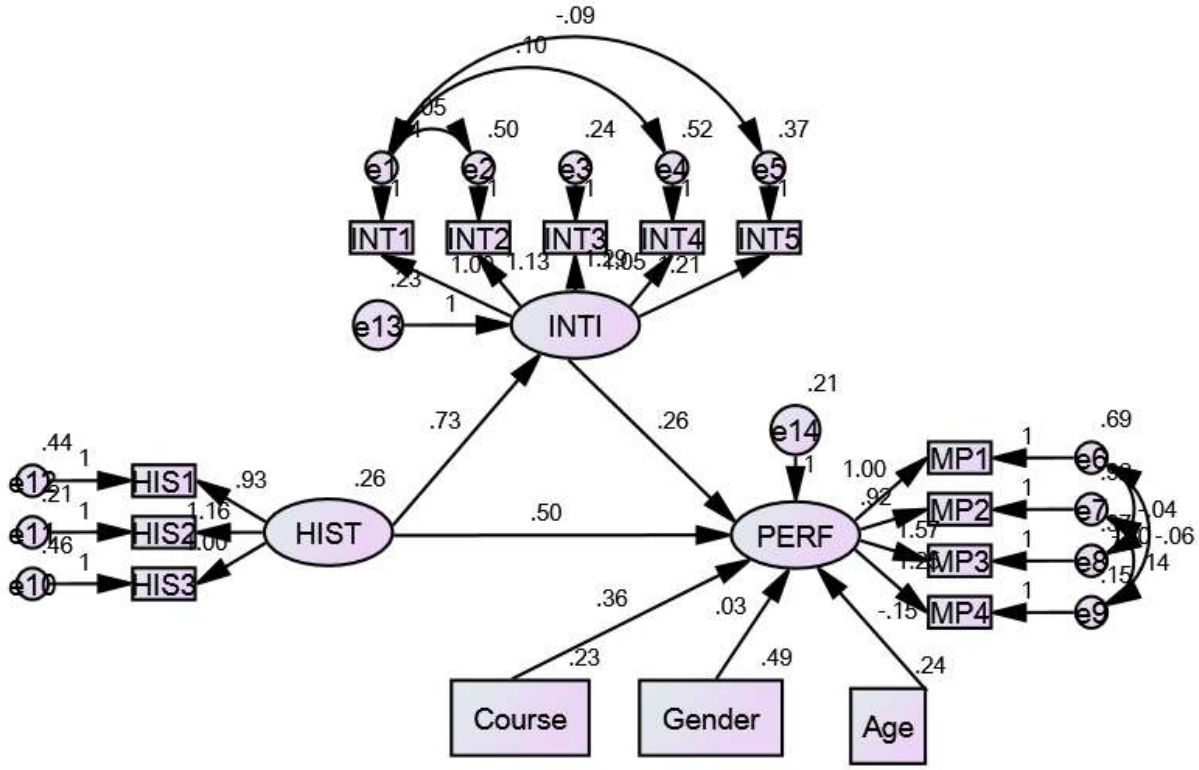

Figure 2. Structural Paths

Discussion

Some empirical studies in the past have assessed the use of mathematics history as a pedagogy tool. However, most of these studies have been exploratory in nature, with limited attention on how it directly affects students' performance (Florio, 2020; Tan-Şişman & Kirez, 2018; Zengin, 2018). Tan-Şişman and Kirez (2018) conducted a content analysis of 5th to 8th Grade mathematics curriculum and textbooks, and found no mention of the history of mathematics in the content and assessment sections of the curriculum, with textbooks also placing less emphasis on history of mathematics. The present study being explanatory in nature, identified that history of mathematics had a direct positive effect on the performance of senior high school students in mathematics. That is, when teachers introduce mathematical concepts by providing the history behind the concept, students enjoy the lesson, thereby paying more attention in class. This significantly affects students' understanding in mathematics and subsequently their overall performance in the subject (Bütüner & Baki, 2020). Costa et al. (2021) conducted a study on teacher trainees, and found that the teaching of history of mathematics enhanced the connections between mathematics and reality, enhanced the understanding of mathematical content, and promoted the development of

transversal skills. The adoption of history of teaching also facilitated the understanding of how mathematics connects with other subjects studied.

The study found the use of mathematics history as a pedagogy tool, to positively influence students' interest in mathematics subject. Providing history behind mathematics concepts makes class interesting, as students are able to better connect to what is being taught. Costa et al. (2021) identified that the adoption of history of mathematics enhanced students' memories of concepts being taught. Florio (2020) studied the possible path from geometry to symbolic algebra, using history of mathematics. It was identified that the adoption of history of mathematics as a pedagogical tool, helped to translate the mathematics problem from "spoken" algebra to "symbolic" algebra. This makes it possible to adapt same mathematics problem in the context of analytic geometry, making it easier and more interesting to learn the concept. Bütüner and Baki (2020) conducted an action on the adoption of history of mathematics in teaching of mathematics, and found that before the introduction of history of mathematics as a pedagogical tool, students regarded mathematics as a branch of science which is not open for further development. After the introduction of history of mathematics in the teaching of mathematics, students appreciated that mathematics is open to development, and is useful for solving everyday problems. Students identified mathematics as interesting and fun, as the use of history of mathematics promoted active problem-solving. Having interest in learning mathematics, enjoying the study of mathematics, and being interested in self-studying mathematics, have a significant influence on the performance of students in mathematics. Arthur 2022 found that among university students, mathematics study interest (among other variables) had a direct positive effect on the performance of students in mathematics. Interest enhanced students' participation during mathematics lessons, enhanced students' participation in group studies, enhanced students' ability to self-learn mathematics, and enhanced performance in mathematics examinations. Studies (such as, Lazarides et al., 2021; Fauth et al., 2019), have also established the effect of interest on mathematics performance among students.

The study further identified mathematics study interest to partially mediate the relationship between history of mathematics and mathematics performance among senior high school students. A study by Förtsch et al. (2017) found a significant relationship between cognitive activation and students' situational interest. It could therefore be deduced that teaching mechanisms (such of history of mathematics) which enhanced cognitive activation are

essential in mathematics classroom. Mathematics learning interest has been established to also influence performance in mathematics (Lazarides et al., 2021; Arthur et al., 2018; Fauth et al., 2019), which therefore means that, whiles mathematics history of mathematics has direct effect on mathematics learning interest, the learning interest also led to achievement in mathematics by students. The effect of history of mathematics on students' mathematics performance, could therefore be achieved through the effect of mathematics learning interest.

Implications

As a managerial implication, the study recommends to Ghana Education Service and the Ministry of Education, to inculcate the history of mathematics as a pedagogical tool in the senior high schools. This must begin by equipping teacher trainees at the various tertiary institutions, with the required knowledge on the histories behind the various concepts taught in mathematics. When these trained teachers are able to impart the history of mathematics knowledge acquired to the senior high school students they teach, it could help improve students' performance in mathematics during the WASSCE. History of mathematics as a novel pedagogical tool requires learners to engage with mathematics in a deep and meaningful. Adopting history of mathematics helps students to see and communicate mathematics within the world at large. Students are able to connect mathematics concepts to real-life scenarios, enhancing problem solving in real-world. Students can also connect mathematics to other subjects being taught. Braun and Kahn (2019) for example identified that students are usually surprised "*to learn that the people who made profound contributions to the field of mathematics struggled with understanding and developing their own theories and solutions, at times making mistakes*" (p. 322). Providing students with such historical knowledge will help them understand that with determination and consistency, they could also perfect their knowledge and skill in mathematics.

Conclusion

The study sough to explore the mediating role of mathematics study interest, in the relationship between history of mathematics as pedagogy tool and performance in mathematics of senior high school students. The study was based on 388 senior high students selected from four senior high schools in Ashanti region of Ghana. After the model estimation by SEM, it was concluded that the use of history of mathematics had a significant

positive effect on mathematics performance of senior high school students. Similarly, history of mathematics had a significant positive effect on mathematics study interest. Also, mathematics study interest had a significant positive effect on mathematics performance of senior high school students. Finally, the relationship between history of mathematics and mathematics performance of senior high school students was partially mediated by mathematics interest.

Limitations and Future Research Suggestions

The present study adopted a survey approach, by administering questionnaire to assess whether or not, students had their mathematics teachers introducing mathematics concepts by providing the history behind those concepts. Statistical analysis was run to ascertain how students' exposure to history of mathematics, influenced their performance in mathematics. Although this methodology is sound, it was recommended that future studies should replicate this research by adopting action research. Action research will be a practical way of assessing the impact of history of mathematics on the performance of students in mathematics.

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Chapter 9 - Integrating Community Leadership and Social Innovation in the University Curriculum: A CLASIC Approach

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Chapter Highlights

- Colleges and universities have consistently re-invented themselves to stay relevant and keep ahead of the competition to meet industry needs and social expectations.
- While a college or university degree is still highly valued by employers, and college or university graduates typically earn higher starting salaries, these advantages become less prominent in places where graduates are more commonplace, such as in Singapore.
- Employers start to look at other qualities, competencies, or experience.
- This chapter shares the educational goals of a young, applied learning university in Singapore - the Singapore Institute of Technology – and the pedagogical approaches and initiatives it adopts in developing and nurturing students to be both industry-ready and socially aware and attuned.
- This is done through social innovation projects undertaken by the faculty and students, curated by the newly established Community Leadership and Social Innovation Centre (CLASIC) in the University.

Introduction

The higher education landscape has undergone significant changes in the past few decades. These changes encompass: the industry-relevance of our university degree programs and the industry-readiness of our university graduates; the creation of more inter-disciplinary learning opportunities for our university students; having a more diverse social and geographical composition of the student body; growing demands by stakeholders on the value of education vis-à-vis financial costs and tuition fees; and the introduction of information technologies in teaching and learning (Henard & Leprince-Ringuet, 2008; Or, 2022; Öztürk et al., 2021; Sagbas & Koc, 2021). The abovementioned changes have dominated conversations surrounding higher education and the consequent strategic decisions universities make.

The current global COVID-19 pandemic has also accelerated the digital transformation of universities, particularly in teaching and learning (Van der Spoel et al., 2020). The global pandemic has jumpstarted the digital transformation process envisioned to take place over 5 to 10 years, to over just a matter of months (Amazon Web Services, Inc., 2020). New technologies are increasingly demonstrating how student outcomes can be enhanced, make teaching more effective, and drive collaboration and engagement among faculty and students. It is then incumbent upon universities to ensure that the higher education landscape and structure continue to evolve to meet shifting and diversifying expectations around how education is delivered and how students want to engage in learning (Matthews, Garratt & Macdonald, 2018; Öztürk, 2017; Türe & Ozturk, 2021).

For instance, "the education system must ensure that current workers can benefit from new developments, while also enabling new generations of entrepreneurs to become reflective and innovative and to create new businesses that operate sustainably in a global world." (Orr, *et al*, 2020, p. 9). In other words, authentic or applied learning that establishes strong links and applications to future workplaces or future work-related social groups would be increasingly important. Such authentic or applied learning opportunities would need to be created and integrated into the undergraduate curriculum.

Among the ideas mooted on the characteristics and features of a university is that by Barnett University (Orr, *et al*, p. 23). Here, Barnett describes three types or visions of any university: (i) the research university – which exists "in itself," i.e., for science and to add to the existing

body of knowledge; (ii) the entrepreneurial university – which exists "for itself," i.e., to support a particular company or the industries in general; and (iii) the ecological university – which exists "for others,", i.e. being open to all and open to the world.

According to Barnett, the approach that a university must take is to place students at the core of its system, surrounded and linked to appropriate higher education resources that meet their learning needs. This approach also emphasizes the inclusion of social contexts, such as the higher education environment and the communities that students would come into contact or interact with, and would involve some form of *social innovation* – that is, how social processes can be reconfigured and improved to achieve better social outcomes not only for the beneficiaries but also for society at large, and effective learning goals for the students involved.

This paper shares the educational goals of a young, applied learning university in Singapore (i.e. the Singapore Institute of Technology), which has positioned itself as an entrepreneurial and ecological university, based on Barnett's description. This paper also showcases the pedagogical approaches that the University adopts in developing and nurturing our students to prepare them to be both industry-ready and socially aware and attuned, through examples of social innovation opportunities and projects done by the University faculty and students.

Educational Pillars of the Singapore Institute of Technology

The Singapore Institute of Technology (SIT) was first founded in 2009 and officially established (through a bill enacted in parliament) as an autonomous university in 2014. SIT advocates the work-learn continuum and strives to instil in our students a culture of lifelong learning and continuous upskilling and reskilling (Singapore Institute of Technology, 2021a). The University does this through the cultivation of four distinctive traits that form what is known as the SIT DNA (Figure 1): (i) **Thinking Tinkerers** - stems from the way that students are trained, where they learn by doing, while being able to think on their feet and address problems or challenges that emerge; (ii) **Able to Learn, Unlearn and Relearn** - hinges on the premise that what our students learn today may not be relevant or current by the time they graduate. Hence, it is important for our students to be ready and open to learning that occurs throughout their lifetime, which involves deconstructing what they know, and learning new things; (iii) **Catalysts for Transformation** – this trait emphasizes the need for

students to initiate and lead change in their workplace or in the communities they are in, by creating value through innovation, not to be afraid to take calculated risks and to be open to learning through failure; and (iv) **Grounded in the Community** - serves to remind students that their skills and knowledge can create positive social impact in society and the communities they live in and work with, and that they should put those skills and knowledge to good use to benefit as many people as possible.

Figure 1. The Four SIT DNA

SIT incorporates a unique pedagogy of **applied learning** in the university curriculum. The applied learning pedagogy is demonstrated through the Integrated Work-Study Program (IWSP), where (i) under the IWSP, students are immersed in companies and industries for a period ranging from 9 to 12 months, learning on the job; and (ii) under the applied learning and research curriculum, students work on real-world industry problems, where they can apply their relevant skills and knowledge learnt from their academic training, to create solutions that meet the industry needs (Singapore Institute of Technology, 2021a). Thus, by working closely with the industry, students gain relevant insights and experience, preparing them to emerge as future specialists in their respective fields of expertise.

Another educational pillar in SIT is **interdisciplinary learning**. With the harmonization of the undergraduate programs in the University, interdisciplinary learning constitutes a graduation requirement for all undergraduate students starting from the intake cohort of the academic year 2022. This is planned through 2 mandatory modules: (i) Interdisciplinary Design Innovation; and (ii) Social Innovation Project (which requires students to work in interdisciplinary teams). In addition, a 'whitespace' timeslot on Wednesday afternoons is

created in the university curriculum to allow this interdisciplinary work to take place where students and faculty can have a common time and space to discuss and explore interdisciplinary projects and initiatives.

The other educational pillar in SIT is **digital competencies** that emphasize using technologies to facilitate teaching and learning. Being a university of applied learning and bearing 'technology' in its name, SIT has taken deliberate steps to incorporate and enhance new technologies in its curriculum and programs. For instance, the University's Centre for Learning Environment and Assessment Development (CoLEAD) has established a new unit, Educational Technology, to "harness new technology solutions that are suitable and aligned to the university's educational needs; (and) develop and run programmes (digital and face-to-face) for students to develop skill sets and traits to learn better" (Singapore Institute of Technology, 2021b). In addition, a new center (Centre of Digital Enablement or CoDE) was established to plan and coordinate digital and data literacy skills for students to ensure that they acquire the necessary digital competencies before they graduate. This is planned through the new mandatory module known as Digital Competency Essentials, which all Year 1 undergraduates would need to complete as part of their graduation requirement.

Having these educational pillars in the SIT curriculum is important in ensuring that our students and would-be graduates develop the requisite skills and knowledge and have the relevant experience to help them be industry-ready. However, being industry ready is only half of what we hope our university graduates will be. We want them also to be aware of and understand social issues and challenges; be able to put their discipline-specific and professional skills, knowledge, and experience to use; and come up with innovate solutions to address some of these social issues and challenges. We want our university graduates to be socially aware and attuned, be able to exercise leadership in the community they are involved, and create positive social impact, which will, in turn, inform and shape their professional practice.

Preparing our Graduates for Society and the World

Numerous university graduate surveys have shown how university education is highly valued by employers and business leaders (Flaherty, April 2021). Thus, university graduates generally can earn higher starting salaries (Lim, Oct 2021). However, in places where the

number of university graduates becomes more commonplace, such as in Singapore, employers start to look for and consider other competencies and experience, beyond just paper qualifications or academic attainment (Chamorro-Premuzic & Frankiewicz, 2019). Among the critical skills employers value most are soft skills such as people skills (culture fit, empathy, collaboration, and communication), and personal skills such as adaptability, and growth potential and mindsets (Chamorro-Premuzic & Frankiewicz, 2019; Flaherty, April 2021; Lim, Oct 2021). Other skills that are highly valued by employers are digital competency, critical thinking, creativity and complex problem-solving (Deloitte, LLP, 2015, p. 2; World Economic Forum, 2021, p. 5).

Soft skills or characteristics such as empathy, teamwork and collaboration, culture fit, communication, creativity, and complex problem-solving can be developed and honed through engagement in real-world communities. For instance, "technology development in itself is predicated on humans being able to observe society, identify problems that require technological solutions and design and build these solutions." (Lim, Oct 2021). As Fredua-Kwarteng (2017) explained, "…students could make significant contributions to their society if they possessed a deeper understanding of that society and were armed with suitable tools for problem-learning, problem-solving and continuous improvement". He termed this a *pedagogy of connection* to society. The philosophy underpinning this pedagogical instruction is that it is "…intimately connected to society, its problems, challenges, culture and language, demographics, economy and institutions." Hence, in SIT, we strive to create opportunities for our students to apply their learning, skills, and knowledge in real-world situations or community-related initiatives and projects. The Community Leadership and Social Innovation Centre (CLASIC) was born out of the desire by SIT to create opportunities for our students to understand societal needs better. This aligns with the University's focus on applied learning and creating opportunities for social innovation in the wider community. CLASIC was formed on 1 October 2020.

One of the objectives in establishing CLASIC is to create opportunities that intentionally develop our SIT-DNA in the curriculum, including that of being 'Grounded in the Community'. These opportunities provide meaningful engagements for our students to apply their skills and knowledge to benefit the wider community. Through such opportunities, it is envisioned that our students will develop empathy and understanding of what they can do to create positive social impact. In addition, it is hoped these opportunities will inform and

shape our students' professional practice as they embark on their respective careers. In the next section, we showcase how the different educational pillars and the SIT DNA described earlier are integrated in community-related initiatives and projects that allow our students to exercise leadership in the community and create positive social impact through social innovation.

Community Leadership and Social Innovation Projects

Smart Water Meters for Low-income Households

One example of a social innovation project led by students in SIT was a curriculum-based module-integrated project where students are to design a prototype of a smart water meter to help low-income households monitor their water usage and thus better manage their water costs. This project was incorporated in the MEC2371 Specialized Engineering Project module under the area of Smart Design.

The motivation for the project was two-pronged. One, a water consumption survey carried out by Singapore's Public Utilities Board (PUB) in 2018/2019 found that for many households, "…shower, flushing, kitchen and laundry remained as the largest water consuming areas in households, constituting 77% of its total water usage." (PUB, 2020). The findings of this survey did not show improvement in water consumption rates and patterns from the earlier survey carried out in 2016/2017, despite continuous public education on water use and conservation.

Two, even though PUB already has a water meter program in place, these water meters are mechanical ones that require manual readings to be made. In addition, these mechanical water meters provide aggregated readings and data of water consumption for the entire household and not for individual water points within the household. Hence, this project would allow each household to monitor their water usage for each water point such as for showering, laundry (via the washing machine), kitchen sink, flushing, and so on. This would then help each household manage their water consumption behaviours in a more targeted and proactive manner.

A group of five students in SIT's Mechanical Engineering degree program embarked on this project, led by an Engineering faculty member in SIT. They visited a couple of public rental

flats to take measurements of the water points and engaged with the household members to understand their water consumption habits and patterns (see Figure 2 and 3). From the measurements made and information gathered, the students designed their smart water meter and made a few prototypes to testbed in 2 different locations – a bathroom in one of their own homes, and a public toilet in the University campus (see Figure 4 and 5).

This project has completed the prototype testing stage at the time of writing, and there are plans by the faculty lead to scale up the project and expand it to 20 households for the next phase of pilot testing. This would provide substantial data to look at (i) methods to improve the engineering design and functions of the smart water meter; and (ii) better understand household water consumption patterns and habits, with subsequent design of public education programs that can emphasise the importance and need for water sustainability in Singapore. The PUB found out about the project and expressed interest in learning more and exploring possible collaboration with the SIT project team.

Students involved in the project shared that the opportunity to engage with the households helped them better understand their water consumption habits and patterns of the household residents and some of the possible constraints in the smart water meter design and installation. The students also expressed that the opportunity to engage with the household members helped them develop a sense of empathy for specific members of society, such as towards the elderly or low-income households, and helped them to have a more grounded and user-centric approach in the engineering design of their smart water meter prototypes.

Figure 2. Visits to Rental Flats to Engage Household Members and Take Measurements of Water Points

Figure 3. Visits to Actual Flats allowed Students to Understand Space Constraints faced by the Household Members and Incorporate These Considerations When Finalizing the Measurements and Designs of their Smart Water Meter Prototypes

Figure 4. Prototype Testing in Project Team Member's Home

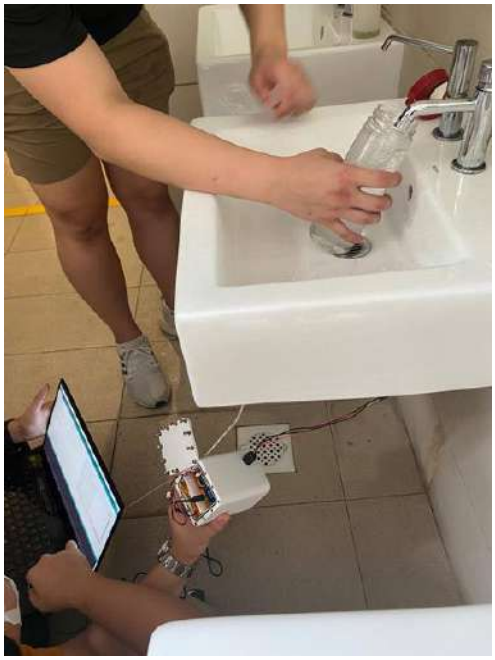

Figure 5. Prototype Testing in the University Campus

Gamification Design of Mobile Application on Healthy Eating for Pre-school Children

This project was first put forth by a non-profit entity in Singapore, which oversees the distribution of funds to support programs, schemes and initiatives targeted at pre-school children from low-income families, who attend a specific pre-school operator's chain of pre-school centers. The intent of this project was to develop a mobile application for the pre-school children (ages 5 to 6 years old) to be able to use, with their parents, to learn about healthy eating and good nutrition. When the project was proposed to SIT, an interdisciplinary team (from InfoComm Technology, Health and Social Sciences, and Food Technology) of SIT faculty (see Figure 6) suggested incorporating a gamified approach to this mobile application.

After several rounds of discussion, the interdisciplinary team decided to incorporate this project into one of the modules within the InfoComm Technology (ICT) programs in SIT (ICT4004 Design Thinking module). Students keen to do this project could complete it as their module assignment. Students from the Health and Social Sciences (HSS) Cluster and Chemical Engineering and Food Technology (CEFT) Cluster were invited to serve as advisers or consultants to the ICT student teams that decided to do this project as their module assignment. As advisors or consultants, students from the HSS and CEFT Clusters provided information and guidance from the perspectives of nutrition, and food safety and preparation.

Four student teams from the ICT4004 module took up the project as their module assignment. Over ten weeks, they had three meetings and presentations with the interdisciplinary SIT faculty team and the team from CLASIC, where they received advice on their plans, designs and content. In addition, the student teams also reached out to parents with young children on their own to better understand possible concerns and expectations parents may have in allowing their pre-school children to play such gamification mobile applications. At the end of the ten weeks, the students did an 'elevator pitch' (Figures 7 to 9) of their gamification design to the non-profit entity where the project idea originated from.

The non-profit entity was impressed with the gamification designs proposed by the student teams. The non-profit entity eventually selected two designs to proceed to the mobile application development stage. Four students from the two student teams with the selected

designs were keen to continue contributing their ideas for the development phase of the mobile application and working with the non-profit entity and a mobile application development company. Students involved in the project had expressed that through the process of engagement with parents with young children and the interdisciplinary composition of SIT faculty and students in this project, they had a better understanding and appreciation of content development and some of its expectations for gamification. The opportunities available to engage and learn from others outside of their own program of study proved to be useful and broadened their perspectives. In addition, in developing the gamification design for the intended mobile application, the students felt that they were able to draw on their skills and experience in gamification design to come up with something exciting and meaningful for pre-school children and their parents to use.

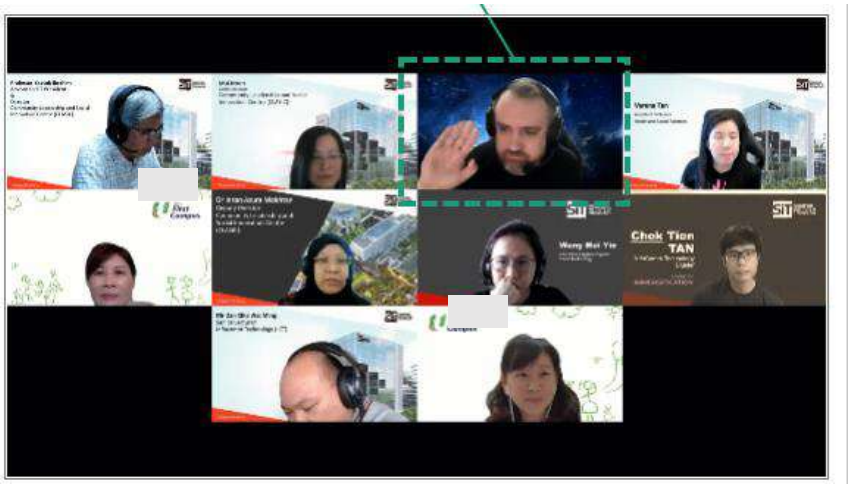

Figure 6. Interdisciplinary Team of SIT Faculty

Figure 7. Samples of Gamification Designs for the Mobile Application produced by the Student Teams

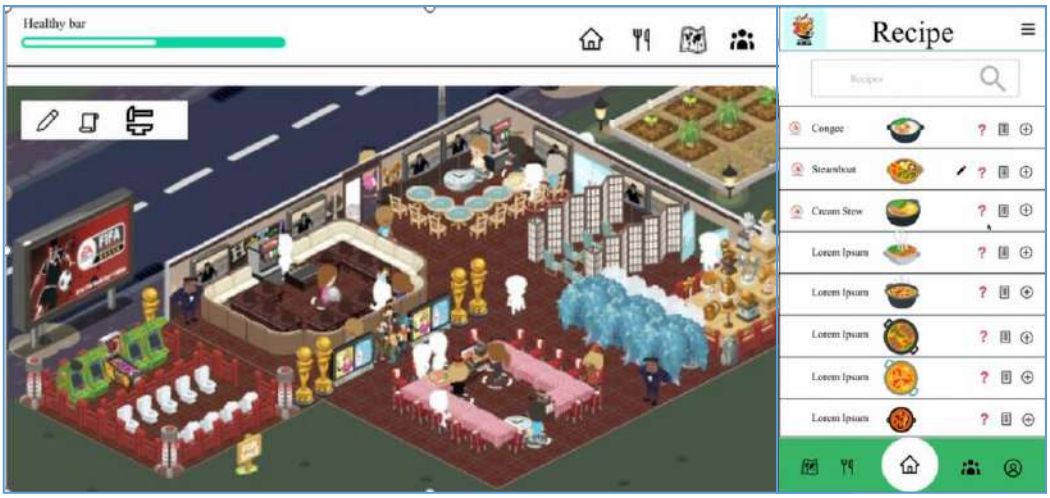

Figure 8. Virtual Restaurant and Social Recipes Sharing among the Gamification Elements Designed by Teams

Figure 9. A Game Designed to Allow Children to Take Care of a Virtual Pet by Making Healthy Meals, with the Inclusion of a Leaderboard

The Way Ahead

What SIT has done so far through the work of CLASIC and its social innovation projects identified and curated for SIT faculty and students, have been nothing short of inspiring,

meaningful and promising. As we learn from the pilot implementations of these social innovation projects that are opportunities for our students to create positive social impact and demonstrate community leadership, we strive to improve on what we have done.

One of the new initiatives we will implement is the inclusion of Student Reflective Practice in projects or initiatives undertaken and completed by our students. We wish for our students to reflect on their progress and the process of the project undertaken. That course of retrospection and introspection are useful for our students to reflect on how they had worked on addressing the social issues or challenges identified, how they have grown both personally and professionally, and future improvement to create positive social impact to relevant community beneficiaries. We are cognizant that learning is not just about academic attainment or achievement in the modules that our students do. Learning is also about the individual discovery and realization of how they have developed and grown.

While we wish to allow a more student-centric approach to self-discovery and learning, we also need to acknowledge students who do exceptional work in their social innovation projects, and who go above and beyond what was initially expected of them. With that in mind, we will be introducing awards for these students. These awards will have both a financial incentive and written recognition of the work done and achieved by the student award winners. We hope these awards will motivate students to continue with their projects that have distinct social impact and which demonstrate social innovation.

A third component that we will implement is the inclusion of the United Nations' Sustainable Development Goals (UN SDGs) in the project plans completed by our students and faculty members. Although each social innovation project done in SIT may not be able to address all seventeen of the UN SDGs, we want to create a level of awareness of the UN SDGs and how the project undertaken addresses some of the goals in the UN SDGs, such as *Goal 3: Ensure healthy lives and promote well-being for all at all ages*; *Goal 6: Ensure availability and sustainable management of water and sanitation for all*; and *Goal 11: Make cities and human settlements inclusive, safe, resilient, and sustainable* – which were actually addressed in the two social innovation projects presented earlier. Including the UN SDGs in the project plans will help the project teams to be more cognizant of how they could plan the process and better articulate the intended outcomes of their projects.

The work we do through social innovation projects in the University is still in its infancy, and

we are still learning how to do better with each project. Making those consistent steps to improve and do better involve much work - critical analysis, retrospection, and introspection, among others - but these are important for us to learn, grow, and create positive social impact and meaningful change in our society. Our work continues.

"*What you leave behind is not what is engraved in stone monuments, but what is woven into the lives of others.*"

— Pericles

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Chapter 10 - Scientific Production and Science Policy in Kazakhstan: A Survey Study

Diana Amirbekova, Meruyert Kussaiyn, Timur Narbaev

Chapter Highlights

- This study investigates existing characteristics, problems, and opportunities for conducting research in higher education institutions in Kazakhstan.
- We conducted a structured survey involving 117 researchers and faculty members.
- Among the significant characteristics in the recent past, we note stagnant financing of academic research and that qualified researchers are essential for boosting scientific production.
- The problems that hinder scientific productivity are bureaucracy, lack of international collaboration, and the English language barrier in publication writing. Among the opportunities to accelerate scientific activities, the respondents noted growing research internships and the recent changes toward a comprehensive scheme of science financing by the government.
- The findings and implications from this study can be helpful for researchers and policymakers in higher education and science in emerging countries that face similar challenges in boosting their scientific production.

Introduction

One of the main characteristics of a country's development is the growth of its scientific production and quality of research outcomes. Scientific production grows with academic globalization, making research in such fields as scientometrics and research policy critical. These fields investigate essential characteristics and directions in science development overall (Gasparyan et al., 2018; Silva et al., 2019; Jack et al., 2021) and in a given discipline (Narbaev et al., 2020; Öztürk et al., 2021; Öztürk & Demir, 2021; Rossetto et al., 2018; Uyar et al., 2022).

In this respect, the scientific output of faculty members of higher education institutions (HEI) plays an essential role in developing these fields. It contributes to the researcher's professional capacity building (Wald & Harland, 2017), which improves the educational system in general (Hajdarpasic et al., 2014). It also contributes to the professional development of educators (Brew, 2010).

The 2017 report by the Organisation for Economic Co-operation and Development (OECD) on higher education in Kazakhstan points out that while the "higher education system is at the forefront of the country's economic diversification challenge" (p.3), the research should achieve a level that can impact economic growth (OECD, 2017). The focus on research capacity building in HEI would force the development of the country's economy. We see an increasing interest in such studies in Kazakhstan (Amirbekova, 2016; Narbaev, 2015b; Zhanbayev et al., 2020; Kuzhabekova and Ruby, 2018) and other emerging markets (Wang et al., 2015; Mukhtarova et al., 2019; Orazalin et al., 2019) that use empirical or scientometric data.

In this regard, research activity is becoming an essential tool in the country's development. Policy initiatives by the government can have a major positive impact on research productivity, patent growth, improved economic performance, and developed scientific infrastructure (Xia et al., 2020; Laverde-Rojas et al., 2019). Moreover, several studies suggest the crucial importance of spending on research and its correlation to the development of science, collaboration among local and foreign researchers, and overall research internationalization (Ahn et al., 2019; Bouabid et al., 2022).

We conduct the current study to understand the current state of conducting research in Kazakhstan and provide valuable insights into its main characteristics, problems, and opportunities. We surveyed local researchers and faculty members of HEI in an attempt to find solutions to the following questions:

1. What are the characteristics and problems of conducting research in Kazakhstan?
2. What are the main opportunities to further improve the "doing research" and its environment in Kazakhstan?

The following section describes our approach, including data collection and the analytical methods used. Then, we present the results and major findings. After, we discuss the main characteristics, problems, and opportunities for performing research activities. Lastly, we summarize our study and provide recommendations for future research.

Methodology

We conducted a survey to identify existing characteristics, problems, and opportunities for conducting a research activity among HEI's researchers and faculty members. Our questionnaire consisted of two sections. The first section included 13 questions to reveal the profile of respondents. The second section had 19 questions to examine the opinion of scientists on the characteristics, problems, and opportunities of doing research in Kazakhstan. This section comprised three blocks: a description of the current state of doing research (addressed by the Block 1 questions), problems (addressed by the Block 2 questions), and opportunities (addressed by the Block 3 questions). The anonymous survey was conducted online from May to July 2021 and, on average, took about 12 minutes to complete. We collected 117 responses from the researchers and faculty members working in HEI.

Results

Profile of Respondents

Of the 117 respondents, 71% were female, and 29% were male (Figure 1). In terms of the age of the respondents, the majority were in the age group of 31-40 years (34% of respondents) and 41-50 years (29% of respondents) (Figure 2). Regarding research-related job experience, 70% of respondents had more than ten years, 24% - had 6-10 years, and the remaining had less than six years.

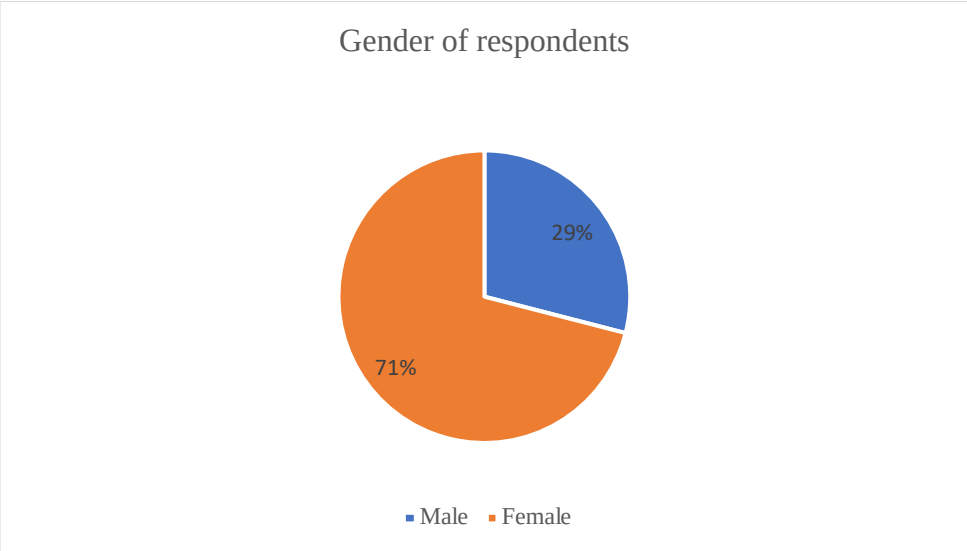

Figure 1. Gender of Respondents

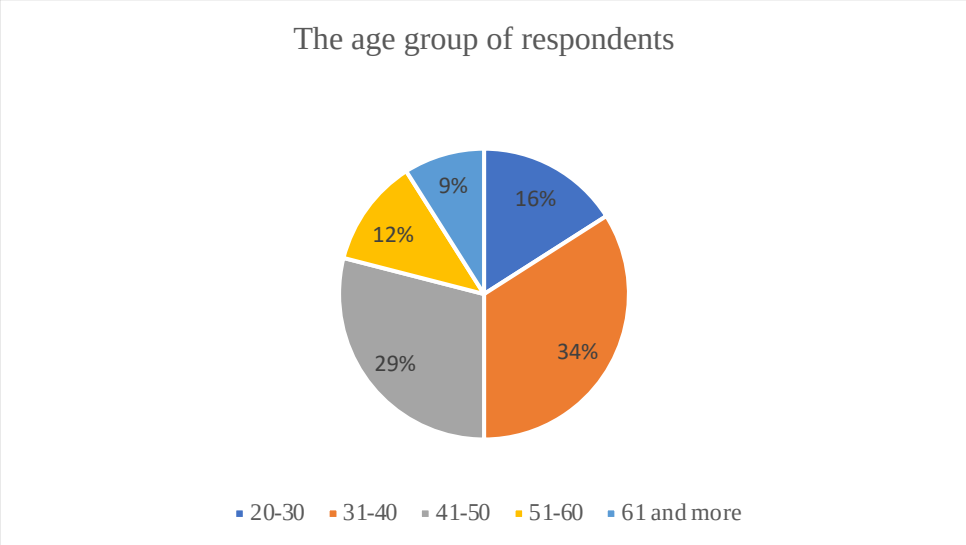

Figure 2. The Age Group of Respondents

For the question, if they had the experience of participating in the implementation of scientific projects funded by the Ministry of Education and Science of the Republic of Kazakhstan (MES RK), 49 respondents answered that they had no experience of participating in such projects, 45 noted in 1-3 projects, 12 in 6 projects or more, and 11 in 4-5 projects (see Figure 3). When asked if they had the experience participating in the implementation of foreign scientific projects, 66% of respondents answered that they had no experience in participating in foreign projects, and 34% indicated that they had the experience in participating in foreign projects (Figure 4). This implies the importance of international collaborations in doing research in Kazakhstan.

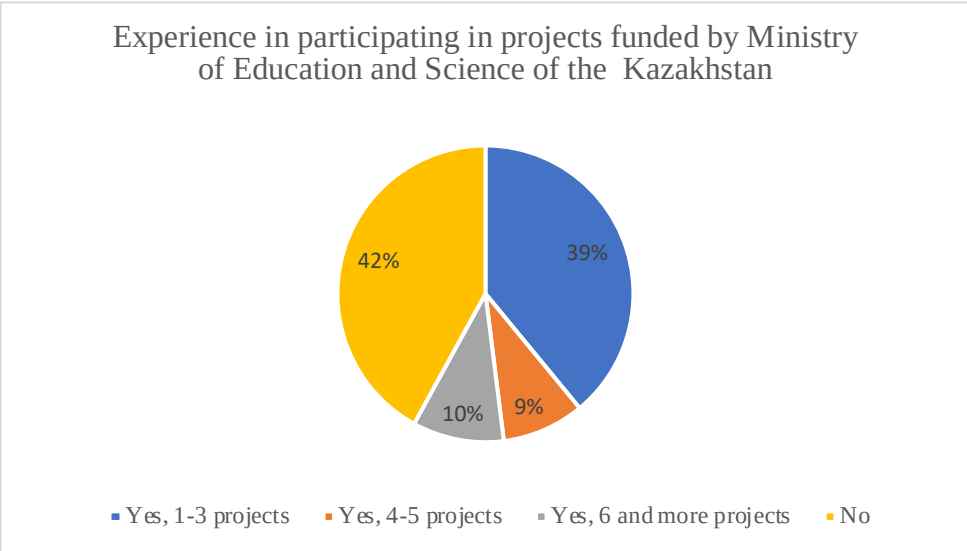

Figure 3. Experience in Participating in Projects funded by MES RK

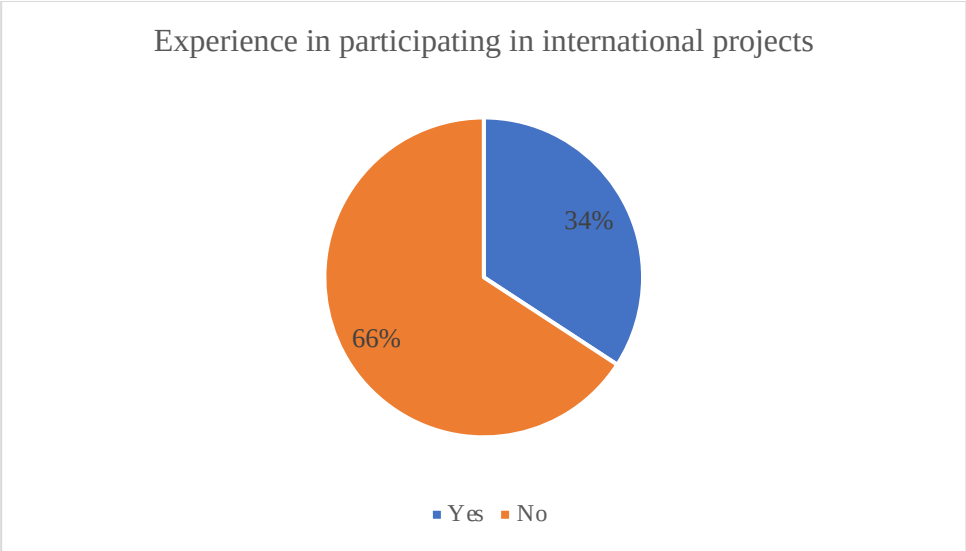

Figure 4. Experience in Participating in International Projects

The survey showed that 45 experts did not have publications in the Scopus-indexed journals, whereas more than half of respondents (72) answered that they had such publications. Seventy respondents indicated that they had no publication in the journals indexed by the Web of Science (WoS). The remaining 47 respondents had one or more publications in the WoS-indexed journals.

Main Characteristics of Doing Research (Block 1 Questions)

This part of the questionnaire targeted to reveal the characteristics included the questions

related to the level of research financing in Kazakhstan, the level of government support in collaboration with foreign researchers, the main factors influencing researchers to publish in local or foreign journals, and the effect of COVID-19 on research activities. It also described what motivated researchers to publish. This part helped collect information about the current situation in HEI.

The validity of the survey responses is crucial to ensure that study results and their interpretations are meaningful. To check for this, we used three tools. We used a histogram and a normal probability plot to verify the normality of the collected responses. The first tool, a histogram of the sample data, identifies the frequency of responses across current research characteristics. According to Narbaev (2015a), the data distribution should be bell-shaped to show the normality. The second tool, the normal probability plot (Chambers et al., 1983), is a graphical tool for assessing if the data is approximately normally distributed. It is used to assess the normal distribution of any numerical data. Then, we used Cronbach's alpha statistics. This statistic assesses data reliability by comparing the amount of shared variance among the items to the amount of overall variance (Collins, 2007). The Cronbach's alpha is made up of Likert-type items and is commonly used to measure the consistency of surveys with numerical data. As Robert (2005) describes, the higher coefficient alpha is achieved if items are more strongly associated with each other. So, we used this method to show the relationship between survey outcomes.

As shown in Figure 5, the histogram result shows bell-shaped data distribution. Also, our normal probability plot (see Figure 6) shows that the data are around an ideal straight line which implies the normality of our data. Departures from this straight line display departures from normality. The results explain that the given normal distribution is a good model for this data set. For the Cronbach's alpha test, the obtained results showed that the alpha is 0.97. Richard (2005) identifies that if the alpha is 0.9 or higher, the internal consistency of this questionnaire is considered "Excellent." According to Collins (2007), if the data is reliable, the covariance among the variance items should be significant. So, our alpha implies that the items which impact the research development are highly correlated with the overall research level. We note that we used the tools to check the questions with numerical answers, part of Block 1 of the questionnaire. We did not conduct such statistical tests for Blocks 2 and 3 of the questionnaire as the responses were not numerical.

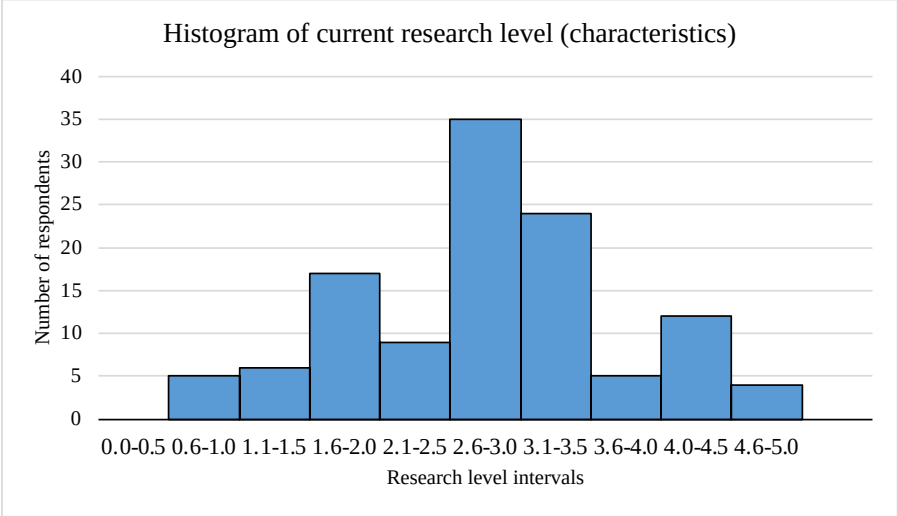

Figure 5. Histogram of Current Research Level

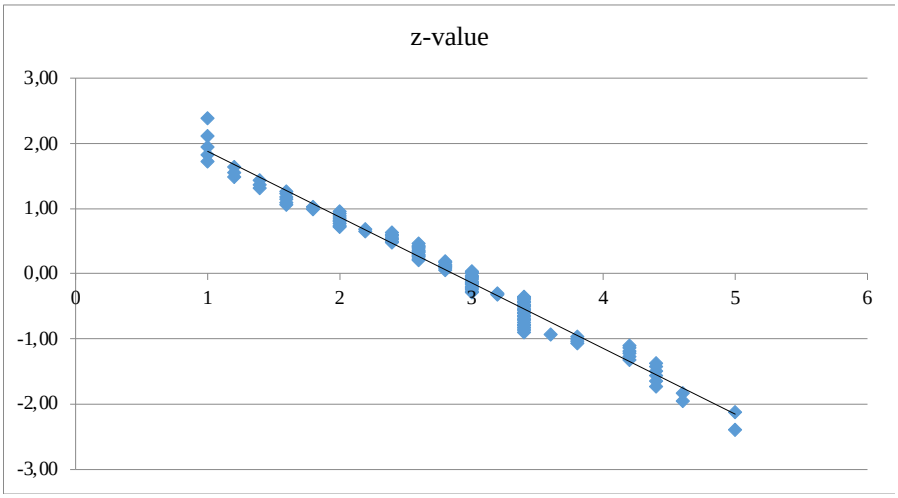

Figure 6. Normal Probability Plot of Research Level

The survey results showed that the current state of conducting research and publishing articles in Kazakhstan is on the average level (Appendix). Almost all participants equally assessed the impact of COVID-19 on research and publication activities. COVID-19 had a moderate impact on scientists' research and publication activities. Most experts believe that conducting research in Kazakhstan requires the organization of a scientific system by the state and state funding of scientific research. Respondents rated the level of state support for Kazakh scientists in collaboration with foreign scientists as an average. The main factors which motivate them to publish in local and foreign journals (indexed in the Scopus and WoS databases) are the fulfillment of their annual work plan, obtaining the title of associate professor/professor, and the possibility of participating in grant funding. It shows that the reason for publishing in local and foreign journals is the same for most of the respondents.

Main Problems of Doing Research (Block 2 Questions)

The questions in this block of our questionnaire are targeted to understand the researchers' opinions on the existing problems of doing research. As the literature shows, some barriers to doing research in higher education also can affect the research performance (Borg & Alshumaimeri, 2012; Xu, 2014; Yuan & Lee, 2014). Such kinds of barriers were identified in this part of the survey. This section consisted of 9 questions that helped identify researchers' main issues in conducting scientific research. It included factors that negatively impact the research grant application stage, research project execution stage, research activities during COVID-19, collaboration with foreign researchers to conduct research, and the problems associated with publishing in different local and international journals. The sample of these questions is listed below:

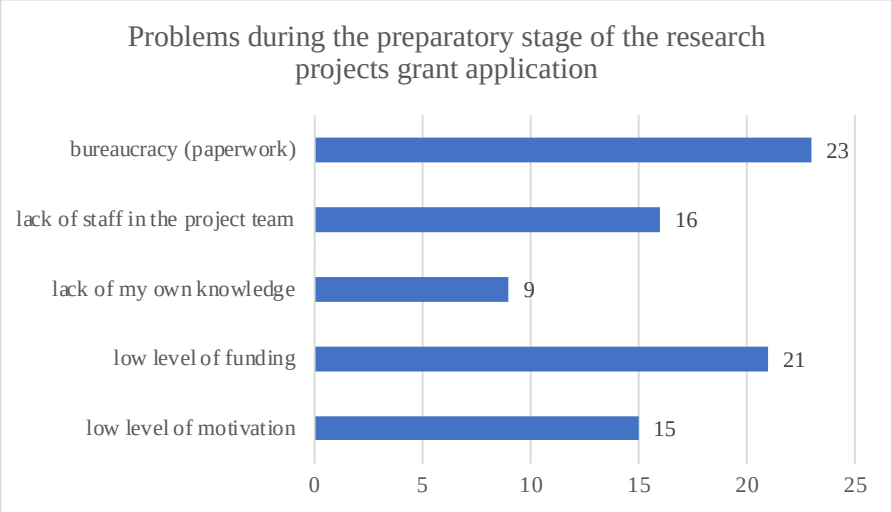

Figure 7. Problems during the Preparatory Stage of the Project Grant Application

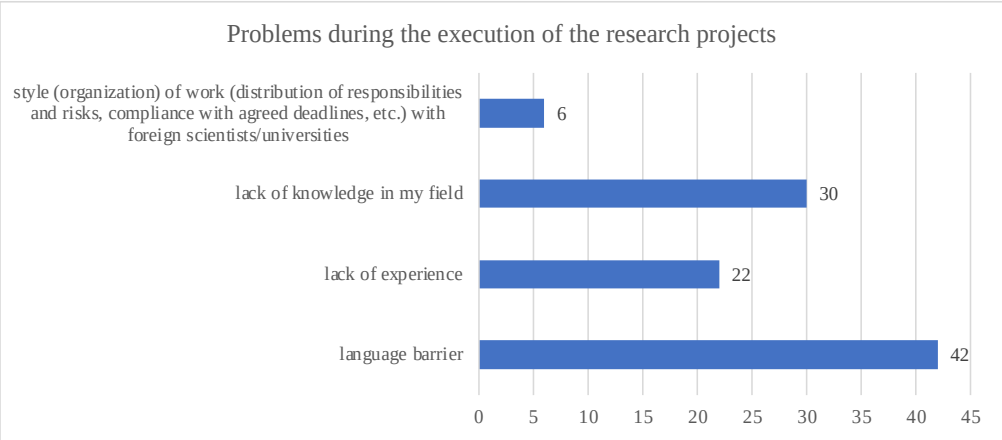

Figure 8. Problems during the Execution of the Projects

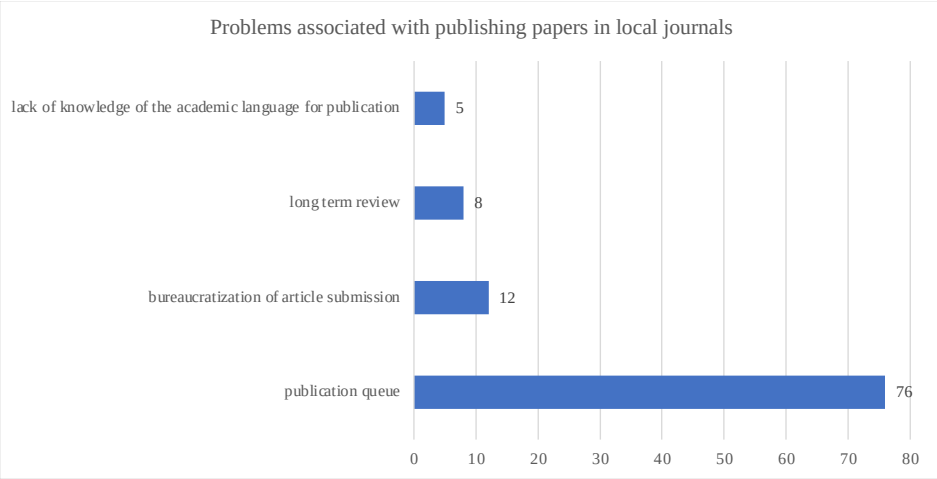

Figure 9. Problems associated with Publishing Papers in Local Journals

Figure 10. Problems associated with Publishing in International Journals

According to survey results, the most critical problem during the preparatory stage of the research project grant application is bureaucracy (Figure 7). It shows that our researchers tend not to apply for grants or get involved in activities related to grant funding because of the paperwork. Twenty-one respondents mentioned that the current level of funding is low. The main problem during the execution of a research project is the language barrier when working with international researchers (Figure 8). Respondents mentioned that lack of knowledge in their field (30 respondents) and lack of experience (22 respondents) are barriers that affect the successful implementation of projects. The rest of the responses answered that work style and approach (distribution of responsibilities and risks, compliance with agreed deadlines, etc.) with foreign scientists/universities make it difficult to run the research projects. Half of the respondents mentioned a long queue in publishing research work in scientific journals as one of the critical problems in publishing their works. Some respondents answered that the

bureaucratization of the article submission and long review process also created problems when preparing articles in such journals. The survey results are shown in Figure 9 and Figure 10. This part of the research identifies the main issues that negatively impact scientists' research activities in Kazakhstan.

Main Opportunities for Doing Research (Block 3 Questions)

This section of the survey described respondents' opinions on research and scientific productivity opportunities in Kazakhstan. It helped to identify the main ways to develop the research in Kazakhstan. This block consisted of four questions to describe the steps needed to solve the problems or difficulties associated with conducting research in the country. The results are presented below:

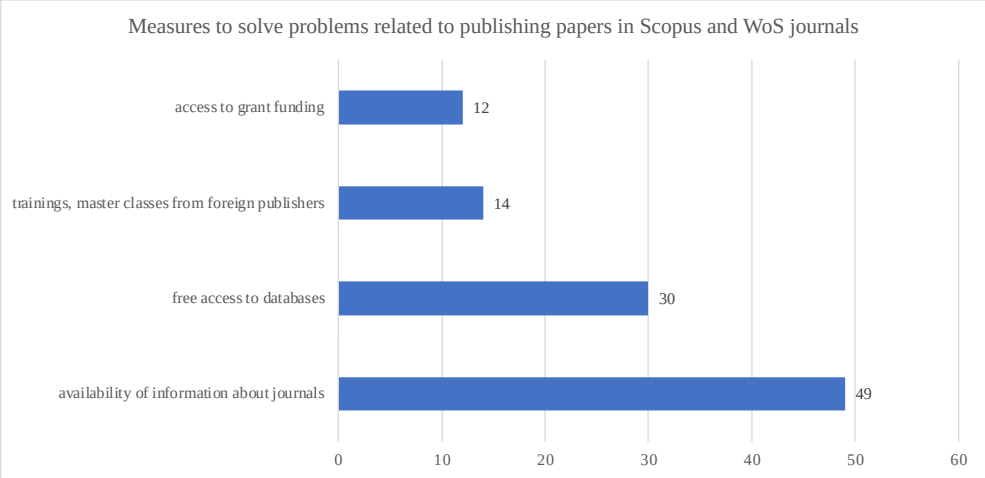

Figure 11. Measures to Solve Problems related to Publishing Papers in Scopus and WoS Journals

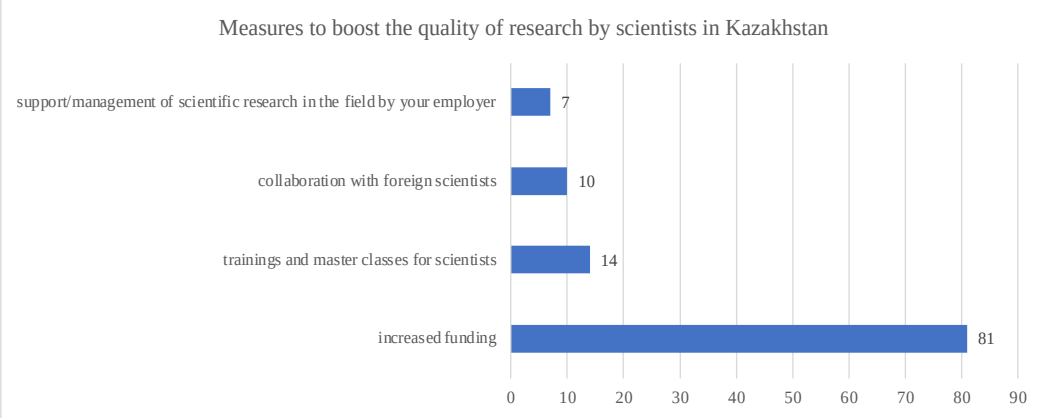

Figure 12. Measures to Boost the Quality of Research by Scientists in Kazakhstan

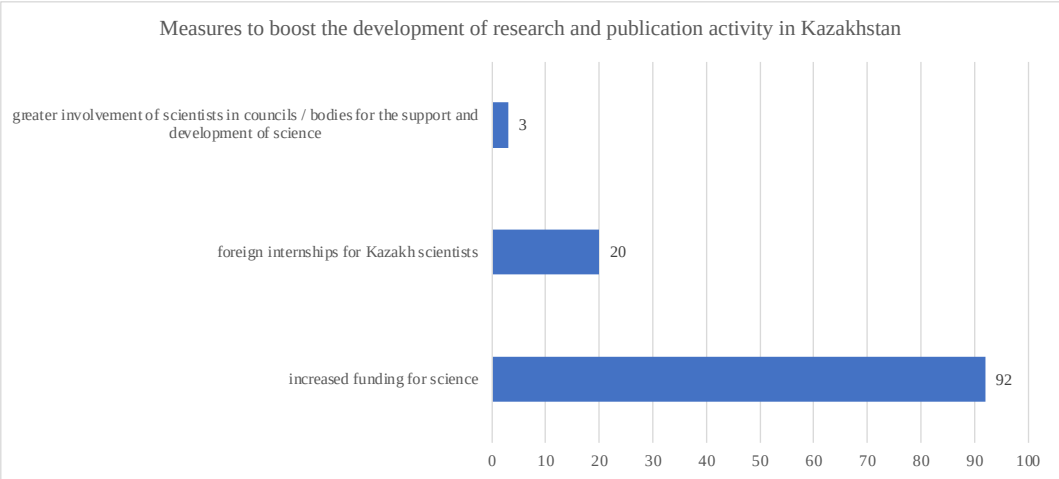

Figure 13. Measures to Boost the Development of Research and Publication Activity in Kazakhstan

Many respondents indicated the availability of information about journals as a solution to publishing in high-level international journals. Thirty respondents identified that free access to databases would allow researchers to publish in Scopus and WoS indexed journals. Other measures to solve problems related to publishing papers in such journals were training, masterclasses from foreign publishers, and access to grant funding (Figure 11). As shown in Figure 12, 81 survey participants answered that the increase in funding could help improve the quality of research conducted by local scientists. The remaining minority of participants answered that training and master classes for scientists (14 responses), collaboration with foreign scientists (10 responses), and the support of university management (7 responses) would also help to improve the quality of research. The survey results (Figure 13) showed that most respondents believe that increased funding for science (92 respondents) can accelerate the development of research and publication activities in Kazakhstan. Twenty respondents answered that the availability of foreign internships for Kazakh scientists also positively affects their research and publication activity development.

Discussion

The survey findings indicate major characteristics, problems, and opportunities for conducting research in Kazakhstan. Among others, we found consistency in answers related to conducting research and publishing papers, scientific funding, and the effect of COVID-19 on publication and research activities. This suggests that the overall experience of scientists in HEI is similar, despite the geographic location in the country, research area, and age.

The survey results related to the existing problems (Block 2 questions) suggest that bureaucracy and a low level of funding are considered major problems during the preparatory stage of the grant application. Although, during execution, internal problems of a research group are indicated, such as language barrier when working with international partners and lack of knowledge in research fields. This suggests that problems could be divided into two categories when conducting research. First, those related to the external environment are mostly related to funding availability and the application process. And those issues related to the internal environment might negatively affect a research team's experience when applying for grants. The results also suggest problems related to the publication process in local and international journals, such as the peer-review and publication queue.

The analysis of the responses to the Block 3 questions suggests that the HEI environment is the main factor in providing better opportunities for scientific productivity in Kazakhstan. The availability of information from journals, free access to databases, training, and masterclasses from foreign publishers are considered the internal environment in HEI and a measure to solve problems related to publishing papers in Scopus and WoS indexed journals. Increased funding, training, masterclasses for scientists, and collaboration with foreign researchers are among the most critical opportunities for local researchers to produce higher-quality research works. Among external measures to help improve the scientific production in the country is greater involvement of scientists in official councils and bodies related to science and the availability of foreign internships for Kazakhstan scientists.

Overall, we note that the findings of our survey can help design science policies and improve the research environment in HEI in Kazakhstan. Joint activities of HEI and the government could provide opportunities for scientists to conduct high-quality research, participate in international research grants, and cooperate with international researchers. The biggest challenge that we found is a creation of a comprehensive system that would stimulate and support the overall development of research in the country.

Conclusion

Research activities of faculty members play a vital role in higher education and its development. In this paper, using a questionnaire, we analyzed the current characteristics of, problems, and opportunities for doing research by local researchers in Kazakhstan. We

conducted a structured survey involving 117 respondents from HEI. We found a few characteristics that explained the local researchers' opinions on performing research activities. They are the organization of a scientific system by the government and the funding of scientific research, which the researchers noted as the main factors in boosting their research capacity. Also, they rated the level of government support in collaboration with foreign scientists as crucial.

Among the revealed problems of doing research was the paperwork in preparing research proposals for funding and the existing low level of funding. Also, the respondents noted the financing of foreign researchers' involvement and the process of contracting them as one of the crucial issues. In addition, most of the researchers noted that when publishing articles both in local and international journals, they experienced long peer-review and publication queues. Among potential opportunities were free access to databases, masterclasses from foreign publishers, and access to grant funding to publish in Scopus and WoS indexed journals. It was noted that the increase in funding helped to improve the quality of ongoing research in Kazakhstan. The respondents noted that the increased funding and foreign internships would contribute to the development of international collaboration and would accelerate the development of their research and publication activities.

Recommendations

The findings of our study will be helpful for the local and international research community. The findings and implications from this study can be helpful for researchers and policymakers in higher education and science in emerging countries that face similar challenges in boosting their scientific production. Among suggested future research are the comparative analysis with other emerging countries (benchmarking), in-depth interviews with the government representatives to understand the support of science from the top-down, and investigation of the contributions of research institutions under the Academy of Sciences (in addition to HEI) to the overall scientific production of the country.

Acknowledgements

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Appendix

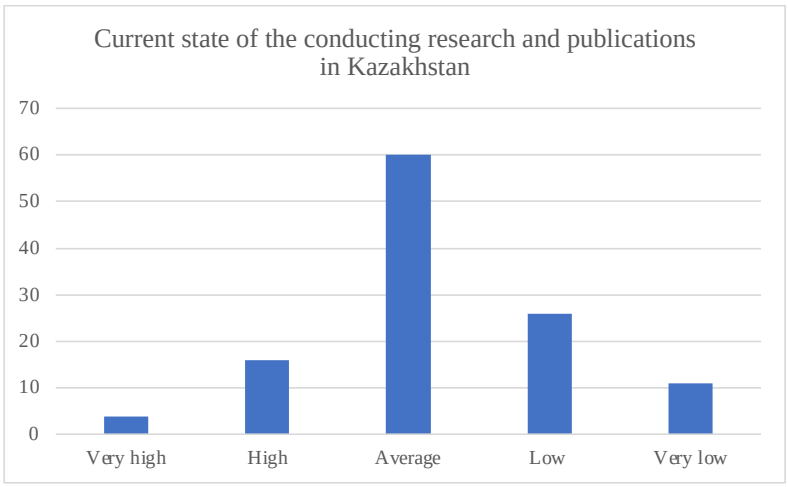

Figure 1. The Current State of Conducting Research and Publishing Papers in Kazakhstan

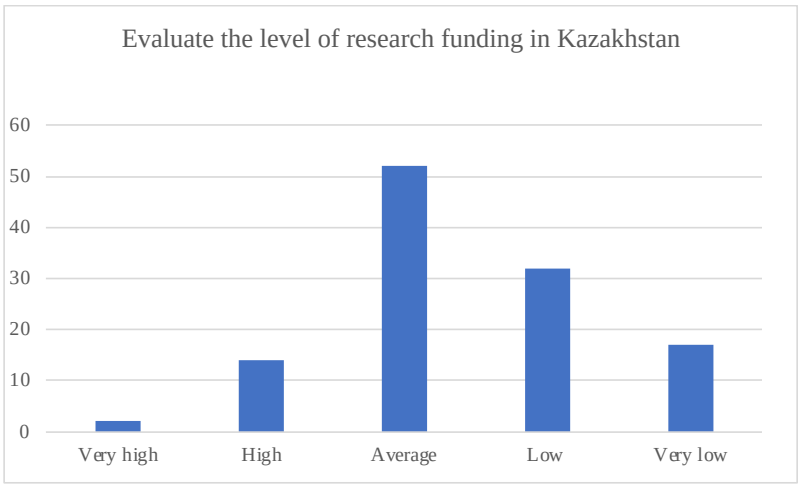

Figure 2. Evaluate the Level of Research Funding

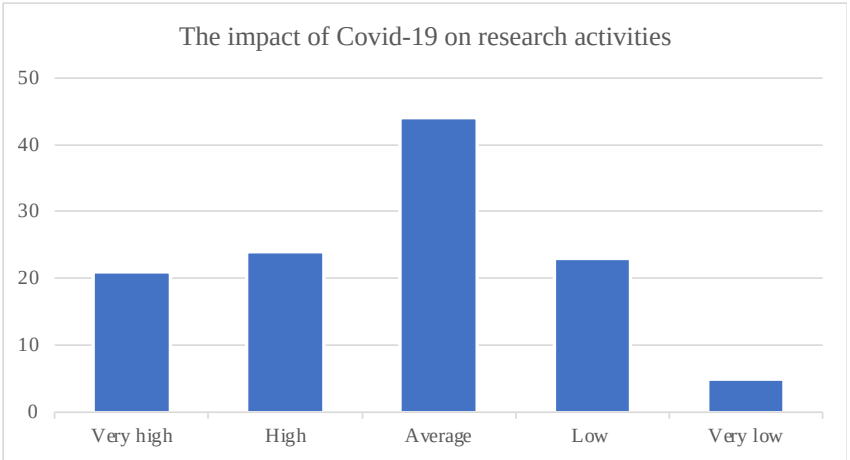

Figure 3. The Impact of COVID-19 on Research Activities

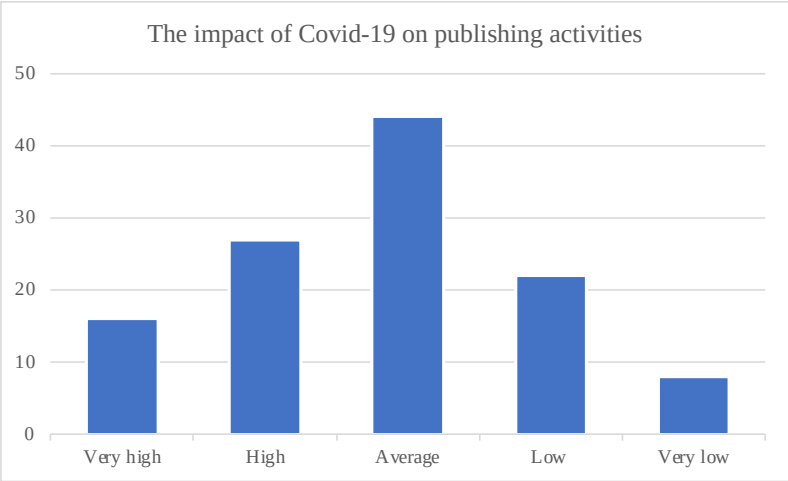

Figure 4. The Impact of COVID-19 on Publishing Activities

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SECTION III - STUDIES ON TECHNOLOGY

Chapter 11 - Sentiments Analysis on Limited Face-to-Face of College Students in the New Normal

Kathryn P. Acosta, Thelma D. Palaoag

Chapter Highlights

- The need to calibrate distance learning to limited face-to-face in the new normal due to the inadequate implementation of online learning is crucial. Such seamless shift needs sentiment analysis to analyze students' views and ideas in the resumption of the limited face-to-face classes.
- This research aims to investigate and predict the students' sentiments of the college students of Colegio de San Juan de Letran-Manaoag on the limited face-to-face classes in the new normal using the different machine learning algorithms and determined student perceptions for an effective way of learning.
- Based on the results of the comparative study among the text analyzers such as Random Forest, Lazy k-NN and Rule Induction which identified the appropriate algorithm model being used is the Rule Induction for sentiment analysis in the preprocessing and testing of the prediction which yielded an accuracy and F-Measure of 100% on the college students.
- The study recommends adopting limited face-to-face classes for an efficient and effective learning method to ensure quality education to the learners.

Introduction

The COVID-19 pandemic has wreaked havoc on education around the world. Students and teachers have faced challenges and are unfamiliar with the abrupt shift to a new educational system as a result of the use of online learning. (Gopal et al., 2021). Nevertheless, students perceived online learning as traumatic and prejudicing their well-being and community life (Chakraborty et al., 2021). The students are more seemingly to interact face-to-face with instructors (Aguilera, 2020). Furthermore, practical courses should be delivered face-to-face to provide the greatest teaching approaches in analyzing and leading students (Almahasee et al., 2021). Students who are accustomed to face-to-face learning and then enroll in online learning experience high levels of negative emotions, such as fear, wrath, or inefficacy (Gherheș et al., 2021).

As a result, recent research studies have found that students perform much better in online learning than in traditional classroom settings.(Gopal et al., 2021). Other research highlighted outcomes that are reluctant to one type of learning over another, but prefer a combination of both(Alsaaty et al., 2016). As a result, the Commission on Higher Education (CHED) has issued Joint Memorandum Circular (JMC) No. 2021 – 004, Guidelines for Gradual Reopening of Campuses of Higher Education Institutions for Limited Face-to-Face Classes During the COVID-19 Pandemic (HEIs) intended to hold limited face-to-face classes during the COVID-19 outbreak and are willing to take on the responsibility for campus re-openings dependent on HEI's capacity to follow health and safety regulations, offer resources, and gain stakeholder support.

Thus, the Colegio de San Juan de Letran-Manaoag anticipates the resumption of the limited face-to-face classes of college students. Hence, this research aims to investigate and predict the sentiments of the college students of Colegio de San Juan de Letran-Manaoag on the limited face-to-face classes in the new normal. Sentiments Analysis (SA) or Opinion mining is a method for tracking people's mood about any specific topic by evaluation (Aung & Myo, 2017). Sentiment analysis is well-known, considering its effectiveness (Tran et al., 2022).

With the integration of sentiment analysis, the sentiment of words stated in text reviews is measured and analyzed (Tian et al., 2021). Sentiment analysis is encompassed in Natural Language Processing classification, a study designed to investigate and distinguish the

unknown pattern included in text information (Kanugrahan & Wicaksono, 2021). Furthermore, sentiment analysis techniques are employed to classify positive and negative emotions expressed by students in their responses. (Aung & Myo, 2017).

Sentiment analysis of evaluations is an actual common approach. Taking analyses has developed as time went by (Gupte et al., 2014). Sentiment analysis can also be executed by analyzing numerous data patterns of views or opinions by generating conclusions from several current opinions (Bahrawi, 2019).

In particular, the objectives of Sentiment Analysis are to obtain thoughts from reviews and then categorize these feelings determined by polarity (Elmurngi & Gherbi, 2017). The sentiment is usually can be categorized into two types (positive and negative classes) or three types positive, negative, and neutral classes (Mariel et al., 2018). A variety of algorithms are used in sentiment analysis to produce precise and pertinent output (Monreal et al., 2021).

The effectiveness of sentiment analysis of all the academic information across various sources can help produce better-informed policies, thus developing holistically to the betterment of education (Archana & Kishore, 2017). Hence, the primary objective of this research is to do sentiment analysis on the limited face-to-face classes of Colegio de San Juan de Letran-Manaoag college students in the New Normal. Based on the classifiers, this research determined the college students' sentiments accuracy regarding the positive, negative, and neutral using machine learning algorithms and by means of getting sentiment scores on students' sentiments. Moreover, this research will also help identify the college students' perceptions of an effective way of learning in implementing the limited face-to-face classes using machine learning algorithms and sentiment analysis on students' sentiments.

Method

This research study used three (3) approaches 1) Data Collection, 2) Data Preprocessing, and 3) Text and Lexical Analysis on student sentiments. Text Mining was used to recognize the key attributes, which extracts and interprets the keywords based on the negative and positive review frequency (Dina, 2020). The feedback of students' evaluation consists of quantitative and qualitative data gathered by two question forms; close-ended questions gathered the quantitative data as multiple choices, and open-ended questions collected the qualitative data

as feedback and recommendations from students' sentiments in text format (Aung & Myo, 2017).

Practical Sentiment analysis conjugates highly efficient and accurate methods that are required for the estimation of the parameters of the models. Thus, using the Machine learning (ML) Approach, which is a type of artificial intelligence (AI) that allows software applications to be revamped into more precise prediction outcomes. The researchers used a variety of machine learning algorithms, including the Random Forest, k-Nearest Neighbor, and Rule Induction, to anticipate the predictors' accuracy.

Data Collection

Mixed methods were used in the study to collect various students' sentiments. Furthermore, the qualitative and quantitative data used open-ended questions. Online survey questionnaires using google forms were conducted to the two hundred eighty-five (285) college students. As course demographics show in Figure 1, there are ninety-seven (97) BSIT, eighty-four (84) BSBA, seventy-five (75) BSED, twenty-five (25) BEED, and four(4) BSCS college students from Colegio de San Juan de Letran Manaoag. Thus, the dataset was downloaded in .csv format enabling further data exploration to determine the polarity of happy, neutral, and negative student feelings.

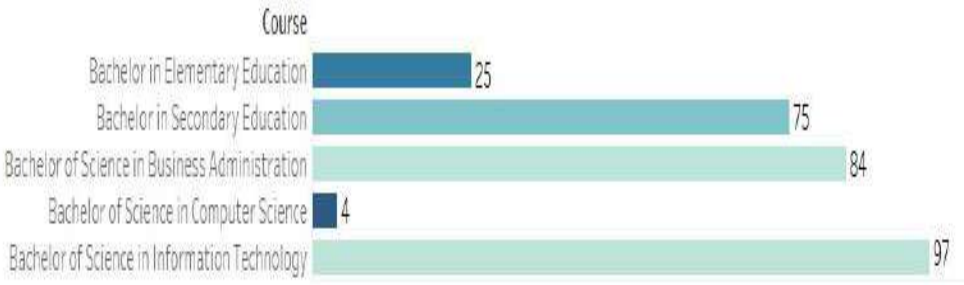

Figure 1. Course Demographics (Data Preprocessing of Students' Sentiments)

The researchers used Data Analysis Tools such as Excel, RStudio, and RapidMiner in the text preprocessing. Machine Learning Tools used are RapidMiner and RStudio in preprocessing, classification, clustering, managing, and visualization. In determining students' sentiments, the preprocessing is a very significant classification algorithm model that is well-built and is

more precise(Bahrawi, 2019). The following processes were done using the sentiment analysis template. Moreover, as shown in Figure 2, the data preprocessing, were importing of the dataset from the local repository to validate the students' sentiment prediction, was done.

Then next is to set up the role operator where the sentiments attribute was selected. In addition, using the nominal to text operator is used to change the nominal attribute to text. Afterwards, the document processing from data by selecting the term frequency-inverse document frequency (TF-IDF), which contains tokenize operator, that is used to split the text of a document into a sequence of tokens, and also used the cases operator where all characters to either lowercase or uppercase are converted.

Then, the filter stopwords are applied to remove every token which are the same to the built-in stopwords list. Lastly, it proceeded with the cross-validation to apply algorithm models to validate the students' sentiments and the performance operator to show the accuracy of the students' sentiments. The following metrics were used for calculation on the text classifiers.

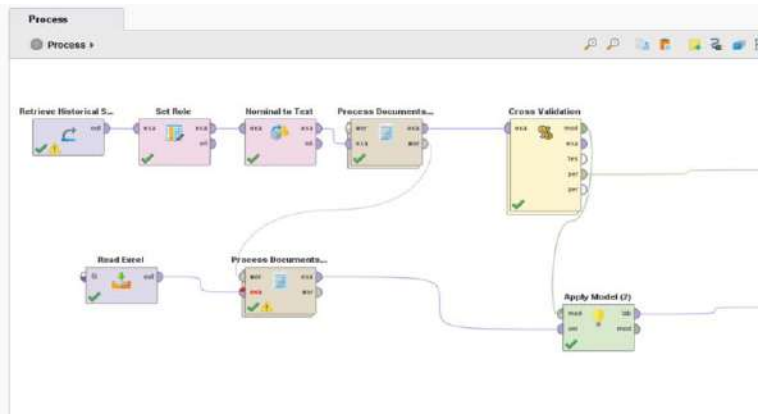

Figure 2. Data Preprocessing

The number of cases predicted positively divided by the total number of instances is used to calculate accuracy. This indicates that the accuracy is the proportion of correctly predicted classes among all classes. Accuracy = ((True Positive + True Negative) / (P + N))*100.

Precision

Precision is the accurateness or exactness of truly classified class, therefore known as positive predictive value. It is the proportion of instances that truly have class x / Total classified as

class x. In summary, it is the number of chosen items that were associated. Precision = (True Positive / (True Positive + False Positive))*100.

Recall

Recall gives a sensitivity of problem and it process values or product quantity or completeness. It returned most relevant and part of the documents that are relevant as result from the query. Succinctly, it is the number of associated objects that were chosen. Recall = (True Positive / (True Positive + False Negative))*100

True Positive

True positive are positive tuples that were accurately labeled by the classifier. It is the proportion categorized as class x / Actual total in class x. True Positive rate = (True Positive / (True Positive + False Negative))*100.

False Positive

False positive is incorrectly predicted compared to original results. False Positive rate = (False Positive / (False Positive + True Negative))*100. Lastly, the F-Measure classified as (2*Precision*Recall / (Precision+ Recall))*100.

Text and Lexical Analysis on the Students' Sentiments Prediction

For a thorough text analysis of student sentiments, the researcher utilized the RapidMiner, a user-friendly integrated environment with a wide range of applications, a machine learning platform, and prediction analysis of the students' sentiments. The overall classifiers are calculated by taking the average of all the metrics from all the classes (Puyalnithi et al., 2016). On the students' attitudes dataset, the researchers employed the classifiers of the three machine learning methods, Random Forest, Lazy k-NN, and Rule Induction, to discover the optimum precision.

Figure 3 significantly illustrates the cross-validation of the dataset using Random Forest, Lazy k-NN, and Rule Induction algorithm models to apply build, and test the model to

validate the performance on the polarity of positive, neutral, and negative students' sentiments. In addition, Sentimentr was used to assess the students' sentiments and detect sentiment. The element id parameter of the sentiment function was used to identify the id number of the given sentiments.

The word count is the total number of words in the review. The standard deviation of the sentiment score of the sentences in the review is indicated by the sd. In addition, there is an aggregated sentiment function that shows the sentiment scores of the sentences in the review.

Students' sentiments per sentence were obtained using the sentiment function. Furthermore, the sentiment function was used to aggregate sentiment scores to display the polarity of negative, neutral, and positive students' sentiments. More specifically, the National Research Council (NRC) emotion lexicon was employed which revealed the eight emotions utilizing the tidytext and syuzhet packages in Rstudio (anger, fear, anticipation, trust, surprise, sadness, joy, and disgust).

Figure 3. Algorithm Models

Results

The purpose of this research was to investigate and predict the sentiments of the college students of Colegio de San Juan de Letran-Manaoag on the limited face-to-face classes in the new normal and help identify student perceptions for an effective way of learning. A comparative study was conducted using the various classification algorithm models, in particular, the Random Forest, Lazy k-NN, and the Induction Rule models were applied in

processing, training, testing, and evaluating the prediction of the students' sentiments. To further meet the research objectives, the RapidMiner was used to identify the polarity of positive, neutral and negative sentiments. As illustrated in Figure 4, the extracted students' sentiments dataset was cleaned in Excel using the filter, replace, trim, lower, and countif functions, and then interpreted using Azure machine learning, and the dataset was loaded into RapidMiner. Whereas Figure 5 determined the students' sentiments polarity using RapidMiner, there were two hundred eighty-five (285) respondents, two hundred forty-seven (247) have positive sentiments, nineteen (19) negative sentiments, and nineteen (19) neutral sentiments.

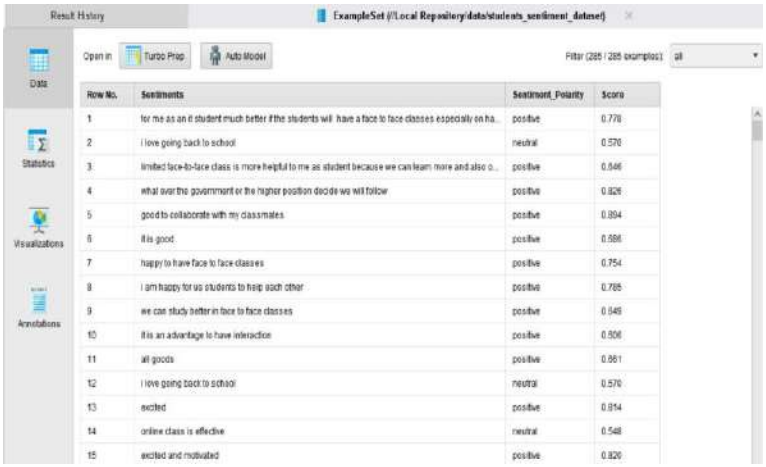

Figure 4. Extracted Students' Sentiments Dataset

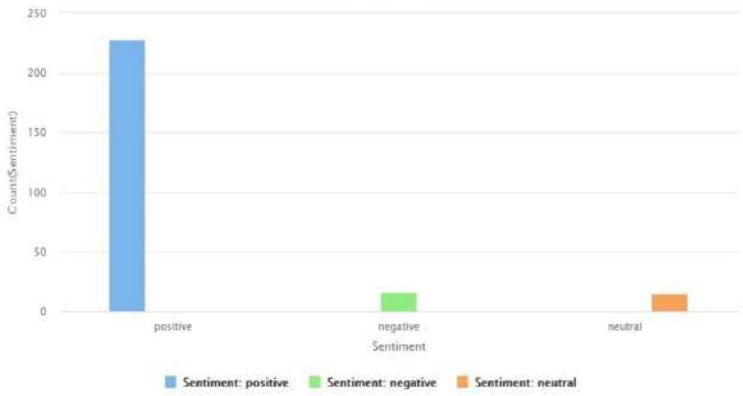

Figure 5. Students' Sentiments Polarity

Algorithm Model Classifiers

The Random Forest Classifiers, Lazy-kNN and the Rule Induction where the classification techniques were used in identifying the sentiments' of the dataset.

Random Forest Classifier

The random forest technique is regarded as one of the most effective classification model algorithms for accurately categorizing vast amounts of data (Al Amrani et al., 2018). The Random Forests technique is one of the best classification algorithm models for accurately classifying large amounts of data (Puyalnithi et al., 2016). Moreover, Figure 6 illustrates the Random Forest Performance Vector, and the result attained an accuracy of 86.66%. There are two hundred forty-seven (247) true positive, nineteen (19) true neutral, and 19 true negative students' sentiments.

accuracy: 86.66% +/- 1.50% (micro average: 86.67%)

	true positive	true neutral	true negative	class precision
pred. positive	247	19	19	86.67%
pred. neutral	0	0	0	0.00%
pred. negative	0	0	0	0.00%
class recall	100.00%	0.00%	0.00%	

Figure 6. Random Forest Performance Vector

Furthermore, the class precision was 86.67 percent on positive and 0 on both positive and neutral. In addition, the class recall of true positive is 100% and 0% of both true neutral and true negative. As shown in Figure 7 depicts Random Forest Confidence 15 sample data out of 285 students, the total confidence attained in positive students' sentiments total min value is 0.606, the max value is equal to 0.929 and an average of 0.895.

Figure 7. Random Forest Confidence

Lazy k-NN Classifier

The Lazy k-Nearest Neighbor is the simplest yet powerful classifier algorithm. The Lazy k-NN predicts a class label based on the majority of votes of the Neighbours (Bhatt & Ashraf, 2021). The Lazy k-NN Algorithm is based on feature similarity. Furthermore, Figure 8 illustrates the results of using Lazy k-NN to count students' sentiments, with 285 most positive students' sentiments and 0 on both least negative and neutral sentiments. Moreover, Figure 9 depicts the Lazy k-NN Performance Vector. The results obtained an accuracy of 87.35%, and there are two hundred forty-six (246) true positive, nineteen (19) true neutral, and sixteen (16) of true negative polarity of students' sentiments.

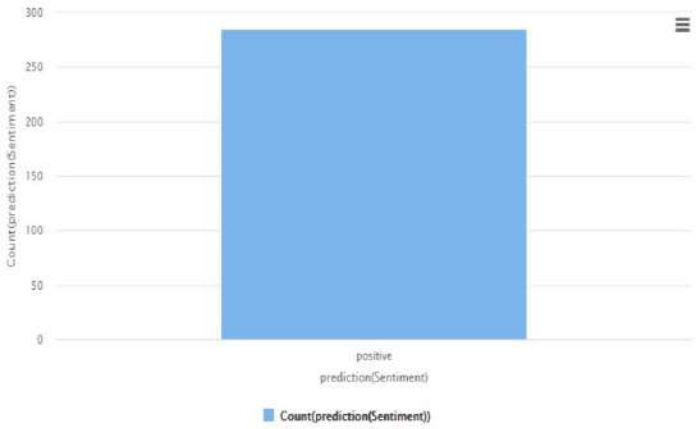

Figure 8. Lazy kNN Count Prediction

There is eighty-seven point fifty-four percent (87.54%) pred. positive, one hundred percent (100%) pred. negative, and zero (0) pred neutral sentiments. In addition, the results in class recall result in true positive is 99.60%, 0% in true neutral, and true negative is 15.79%. Moreover, Figure 10 illustrates the total confidence using the Lazy k-NN is 0.5 positive min value, the max value is equal to 1, and an average of 0.960 positive and neutral.

accuracy: 87.35% +/- 3.80% (micro average: 87.37%)

	true positive	true neutral	true negative	class precision
pred. positive	246	19	16	87.54%
pred. neutral	1	0	0	0.00%
pred. negative	0	0	3	100.00%
class recall	99.60%	0.00%	15.79%	

Figure 9. Lazy k-NN Performace Vector

Figure 10. Lazy k-NN Confidence

Rule Induction Classifier

Moreover, Rule Induction (RI) is a method used for inevitably making rules from a set of samples(Asghar et al., 2018). The Rule Induction method was also utilized to investigate a trimmed set of rules relating to the information obtained from the given dataset, with the Random Forest and Lazy k-NN methods performing better as shown in Figure 11, the Rule Induction Performance Vector. The result shows a significant performance achieving one hundred percent (100%) accuracy than Random Forest and Lazy k-NN achieving an accuracy of 100%, there are two hundred forty-seven (247) true positive, nineteen (19) true neutral, and nineteen (19) true negative polarity of students' sentiments.

accuracy: 100.00% +/- 0.00% (micro average: 100.00%)

	true positive	true neutral	true negative	class precision
pred. positive	247	0	0	100.00%
pred. neutral	0	19	0	100.00%
pred. negative	0	0	19	100.00%
class recall	100.00%	100.00%	100.00%	

Figure 11. Rule Induction Vector Performance

The class precision revealed 100% on prediction positive, prediction neutral and prediction negative. Subsequently, 100% is attained in class recall in the true positive, true neutral, and true negative. In addition, Figure 12 shows the total confidence precision of positive min value is 0, the max value is equal to 1, and an average of 0.867 in the students' sentiments.

Figure 12. Rule Induction Confidence

Summary of the Accuracy on the Methods used for Sentiments Analysis

As a result of comparing the three text analyses, the performance precision and accuracy for positive, neutral, and negative sentiment analysis is achieved. As shown in Table 1, the Rule Induction outperformed with the highest prediction accuracy of 100%. In comparison, the Lazy k-NN obtained 87.35% accuracy, which is moderately better than Random Forest with an accuracy of 86.66%. The Random Forest classifier revealed the Precision of 86.67, Recall 100, F-Measure of 0.928591 and Class polarity of Positive.

Summary of the Accuracy on the Methods used for Sentiments Analysis

Moreover, the Lazy k-NN depicted 87.54, recall of 99.60, F-Measure is 0.931814 and Class polarity of positive. Furthermore, the last classifier shown 100 precision, 100 recall, F-Measure of 1 class polarity. The results revealed students' preferred positive response from the students' sentiments on the resumption of face-to-face in the new normal.

Table 1. Comparison of Classifiers

Classifier	Precision	Recall	F-Measure	Sentiment
Random Forest	86.67	100	0.928591	Positive
Lazy kNN	87.54	99.60	0.931814	Positive
Induction Rule	100	100	1	Positive

Text and Lexical Analysis

Lexical text analysis was used to recognize and extract subjective information in the students' sentiments using the tidyverse and syuzhet packages as shown in Figure 13. The top five highest students' sentiments word frequency excited has 82 words, happy hold 77 words, face contains 72 words, glad consists of 48 words, and classes holds 24 words. While Figure 14 illustrated the barplot which revealed the eight emotions (anger, fear, anticipation, trust, surprise, sadness, joy, and disgust).

dtm_finalsentiments | corpus

Filter

	word	freq
excited	excited	82
happy	happy	77
face	face	72
glad	glad	48
classes	classes	24

Figure 13. Word Frequency

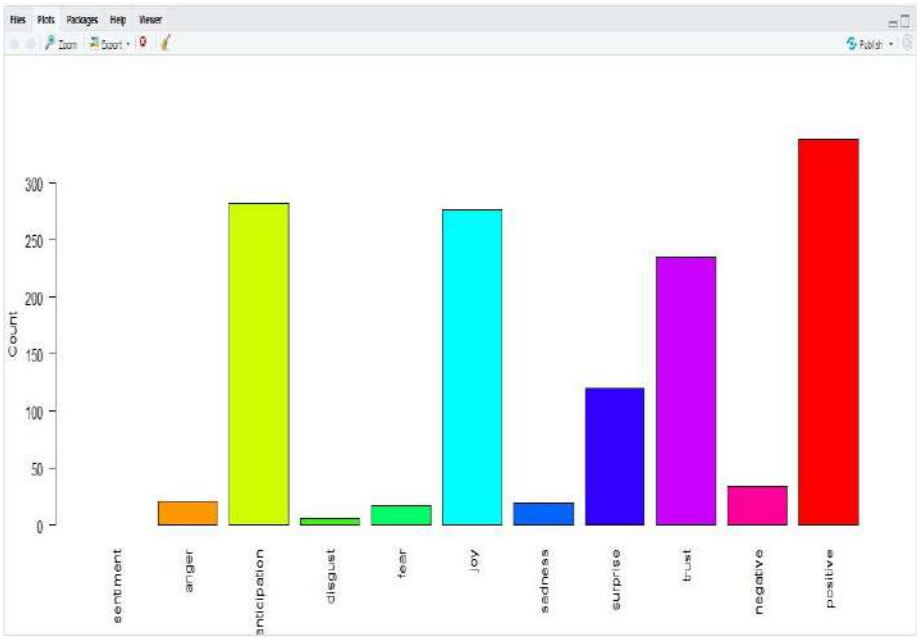

Figure 14. Students' Sentiments Emotions

The most crucial stage in this analysis is to determine whether the presented text is positive,

negative, or neutral in terms of polarity. The researchers randomly selected 10 students' sentiments per course and aggregated sentiments score sentiments less than zero is negative, 0 is neutral, and greater than zero positive polarity using sentiment function that revealed the negative, neutral and positive students' sentiments polarity. As shown in Table 2 the 10 BEED students' sentiment score, the sentence number 4 has the maximum wordcount of 4 and got the highest sentiment score of 0.87500000 which has a positive students' sentiments.

Table 2. BEED Students' Sentiment Score

Student Sentiments	element_id	Word count	Sentiment Score	Polarity
1	1	1	0.75000000	Positive
2	2	3	0.43301270	Positive
3	3	7	0.28347335	Positive
4	4	4	0.87500000	Positive
5	5	10	-0.01581139	Negative
6	6	13	0.20801257	Positive
7	7	9	0.25000000	Positive
8	8	12	0.21650635	Positive
9	9	26	0.03922323	Positive
10	10	109	0.68773964	Positive

As shown in Table 3 the 10 BSIT students' sentiment score, the sentence number 1 has the maximum wordcount of 3, and got the highest average sentiment with a score of 0.8660254 which has a positive students' sentiments. Table 4 shows the 10 BSED students' sentiments score, the sentence number 1 has the maximum wordcount of 3, and got the highest average sentiment with a score of 0.72168784 which has a positive students' sentiments.

As illustrated in Table 5, the 10 BSBA students' sentiment score, the sentence number 3 has the maximum wordcount of 14 and got the highest sentiment score of 0.86602540 which has a positive students' sentiments and Table 6 shows the 4 BSCS students' sentiment score, the sentence number 3 has the maximum wordcount of 1, and got the highest sentiment score of 0.750000 which has a positive students' sentiments.

Table 3. BSIT Students' Sentiment Score

Student Sentiments	element_id	Word count	Sentiment Score	Polarity
1	1	3	0.8660254	Positive
2	2	4	0.4000000	Positive
3	3	6	0.3061862	Positive
4	4	6	0.3061862	Positive
5	5	9	0.1666667	Positive
6	6	9	0.3500000	Positive
7	7	10	0.2371708	Positive
8	8	26	0.5765814	Positive
9	9	27	0.3733532	Positive
10	10	18	0.5161880	Positive

Table 4. BSED Sentiments Score

Student Sentiments	element_id	Word count	Sentiment Score	Polarity
1	1	3	0.7216878	Positive
2	2	12	0.4474465	Positive
3	3	14	0.4543441	Positive
4	4	14	0.5853021	Positive
5	5	24	0.3572173	Positive
6	6	29	0.0278543	Positive
7	7	34	0.6225399	Positive
8	8	37	-0.200000	Negative
9	9	44	1.7110769	Positive
10	10	54	0.5021454	Positive

Table 5. BSBA Sentiments Score

Student Sentiments	element_id	Word count	Sentiment Score	Polarity
1	1	2	-0.53033009	Negative
2	2	3	0.43301270	Positive
3	3	3	0.86602540	Positive
4	4	5	0.06708204	Positive
5	5	9	0.25000000	Positive
6	6	10	0.38333333	Positive
7	7	14	0.10690450	Positive
8	8	11	0.48241815	Positive
9	9	19	0.117855113	Positive
10	10	28	0.14173668	Positive

Table 6. BSCS Sentiments Score

Student Sentiments	Element id	Word count	Sentiment Score	Polarity
1	1	3	0.4330127	Positive
2	2	1	0.7500000	Positive
3	3	6	0.3061862	Positive
4	4	16	0.5875000	Positive

WordCloud

Moreover, word cloud is used to summarize the data from the students' sentiments as shown in Figure 15, the corpus codes. Whereas, Figure 16 illustrates the WordCloud of data visualization of the extracted in RStudio using 387 words from students' sentiments, corpus is also applied to transform the text tolowercase, stripwhitespaces, remove numbers, and remove stopwords in the dataset in RStudio codes.

```
students_sentiments <- VectorSource(new_dataset$Negative_Positive_Sentiments)
corpus <- Corpus(students_sentiments)

corpus <- tm_map(corpus, content_transformer(tolower))
corpus <- tm_map(corpus, stripwhitespace)
corpus <- tm_map(corpus, removeNumbers)
corpus <- tm_map(corpus, removeWords, stopwords("english"))
corpus <- tm_map(corpus, removeWords, c("andor", "status well", "within",
                                        "business", "learning", "field",
                                        "span", "amp", "across", "strong", "large", "using",
                                        "help", "clients", "class", "classresultlinkbarcontainer",
                                        "every", "work", "can", "position", "risk", "global", "work",
                                        "will","brbr", "resultlinkbarviewjob", "years",
                                        "idjobsummary","div","new", "skills" , "i'm", "a", "i", "face" , "mom", "also",
                                        "much", "finally", "government","time", "covid", "especially", "fare", "money",

sentiments <- DocumentTermMatrix(corpus)
student_sentiments <- as.matrix(sentiments)
view(student_sentiments)


frequency <- colSums(student_sentiments)
frequency <- sort(frequency, decreasing=T)

student_frequency <- head(frequency, 20)
kable(student_frequency)

words <- names(frequency)
wordcloud(words[1:287], frequency[1:287],
          colors=brewer.pal(8, "Dark2"))
```

Figure 15. Corpus Codes

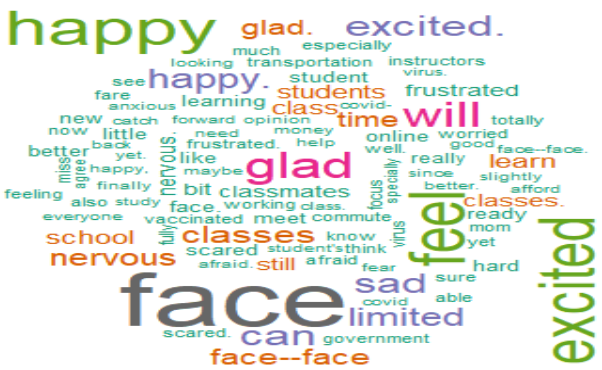

Figure 16. Students' Sentiments WordCloud

Conlusions

The results of the study obtained the polarity of the students' sentiments using RapidMiner having two hundred eighty-five (285) respondents, two hundred forty-seven (247) have positive sentiments, nineteen (19) negative sentiments, and nineteen (19) neutral sentiments. The study has shown the students' sentiments prediction of two hundred eighty-five (285) positive both on Random Forest and Lazy k-NN while the sentiments prediction of Rule Induction has two hundred forty-seven (247), nineteen (19) neutral. Hence, testing and validation using the three models, specifically the Random Forest, Lazy k-NN, and the Rule Induction revealed the polarity of true positive, true negative, and true neutral sentiment results.

The classifiers have generated each classifier performance vector. The Rule Induction classifier method is the most excellent algorithm model in sentiment analysis which obtained 100% high accuracy performance and F-measure compared to the Random Forest classifier revealed the Precision of 86.67, Recall 100, F-Measure of 0.928591 and Class polarity of Positive. Moreover, the Lazy kNN depicted 87.54, recall of 99.60, F-Measure is 0.931814 and Class polarity of positive. Furthermore, the student perception based on the students' sentiments revealed positive results per course. The study has proven that there is a need to calibrate and gear up the implementation of the limited face-to-face classes in Colegio de San Juan de Letran-Manaoag.

In conclusion, the sentiments analysis has evaluated the positive polarity of the students' sentiments after a thorough exploratory data analysis is done. A comparative study among various algorithm classifiers is performed and determining the polarity of the students' sentiments. This study has achieved its objectives, which determined a significant results in predicting the accuracy and F-Measure of positive, neutral, and negative students' sentiments using the machine learning algorithms, the Random Forest, Lazy kNN, and the Rule Induction. The study also identified that the Rule Induction is the most appropriate model that significantly gave the best results, extrapolating the high prediction of the students' sentiments with 100% accuracy and 100% F-Measure were found to be very positive. Moreover, there positive polarity on students perceptions based from the students' sentiments per course which inevitably has a profound impact on the implementation of the limited face-to-face classes.

Recommendations

The study recommends adopting limited face-to-face classes for Colegio de San Juan de Letran Manaoag for an efficient and effective learning method to ensure quality education to the learners. The implementation of the limited face-to-face classes must be conducted as the students' are optimistic about it.

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Chapter 12 - The Comparative Effects of Technology and Hands-On Modeling on High School Students' Performance in a Biology Classroom

Kimesha Brooks, Emily Surber

Chapter Highlights

- Due in large part to adjustments in teaching necessitated by the COVID-19 pandemic, recent district-wide mandates have required all students to use Chromebooks as the primary technology source in the classroom and at home.
- Consequently, student academic performance has decreased noticeably in the 9th grade biology classes described in this study.
- For this study, three different interventions were used in three 9th grade biology classes all taught by the author. The first class received hands-on modeling during the lessons; the second class received both hands-on modeling with supplementing computer technology; the third class received the instruction only with the computer technology.
- Both quantitative and qualitative results show that a hands-on modeling with supplemental technology was most effective in improving students' performance.

Introduction

Providing students with an engaging and fulfilling experience in the classroom has always been the highest priority of educators since the first schools in Ancient Egypt were built (Foways, 2017). As we move into the digital era and technological advances continue to push society forward, students have access to knowledge beyond their textbooks' confinements. By using technology, such as district-issued Chromebooks students are given for free, they can access many online platforms and simulations that will help them better access and understand the content. As advances continue to be made and new software is developed, educators are challenged with finding innovative ways to use technology in the classroom to facilitate student learning.

During the recent COVID-19 pandemic, students and teachers throughout the school district were sent home with Chromebook laptops to complete classes online via Zoom, Microsoft Teams, Google Meet, or another virtual meeting platform. Educators had to find a creative way to teach content to students, do laboratory exercises, and provide activities requiring only the use of Chromebooks, all while working from home. Now that students and teachers are back in the classroom, the school district has a mandate to continue using Chromebooks as the primary resource in the classroom. In-class activities, laboratory exercises, homework, and assessments are completed on the district-issued Chromebooks.

Technology, including Chromebooks, is essential because students using these devices have access to vast amounts of information, and they are being prepared for careers across STEM (Science Technology Engineering Mathematics) and trade fields that are being made available (Code, Ralph, & Forde, 2020). Using technology in the classroom can be a great tool to foster student success (Tucker, 2020). It opens doors for students to access information, diagrams, labs, and simulations that would be readily accessible in a typical classroom due to limited district and school funding. Technology in the classroom also levels the field for students with disabilities by supplying additional resources and software such as "Read and Write" (Roland, 2015).

Utilizing computer technology in the classroom does have its drawbacks. Using Chromebooks as the primary technical resource in the classroom does not provide students with hands-on experiences because all the manipulations are being done virtually. Complete

engagement for a student would require them to use all their senses to immerse themselves in an experience. A study conducted by Code, Ralph, & Forde (2020) to assess how students learned at home during the COVID-19 pandemic showed that teachers had many concerns because students could not do hands-on activities. One teacher noted during the study, "I am afraid that students will not get the hands-on experience and therefore will not get to develop the passion for our subject (Code, Ralph, & Forde, 2020)". Understanding how Chromebooks and laptops are being used as the leading technical resource and whether they facilitate or impede student success will drive more conversations among educators on how these tools are used in the classroom.

Statement of the Problem

As a current biology teacher for the Atlantic Public School district using Chromebooks as the primary resource in the classroom, the problem the instructor faced in her biology classes is that students are not performing as consistently as in prior years. Could this be due to the lack of hands-on modeling and laboratory activities? This study with the instructor's biology classes focused on how using technological devices as a primary resource affects student performance compared to utilizing hands-on modeling activities using a combination of technology and hands-on modeling in the classroom.

Purpose and Rationale

The purpose of this study was to understand what interventions work best to increase content mastery for students in high school biology. "During the present time of upheaval, teachers are being asked to adopt different values, attitudes, habits, and behaviors to overcome the current challenges in education with having a concrete sense of what happens next (Code, Ralph, Forde, 2020)." As technology advances, there has been an increased push to implement technology into daily lessons, activities, and labs in the classroom. Technology should be a tool used in the classroom to allow for better engagement amongst students and better serve students in different capacities in the classroom (Edmonds & Edmonds, 2008). Students have access to vast amounts of knowledge of these new implementations, but there are still deficits in retaining content amongst students. The inability to master content after a digital activity has been completed is causing researchers to question whether using technology in the classroom as the primary resource fosters or hinders student success.

Research Questions

- Will using technology as a primary method help students perform better in biology class?
- Will using hands-on modeling as a primary method help students perform better in biology class?
- Will using a combination of hands-on modeling and technology help students perform better in biology class?

Theoretical Framework

Using Chromebooks as a primary technological resource promotes personalized learning, increases independence, and facilitates better communication between the teacher and the student (Tucker, 2020). Technology in the classroom enables student engagement by using different education apps such as Nearpod, which provides students with immersive and interactive experiences (Tucker, 2020). While technology can be a good tool in the classroom, however the use of it may take away from students' hands-on experiences when they physically manipulate objects. Students are easily distracted when using their Chromebooks for an in-class lab activity. A study by Bernard McCoy (2016) on digital devices for non-class-related purposes showed that students use machines for off-task purposes such as texting and internet surfing because they are bored.

Before software and Chromebooks became the primary source in the classroom, students had to physically manipulate objects and write things down using pencil and paper. Model-based learning bridged the gap and allowed students to make connections between theories and concepts being taught to real-world experiences, and students were able to retain content better (Mierdel & Bogner, 2020). The primary issue that teachers are facing using hands-on modeling alone is the inability to bring in new concepts and 3D models to provide students with better imaging and visualizations. Students will retain content better by combining hands-on modeling and technology when completing labs and activities in the class. Using the sources individually has drawbacks that directly affect student content retention and engagement during activities in the classroom. Using a combination of both resources, we would expect to increase student content retention because both would complement each

other and not stand alone. In this study, the author chose to teach biology courses using Chromebook technology and hands-on modeling during different class periods to assess which method has the most significant effect on content mastery amongst students.

Literature Review

Examination of past studies relating to technology integration and studies of hands-on modeling highlights challenges and opportunities with each approach. Integrating technology into education allows students to carry out their studies beyond the classroom. Hands-on modeling will enable students to participate in laboratory activities, gaining practical experience. Oftentimes students are quickly drawn off to other activities such as texting and internet browsing on their cellphones. Hands-on modeling without technology only limits instructors to static sources, thereby denying extra knowledge available online. A combination of two approaches in education can potentially improve student performance.

Utilizing Technology as a Primary Method to Enhance Student Learning

Various online sources provide students and teachers with valuable learning materials. These materials are made available through sites like the National Archives, The Library Congress, American Memory Collection, and the CDP database. According to Courts and Tucker (2012), about 76% of college students use the internet to interact, socialize, and assimilate information. The internet has various features that can help deliver a variety of topics and learning resources to students to supplement their learning (Villalba & Hoekman, 2017). The method of information delivery over the internet **(**cloud computing) is a rapidly growing approach that many high schools are extensively employing. The technique uses webmail services such as Google and social media services such as Telegram and Facebook (Courts & Tucker, 2012). A survey conducted by the Campus Computing Project (Green, 2010) showed that most college and university students extensively use Google services to acquire information from their teachers and other students. Moodle is also another method used in high schools to enhance smooth teacher-student interaction digitally. Moodle is an online course designed to freely enable students to create and deliver learning materials through the internet.

A study on both elementary and primary school teachers' perception of online platforms and

simulations in the classroom showed that not all of them find it comfortable despite teachers' frequency of computer use at home and school (Al Musawi, Mbusaidi, & Al Balushi, 2015). A similar study by Merc (2015) with Turkish pre-service EFL teachers shows that not all students and teachers benefit from technology available to them in their teaching practice at a satisfying level. Some teachers are more familiar with technology than others, making it a non-uniform method. The more familiar a teacher is with technology, the more comfortable they will be with content integration, hence high performance from students. Therefore, teachers' comfortability with integrating computers in the classroom affects students' performance (Merc, 2015). Research shows that proper technology integration in the classroom can provide better aid to students in understanding concepts that are taught in class (Kapur, 2018).

Another study found that students highly rely on the internet to carry out their research and further readings (Tucker, 2020). Integrating Chromebooks, virtual simulations, and virtual platforms in the classroom can be a helpful tool in enhancing students' success. Most students in the 21st century spend their time on the internet. Among them, 86% use the internet for multimedia purposes (animation, video, audio, text, and slideshow). Research has shown that the effective integration of multimedia services in the classroom positively influences students' learning experience (Tucker, 2020). According to Tucker (2020), students are not engaged in learning materials from static sources such as textbooks or static websites. Multimedia and the internet provide students with learning materials rich in knowledge and experience. Contrary to Merc's (2015) finding is the belief that students use the internet to carry out their activities not related to classwork, such as texting and browsing through the internet (McCoy, 2016). According to Mccoy (2016), students get drawn off quickly to other non-academic activities while using their cellphones, tablets, and Chromebooks to read.

A significant advantage to using classroom technology is enhanced mobility. Technology in classroom learning improves mobility. Mobility enables students to learn anywhere, anytime they want, using digital communication platforms such as Zoom. During the COVID-19 pandemic, students and teachers continued learning and teaching activities from home, primarily using laptops and tablets (Code, Ralph, & Forde, 2020). Mobile phones have learning management system applications such as Blackboard Mobile. These technologies enable students and instructors to interact virtually using their smartphones, tablets, and

laptops (Code, Ralph, & Forde, 2020).

Utilizing Hands-on Modeling as a Primary Method to Enhance Student Learning

According to Mierdel and Bogner (2020), hands-on modeling has been the most compelling and efficient method of increasing students' academic achievement in scientific subjects. Mierdel and Bogner (2020) believe this approach can make abstract theoretical knowledge concrete and clear. It also allows students to observe, manipulate and determine significant changes in variables directly. Hands-on modeling is an approach that allows students to gain knowledge through experiencing phenomena firsthand. It equips students with much practical experience by enabling them to manipulate learning objects in the classroom mathematics and science are practical and lab-related courses. Skills in science and mathematics can be acquired best through inquiry, creative and intelligent manipulation of rocks, scientific instruments, insects, anatomical bodies, mathematical sets, and magnetic fields, among many others (Ekweume, Ekon, & Nebite, 2015). A study on science and mathematics students' performance proposed that they need to be highly exposed to laboratory experience to solve their problems and society's (Ekweume, Ekon, & Nebite, 2015). Ekwueme, Ekon, and Nebite (2015) surveyed to measure the impact of exposing science and mathematics students to laboratory activities. The study found that students who are more experienced with laboratory activities, experiments, and assessments have a better chance of solving their problems and those of society. According to Ekwueme, Ekon, and Nebite (2015), in-class labs prepare students for work in the science field after graduating.

A study by Howe on musical students to determine their responses to the hands-on modeling approach with STEM subjects showed that experience is crucial in learning complex to learn the appropriate skills (Howe, 2015). Students' music performance increased as they spent time practicing and familiarizing themselves with the musical instruments, being hands-on. According to Howe, this approach helps build students' confidence and self-efficacy while using musical instruments in class. Similarly, integrating hands-on dynamics laboratories in the classroom is a very vital intervention for mechanical engineering students.

According to Sirinterlinki (2012), most colleges and universities have devoted themselves to using Vex Robotics to provide students with hands-on examples. Students can employ the theories and engineering concepts they learn from class to perform simple experiments with

robots. Vex Robotics is a type of robotics that provides students with an accessible, scalable, affordable educational experience and real-life solutions. Research shows that vex robotics emerged due to excellent collaboration between mechanical engineering professors and Vex manufacturers to boost students' mechanical skills (Stewardson, Robinson, Furse, & Pate, 2019). Hands-on modeling with Vex programs allows engineering students to better interact with vex robotics in carrying out simple experiments and collecting and comparing their analytical data in their group discussions.

Utilizing Both Technology and Hands-on Modeling to Enhance Student Performance

The lab has been established as the most profound resource for enriching students with proficient knowledge (Code, Ralph, & Forde, 2020). Scientists and school professors have suggested that giving students a better opportunity to undertake lab activities is vital. Worksheets, hands-on modeling, and labs continue to enrich students by activating their senses. They may retain content better because they can physically connect the manipulative and the content. This revolution in school learning has emerged while the world is experiencing rapid growth in technology. Students can learn independently, carry out their scientific research using various digitized sources, and only rely on their teachers for inquiry.

Integrating technology in school learning is no longer a luxury but a vital requirement in developing students and educational structures. E-learning technology has become an integral part of everyone's daily lives. Today, electronic devices and services such as mobile learning, electronic visualization, and virtual applications are extensively employed in education. Recent research has found that classroom experimentation and laboratory activities increase students' active participation in learning processes and acquire different skills (ICSU, 2011).

School instructors have driven their focus on using both technology and a hand-in-model approach (West & Graham, 2014). Combining these two approaches enables students to use a virtual lab to carry out their lab activities virtually. An e-laboratory can be defined as "a tool consisting of interactive computerized software linked with sensitive connector endings called sensors. The components of practical sciences experiments are integrated with computers as a measurement instrument to collect and analyze data (Al-Shaiey, 2006)."

In the usual context, technology enhances distance learning in areas mostly faced with

epidemics and natural disasters because students can receive the information without being physically present in the classroom. With distance learning, students acquire their learning materials through webmail and learning modules prepared by their instructors. However, distance learning poses a more significant challenge for scientific subjects. Lab practicals are often not possible with distance learning. Therefore, studies have found a new model known as Open Distance Learning (ODL), which aims to incorporate practical work into distance learning using technology (Bhukuvhani, Mupa, Mhisi, and Dziva, 2012). Bhukuvhani, Mupa, Mhisi, and Dziva (2012) describe ODL as mobile communication and media to enhance learning without physically being present at school.

Each of the interventions discussed has its benefits and challenges when used independently; using a hands-on model alone limits the teacher's ability to bring in new concepts in class. It also limits on 3D model hence limiting students' ability to visualize objects better during lab experiments. Using both models in classroom learning has a better impact on student performance than when used independently. Students will master content better by using both technology and hand-on-model when carrying out lab activities in class.

Method

Context

This research study was conducted at a high school located in Atlanta, Georgia, and is part of the Atlanta Public School district. The school currently has 954 enrolled students and 63 teachers, roughly a 16:1 ratio of students to teachers. African American students make up 96% of the student population, and Hispanic students make up 4% of the population. There are no Caucasian (or other ethnicity) students. The instructional staff at this Atlanta high school is predominately African American. The school is a Title I school; this means that the Georgia Department of Education aids in providing schools with federal funding because the poverty numbers among students and their families are high (Nolan, 2021). It is estimated that 31.4 % of the student population lives below the poverty line.

There are an estimated 225 true 9^{th} grade students enrolled at this school. Three teachers teach biology. This school teaches on an A/B schedule, which means students have one set of four classes on A-days and another set of four classes on B-days. The schedule continues for the entire school year (August to May).

The achievement level of students across all biology classes in this study varied from beginning to distinguished levels of achievement. Reading and math MAP (Measure of Academic Progress) scores of students across all classes are low, meaning that students may have difficulty understanding content and struggle when working independently. Students stayed home and attended school virtually during the 2019-2020 school year and 2020-2021. Academic performance declined, likely because students were not in the classroom and did not have parental guidance on completing assignments, along with distractors such as cellphones and video game consoles. Additionally, students did not complete assignments or attended class when they were supposed to.

Design

This study used a mixed-methods research design to conduct the research because both quantitative and qualitative data were collected. Before the interventions, a pre-test was given, and following the interventions, a post-test was given. Student surveys and off-task behavior checklists were used to collect qualitative data, and assessment scores were used as quantitative data. Each intervention also served as a control for the others.

Participants

The students that took part in this study are a part of the 9th-grade student population at this school. These students are a non-probability sample of the population of students at my school. The population of students is 100% African American, including 30% are females and 70% are males. Three of six available biology classes were randomly selected to take part in the study from the four co-taught classes. The instructor met with student participants on A and B days during regular instructional times. The times the instructor met with students varied throughout the day because the classes were randomly selected. The administration was made aware of the research in the classroom. Only students who agreed to or whose parents/guardians gave permission to take part had their data counted.

Intervention

Three interventions to implement three different methods of teaching were used, namely: hands-on modeling, technology, and a combination of both. Each intervention was given to a

different biology class taught on A and B days. All activities were focused on *SB2. Georgia Biology Standard*. This standard states that students will be able to obtain, evaluate, and communicate information to analyze how genetic information is expressed in cells; the lessons will focus on protein synthesis.

Intervention One was the hands-on modeling only teaching method. Students that took part in this intervention completed all activities by hand; no technological equipment was used by the students or the instructor. All lecturing was done verbally or by using the assigned biology textbook. Digital assistance was unavailable for students who took part in this intervention. All activities and labs completed during this unit of the study were completed by hand, and all documentation for the unit was completed on paper. Students in the 1B biology class took part in Intervention One.

Intervention Two was the technology-only teaching method. Students that took part in this intervention completed all lectures, activities, and assessments using Chromebooks. All teaching was done using digital tools as well. Chromebooks are digital laptops given by the Atlanta Public School District at no cost to students and families. During lectures, the instructor used technology such as BoxLight computers, and all interactions and resources used to teach were digital. Students in the 3B biology class took part in Intervention Two.

Intervention Three was a combination of technology and hands-on modeling. Students who took part in this intervention used technology and hands-on modeling during the unit. All activities, assessments, and student notes were completed on paper and using their Chromebooks. During lectures, the instructor used the BoxLight computer, paper notes, and digital imagery to teach students.

Data Collection

Three interventions were used to determine which intervention yielded the highest post-test scores in the biology classes. Higher post-test scores indicate content mastery, meaning the higher the post-test scores, the better students mastered the content. Outlined below are the procedures, instruments, reliability/validity, dependability/creditability, and triangulation used in my action research study.

Procedures

Table 1 shows the schedule for data collection. During Week 1, students took a biology pre-test on the unit of study (see Appendix A). A pre-intervention survey (see Appendix B) on how students learn best in the classroom and parent/guardian permission forms (see Appendix C) were given during Week 1.

Table 1. Data Collection Schedule

Week	**Scheduled Event**
Week 1	Pre-Test and Pre-Intervention Survey Parental/Guardian Permission Form Distributed
Week 2	Intervention and Behavior Checklist Monitoring
Week 3	Intervention and Behavior Checklist Monitoring
Week 4	Intervention and Behavior Checklist Monitoring
Week 5	Post Test and Post Intervention Survey
Week 6	Data Analysis; Action Research Report Writing

Weeks 2, 3, and 4 classes that participated in the research study received their interventions. The 1B biology class received the hands-on modeling intervention. During this intervention, all activities and lecturing materials were given on paper. Throughout the unit, the instructor did not use any digital technology. The 3B biology class received the technology-only intervention. Activities were distributed to students using the Google Classroom platform, and all lectures used the digital BoxLight to assist while delivering the content.

Chromebooks were used to complete all students' lab simulations, and they were used to answer lab analysis questions. The 4A biology class received a combination of hands-on technology and hands-on modeling intervention. Students in this class received all activities and all lecturing materials. The BoxLight was used during lectures to show digital imagery and PowerPoint presentations to supplement the content being taught in the unit. Chromebooks were used to run lab simulations, and lab analyses were completed on paper. During each class period that the interventions took place, the instructor also monitored student behaviors and collected data on the behaviors displayed during each class period using a behavior checklist (see Appendix D).

During Week 5, students took a post-test (Appendix E) and post-intervention survey (Appendix F). The post-test measured how well students mastered the content was taught during the interventions. The post-intervention survey asked students how they felt their learning may have changed during the interventions. In Week 6, the data that was collected was analyzed, and the instructor reported findings during this time.

Instruments

The instruments used are vital to understanding the possible correlations between content mastery and technology use in the classroom. Students will complete an intervention survey before and after the interventions are implemented. The intervention survey elicited student opinions on how students feel they learn best before and after the intervention; students were given a similar survey to see if their opinions about their learning have changed throughout the interventions. Other instruments were the pre- and post-tests. The pre-test provided a baseline of what students knew about the content before the interventions were introduced. The post-test will measure their mastery of the content after the interventions are introduced. The post-test data was then used to determine which intervention caused students to perform the best in the post-test. The final instrument used was a behavior checklist. The behavior checklist allowed the instructor to keep track of students' behaviors during the interventions. Examples of the behaviors observed included: sleeping in class, walking around the room, cellphone use, working on other assignments, etc. Using the off-task behavior checklist, I was able to conclude student engagement during each intervention.

Reliability/Dependability

The reliability method used was the equivalent forms method. The test-retest approach ensures reliability because the same assessment will be given to the same group of students twice. The reliability and dependability of the instruments have been determined by providing the same assessment to students twice. The pre-test and post-test are comprised of the same questions. The assessments were created using the All in Learning (AIL) platform. The AIL platform consists of questions from various test banks such as Pearson education. These questions were created and vetted by science board members. The first assessment was given before the interventions are implemented. The assessment was given again after the interventions were implemented.

Validity/Accuracy

Both quantitative and qualitative data collection tools have been checked for validity and accuracy. After the student surveys were collected, the instructor interpreted what students wrote when answering the questions. Any misconceptions were addressed by the instructor speaking with the individual students directly to make. Confirming direct quotes with students by member check will ensure the validity and accuracy of their statements while completing the intervention surveys. When checking the validity and accuracy of the quantitative data collection tool that used in this research was the Expert Review Method, completed by checking with several colleagues regarding the questions asked on the assessment tools. By double-checking with colleagues, it could be confirmed that the questions asked in the assessments are aligned with the Georgia Standards of Excellence for Biology. It is pertinent that the questions being asked in the assessment align with the correct standards to measure content mastery amongst students accurately.

Triangulation

The collected and analyzed data led to several contrary correlations to the original research questions. Student pre-interview data indicated that the favorable preference for teaching was hands-on only. Students felt that being able to write instead of type and manipulate objects physically would better help them master the content. However, the data shows that this preference does not translate into the highest content mastery. Students' preference for learning and the teaching method that yielded the highest post-test mean score did not coincide. Total off-task behaviors did not decrease, over each week, as the interventions took place within each class; as a result, overall test scores remained low across all teaching methods, and off-task behaviors seemed to be contributing factors to why the test scores remained low because the total off-task behaviors were higher than the mean.

Data Analysis

Descriptive statistics were used to calculate the means and standard deviations of the dependent variables. Then pre-test and post-test data collected from each teaching method were analyzed using the Analysis of Covariance (ANCOVA). ANCOVA evaluates where the calculated mean across each dependent variable is at equal levels of the independent variable.

Post-test scores and post-intervention off-task behaviors were compared across three teaching methods using the content pre-test and pre-intervention off-task behaviors as covariates. Descriptive analysis techniques were used to analyze the data to decide central tendency and variability measures. Off-task behaviors were recorded using a checklist; each time a student displayed a behavior on the checklist, a tally was placed by their name. After the behaviors were tallied, students were then given a number, and their names would be coded so their identities would not be revealed. Using an Excel spreadsheet, their behaviors for that week were totaled using the Excel formula. Once the student names and weekly totals were calculated, the mean and standard deviation were calculated.

Threats to Internal Validity

Threats to internal validity that faced during this research included students cheating during pre-tests and post-tests and the presence of a co-teacher during co-taught classes also posed an issue. To decrease cheating during testing, I used the Securely screen monitoring platform to watch student screens while they took their assessments. Securely also allowed me to preset their websites, so students could not maneuver to different websites to look up the answers. By discussing with the co-teacher the purpose of the action research, the instructor was able to clarify the co-teacher's role during the interventions, so she did not interfere with student scores. Because some students in the class receive Individualized Education Plan (IEP) services, their data were not counted even though they were all allowed to take part. The final threat to internal validity faced was the time-lapse between seeing the students. Several school-wide events took place throughout the research period that changed the school-wide scheduling, and as a result there was a significant lapse in time in which students attended class, which created gaps in their learning of the content.

Limitations

The interventions were built into each lesson because they took place during the unit required to be covered according to the Georgia Standards of Excellence. There was limited flexibility in what content students were taught. Students may have found the content uninteresting and did not actively take part in a class or the activities as they would have if they enjoyed the content they were learning about. During this research, another limitation faced was the time frame to conduct my research and analyze it. The final limitation faced during this research

period was the scheduling of classes. There was considerable variation in how many times the students were seen each week. On several occasions, the instructor did not see classes in their entirety due to school-wide testing; this made it challenging to continue content so that students could adequately master it because of the continued disruptions to the unit of study.

Protection of Human Subjects

A letter was sent home to parents and guardians informing them of the research in the classroom. Parental permission was unnecessary as hands-on and technological techniques were already used in the classroom before this research project. Approval was obtained from the principal and instructional coach; after permission was granted, the data were collected. Identifying student information was removed from all collected documentation, and sensitive information was kept in a locked filing cabinet. When presenting student data, codes were used to protect their identities. Before implementing the interventions in the class, the instructor received PHRP training and ensured the proper IRB application was submitted.

Results

Measures of central tendency for post-tests show that the combined Chromebook and Hands-on modeling teaching method had the highest mean (M=65.33) among the three interventions (see Table 2).

Table 2. Summary of Assessment Data Amongst All Interventions

Strategy	Mean	Std. Deviation	N
CB&HO	65.33	23.258	15
ChromeBK	50.00	10.000	7
Hands-On	33.33	18.257	12
Total	50.88	23.788	34

The frequency of off-task behaviors was calculated to compare the three interventions (see Table G1 in Appendix G for the raw data that was collected). The combination of Chromebook use and hands-on modeling yielded the most off-task behaviors during the

interventions. A one-way between-subjects ANCOVA was calculated to examine the comparative impact of using three methods to teach Biology on the students' off-task behaviors (see Table G2 in the Appendix). Pre-intervention off-task behaviors are related to the post-test off-task behavior. The off-task behavior during the three teaching methods in the study's biology unit does not differ significantly. Table 3 shows the three learning methods' mean off-task behavior in the three classes. With pre-intervention off-task behavior control, the main effect of the strategy was not significant ($F(2.53)=0.199$, $p=0.820$). Student behaviors did not differ significantly over time among the three strategies.

Table 3. Summary of Off-Task Behaviors Amongst Interventions

Strategy	Mean	Std. Deviation	N
CB&HO	2.52	1.855	23
ChromeBK	2.86	4.055	14
Hands-On	2.65	2.368	20
Total	2.65	2.663	57

Another one-way between-subjects Analysis of Covariance (ANCOVA) was calculated (see Table G3) to examine the relative effects of three strategies for teaching Biology on students' performance in the unit of study. The main effect of the teaching strategy was significant ($F(2,30)= 7.74$, $p<.001$) (see Table G3), with the combination of Chromebook and Hands-on use producing a significantly more significant effect ($M=65.33$, $SD=23.26$), than Hands-On alone ($M=33.33$, $SD=18.26$), but not substantially more significant than Chromebook use alone ($M=50.0$, $SD=10.0$) (see Table G4). When comparing the three methods of teaching Biology, using the Chromebook and hands-on had the highest post-test mean, and the lowest off-task behaviors mean.

Discussion

Combining hands-on teaching with Chromebook technology yielded the highest content mastery scores among the three different teaching methods used. The teaching method utilized technology and hands-on modeling and had the highest post-test mean and the lowest mean of off-task behaviors. Kapur's (2018) findings reveal that students could better

understand the content being taught and perform better on assessments by integrating the appropriate use of computer technology. These results align with Kapur's findings that students mastered content better when technology-specific Chromebook computer use was incorporated into the lessons.

According to Tucker (2020), students are not engaged in materials such as textbooks because the learning experience is not being positively influenced, and students find it hard to relate to the material. The results presented here relate to Tucker (2020) in that those students who received the hands-on only teaching did the poorest on the post-test, indicating that the students who received this teaching method did not master the content very well. This correlates to Tucker in that the higher the off-task behaviors, the lower the post-test scores were, indicating that students were not engaged in the hands-on activities that were taking place. Mierdel and Bogner's (2020) research results indicated that hands-on modeling was the most effective way to increase scientific, academic achievement.

The data presented here suggest that using hands-on modeling as a single approach to teaching content is not the most effective for achievement. Students utilizing only Chromebooks during the provided teaching method had a higher post-test mean than students only using the hands-on approach, indicating that this group mastered the content better. Students utilizing the Chromebook-only teaching method had the highest standard deviation regarding off-task behaviors implying that off-task behaviors during this teaching method were higher than the mean among all three teaching methods. McCoy (2016) states that students get easily distracted and were off-task frequently when using their Chromebooks. This result is also consistent with the findings presented here, because students using only their Chromebook during the lessons got off task by texting, doing activities unrelated to the current task, and browsing the internet.

The instructor consistently found that students were not performing well on assessments using a single teaching method, whether a Chromebook-based technology lesson or a hands-on modeling lesson. ANCOVA analysis on teh pre-test and post-test, it was determined which teaching method allowed students to perform better on the post-test. Students utilizing the teaching method that combined both Chromebook use and hands-on modeling performed significantly better on the post-test, indicating students mastered the content better than the other groups of students using each method by itself.

Future Directions

In future studies, it would be interesting to focus this research on the off-task behaviors. Though the standard deviation during the hands-on only teaching method was the highest among the mean, the total behaviors across all three groups were high by looking at the specific activities during each teaching method. Active learning did not occur during the teaching methods students received in the classroom. Active learning is defined as classroom-based activities designed to engage students in their learning; these activities require students to discuss problems, take part in class discussions, and group and learning activities, including student teaching (Borrego et al., 2021). Patrick, Howell, and Wischusen (2016) indicate that students believe active learning will benefit their learning. Still, there are not enough studies to support this theory, and as a result, instructors stick to traditional lecturing. By focusing attention on the specific activities, it is possible to determine if active learning plays a part in decreasing off-task behaviors and continuing to improve content mastery. This will allow me to expand on content mastery and determine if active learning plays a role in how well students master the content being taught.

Acknowledgements

The authors would like to extend thanks to Dr. Winifred Nweke of Clayton State University (Morrow, Georgia, USA) who provided invaluable support in the data calculations and ANCOVA analysis.

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Appendix A. Pre-Test

1. Which of the following are found in both DNA and RNA?

a. Ribose, phosphate groups, and adenine

b. Deoxyribose, phosphate groups, and guanine

c. Phosphate groups, guanine, and cytosine

d. Phosphate groups, guanine, and thymine

2. Which nucleotide in the above figure indicates the nucleic acid above is RNA?

a. Uracil

b. Guanine

c. Cytosine

d. Adenine

3. What is produced during transcription?

a. RNA molecules

b. DNA molecules

c. RNA polymerase

d. Proteins

4. During eukaryotic transcription, the molecule that is formed is

a. complementary to both strands of DNA.

b. identical to an entire single strand of DNA.

c. double-stranded and inside the nucleus.

d. complementary to part of one strand of DNA.

5. There are 64 codons and 20 amino acids. Which of the following is true?

a. Several different codons can specify the same amino acid.

b. Each codon specifies a different amino acid.

c. Some amino acids have no link to a codon.

d. Each amino acid is specified by only one codon.

6. A promoter is

a. binding site for DNA polymerase.
b. binding site for RNA polymerase.
c. start signal for replication.
d. stop signal for transcription.

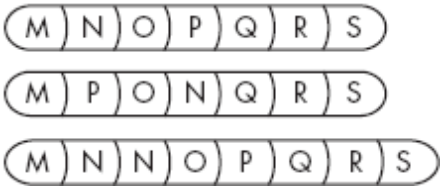
7. During translation, the type of amino acid that is added to the growing polypeptide depends on the

a. codon on the mRNA and the anticodon on the rRNA.
b. anticodon on the mRNA and the anticodon on the tRNA.
c. anticodon on the rRNA and the codon on the mRNA.
d. Codon on the mRNA and the anticodon on the tRNA.

8. In eukaryotes

a. Transcription takes place in the cytoplasm, and translation takes place in the nucleus.
b. Transcription takes place in the nucleus, and translation takes place in the cytoplasm.
c. Transcription and translation both take place in the cytoplasm.
d. Transcription and translation both take place in the nucleus.

9. Insertions and deletions that change the entire genetic message that comes after the mutation are called _____.



10. Mutant 1 in the above figure is the result of a(n) _____ because part of the chromosome is in the reverse position.

Appendix B. Pre-Intervention Student Survey

1. Do you learn best using your Chromebook or doing things on paper using your hands?

2. Would you like to do more hands-on labs in class or more online simulations if you had a choice? Please explain your choice.

3. On a scale of 1-5, do you think your behaviors (frequently using the bathroom, being on your cellphone, doing other assignments) will affect your ability to master the content taught during class?

Appendix C. Parental/ Guardian Permission Form

Consent Form for Class Projects

Clayton State University

Title of Project: The Effect of Technology and Hands-On Modeling on High School Student Performance

Student Researcher(s): Kimesha Brooks, kbrooks14@student.clayton.edu
Course: EDUC 5401 Action Research
Semester: Spring 2022 Semester
Course Professor: Dr. Nweke, wnweke@clayton.edu

1. **Project Purpose:** Your child is invited to participate in a project conducted as part of the course requirements in the Department of Education at Clayton State University. For this project, I will be using three different teaching methods, singly and in combination. I am collecting this information to examine content mastery in the classroom. The course instructor will supervise the project: EDUC 5401: Action Research, Dr. Nweke.

The purpose of this study is to investigate what interventions work best to increase student performance in my biology class; I will also monitor distractive behaviors during the interventions. The information generated will not be used for academic research or publication. All information collected will be aggregated and analyzed; your child's name will not be identified with the final results. All information obtained will be treated confidentially.

2. **Procedures to be followed:** For this project, your child will complete the unit of study normally, there will be a variation in how they complete the activities during the unit of study. For this project, I will collect data on distractive behaviors and assessment scores before and after the intervention.

3. **Duration/Time:** Your child's participation in the study will only last four weeks.

4. Statement of Confidentiality: Your child's participation in this research is confidential. Data collection methods do not ask for any information that would identify your child's responses.

5. Right to Ask Questions: If you have any questions or concerns, feel free to contact my instructor, Dr. Nweke, at 678-466- 4824. If you have questions about your child's rights as a participant in this project, please contact Dr. Jill Lane, Associate Provost, at (678) 466-4100 or Jill Lane@clayton.edu .

6. Voluntary Participation: Your decision to allow your child to be in this project is voluntary. Your child can stop at any time. Your child does not have to answer any questions he/she does not want to answer.

If you agree for your child to take part, please sign your signature and indicate the date below.

You will be given a copy of this form for your records.

_____ _____

Parent/Guardian Signature Date

_____ _____

Student Researcher Date

Appendix D. Off-Task Behavior Checklist

	Head Down	Sleeping	Walking Around	Using Cellphone	Leaving the Classroom	Doing other Assignments	Total # of Behaviors
Student 1							
Student 2							
Student 3							
Student 4							
Student 5							
Student 6							
Student 7							
Student 8							
Student 9							
Student 10							
Student 11							

Appendix E Post-Test

1. Which of the following bases pairs with guanine?
   a. Adenine
   b. Guanine
   c. Cytosine
   d. Uracil

2. Which of the following are found in both DNA and RNA?
   a. Ribose, phosphate groups, and adenine
   b. Deoxyribose, phosphate groups, and guanine
   c. Phosphate groups, guanine, and cytosine
   d. Phosphate groups, guanine, and thymine

3. Which nucleotide in the above figure indicates the nucleic acid above is RNA?
   a. Uracil
   b. Guanine
   c. Cytosine
   d. Adenine

4. What is produced during transcription?
   a. RNA molecules
   b. DNA molecules
   c. RNA polymerase
   d. Proteins

5. During eukaryotic transcription, the molecule that is formed is
   a. complementary to both strands of DNA.
   b. identical to an entire single strand of DNA.
   c. double-stranded and inside the nucleus.
   d. complementary to part of one strand of DNA.

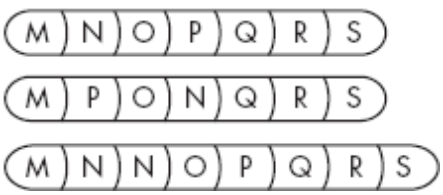
6. There are 64 codons and 20 amino acids. Which of the following is true?
   a. Several different codons can specify the same amino acid.
   b. Each codon specifies a different amino acid.
   c. Some amino acids have no link to a codon.
   d. Each amino acid is specified by only one codon.

7. A promoter is
   a. binding site for DNA polymerase.
   b. binding site for RNA polymerase.
   c. start signal for replication.
   d. stop signal for transcription.

8. During translation, the type of amino acid that is added to the growing polypeptide depends on the
   a. codon on the mRNA and the anticodon on the rRNA.
   b. anticodon on the mRNA and the anticodon on the tRNA.
   c. anticodon on the rRNA and the codon on the mRNA.
   d. Codon on the mRNA and the anticodon on the tRNA.

9. In eukaryotes
   a. Transcription takes place in the cytoplasm, and translation takes place in the nucleus.
   b. Transcription takes place in the nucleus, and translation takes place in the cytoplasm.
   c. Transcription and translation both take place in the cytoplasm.
   d. Transcription and translation both take place in the nucleus.

10. Insertions and deletions that change the entire genetic message that comes after the mutation are called _____.



11. Mutant 1 in the above figure is the result of a(n) _____ because part of the chromosome is in the reverse position.

Appendix F. Post- Intervention Student Survey

1. Which intervention did you participate in?

2. Is there anything you would change regarding the activities we did in class, if so what changes would you make?

3. Did you feel distracted during the activities in class? Please list what those distractions. Be specific.

4. If you were the instructor, how would you decrease the distractions?

5. On a scale of 1-5 how engaged were you during the activities, we did in class? 1 being least engaged and 5 being most engaged?

Appendix G. Summary of All Data

Table G1. Off-Task Behavior and Pre and Post Test Scores

Strategy	Stud Code	Pr Intv OT	Bio Pr Tst	OT WK1 Tl	OT WK2 Tl	OT WK3 Tl	OT WK4 Tl	Pst Intv OT	Bio Pstst
ChromeBK	CB1	8	20	8	7	7	4	4	50
ChromeBK	CB2	15		15	6	0	16	16	50
ChromeBK	CB3	5		5	1	3	0	0	
ChromeBK	CB4	7		7	4	6	2	2	
ChromeBK	CB5	2		2	0	4	1	1	50
ChromeBK	CB6	0	10	0	1	0	1	1	40
ChromeBK	CB7	4	10	4	2	0	4	4	40
ChromeBK	CB8	2	10	2	3	5	1	1	60
ChromeBK	CB9	3	10	3	0	3	2	2	
ChromeBK	CB10	6	0	6	0	1	2	2	60
ChromeBK	CB11	1	0	1	2	2	0	0	60
ChromeBK	CB12	8		8	1	2	3	3	
ChromeBK	CB13	3	0	3	2	1	4	4	40
ChromeBK	CB14	4		4	0	0	0	0	
Hands-On	HO1	4	10	4	2	0	3	3	40
Hands-On	HO2	10	0	10	6	7	2	2	10
Hands-On	HO3	5	30	5	1	4	4	4	60
Hands-On	HO4	2	20	2	0	1	0	0	20
Hands-On	HO5	4	40	4	3	0	4	4	70
Hands-On	HO6	8	20	8	1	2	6	6	40
Hands-On	HO7	9	0	9	1	7	6	6	30
Hands-On	HO8	6	10	10	0	7	0	0	30
Hands-On	HO9	3	40	3	4	2	3	3	20
Hands-On	HO10	5		5	7	1	8	8	

Strategy	Stud Code	Pr Intv OT	Bio Pr Tst	OT WK1 Tl	OT WK2 Tl	OT WK3 Tl	OT WK4 Tl	Pst Intv OT	Bio Pstst
Hands-On	HO11	7		7	0	5	0	0	
Hands-On	HO12	9		9	2	9	1	1	40
Hands-On	HO13	10		10	3	3	1	1	
Hands-On	HO14	3	20	3	0	0	2	2	
Hands-On	HO15	6		6	5	2	0	0	50
Hands-On	HO16	5	10	5	4	6	3	3	
Hands-On	HO17	8	0	8	1	7	1	1	10
Hands-On	HO18			0	0	0	0	0	20
Hands-On	HO19	7		7	0	2	5	5	10
Hands-On	HO20	9	20	9	8	2	4	4	30
Hands-On	HO21	0	10	0	0	0	0	0	40
CB&HO	CBHO1	6	50	6	3	5	6	6	70
CB&HO	CBHO2	4	40	4	0	0	2	2	80
CB&HO	CBHO3	8	20	8	5	3	2	2	
CB&HO	CBHO4	3	40	3	3	2	4	4	60
CB&HO	CBHO5	3	10	3	1	0	2	2	100
CB&HO	CBHO6	5	20	5	1	3	1	1	90
CB&HO	CBHO7	7	0	7	0	0	3	3	80
CB&HO	CBHO8	6	0	6	2	3	3	3	
CB&HO	CBHO9	9	50	9	1	0	0	0	
CB&HO	CBHO10	4	10	4	4	0	0	0	
CB&HO	CBHO11	3	30	3	1	0	2	2	20
CB&HO	CBHO12	3	30	3	0	0	3	3	90
CB&HO	CBHO13	7	30	7	2	6	3	3	30
CB&HO	CBHO14	2	30	2	0	0	2	2	50
CB&HO	CBHO15	13		13	3	0	1	1	
CB&HO	CBHO16	5	40	5	1	2	1	1	70

Strategy	Stud Code	Pr Intv OT	Bio Pr Tst	OT WK1 Tl	OT WK2 Tl	OT WK3 Tl	OT WK4 Tl	Pst Intv OT	Bio Pstst
CB&HO	CBHO17				0	0	5	5	
CB&HO	CBHO18	3	20	3	1	1	3	3	40
CB&HO	CBHO19								
CB&HO	CBHO20								
CB&HO	CBHO21	10	10	10	3	1	1	1	
CB&HO	CBHO22	7	20	7	0	4	4	4	
CB&HO	CBHO23	3	0	3	2	0	4	4	80
CB&HO	CBHO24	4		4	0	2	8	8	20
CB&HO	CBHO25	1	50	1	2	2	1	1	70
CB&HO	CBHO26	1	10	1	2	0	2	2	50

Legend

This legend provides a breakdown of the codes used, and their meanings.

ChromeBK- Chromebook Only	CB#- Chromebook Only Student #	PrIntvOT- Pre-Interventon Off Task Behavior	PstIntvOT- Post Intervention Off Task Behavior
Hands-On- Hands On Only	HO#- Hands-On Only Student #	BioPrTst- Pre-Test Score	BioPstst- Post Test Score
CB&HO- Chromebook & Hands-On	CBHO#- Chromebook& HandsOn Student #	OTWK#Tl- Off Task Week # Behavior Total	StudCode- Student Code

Table G2. Tests of Between- Subjects Effects

Dependent Variable:	PstIntvOT				
Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	51.425[a]	3	17.142	2.629	.060
Intercept	15.503	1	15.503	2.378	.129
PrIntvOT	50.445	1	50.445	7.737	.007
Strategy	2.599	2	1.300	.199	.820
Error	345.558	53	6.520		
Total	797.000	57			
Corrected Total	396.982	56			

a. R Squared = .130 (Adjusted R Squared = .080)

Table G3. Tests of Between-Subjects Effects

Dependent Variable:	BioPstst				
Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	6890.286[a]	3	2296.762	5.848	.003
Intercept	29810.725	1	29810.725	75.898	.000
BioPrTst	56.757	1	56.757	.145	.707
Strategy	5924.684	2	2962.342	7.542	.002
Error	11783.243	30	392.775		
Total	106700.000	34			
Corrected Total	18673.529	33			

a. R Squared = .369 (Adjusted R Squared = .306)

Table G4. Pairwise Comparisons

Dependent Variable:	BioPstst					
					95% Confidence Interval for Difference[b]	
(I) Strategy		Mean Difference (I-J)	Std. Error	Sig.[b]	Lower Bound	Upper Bound
CB&HO	ChromeBK	13.486	10.291	.200	-7.530	34.503
	Hands-On	31.054*	8.069	.001	14.575	47.533
ChromeBK	CB&HO	-13.486	10.291	.200	-34.503	7.530
	Hands-On	17.568	9.719	.081	-2.281	37.416
Hands-On	CB&HO	-31.054*	8.069	.001	-47.533	-14.575
	ChromeBK	-17.568	9.719	.081	-37.416	2.281
Based on estimated marginal means						
*. The mean difference is significant at the .05 level.						
b. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).						

Table G5. Mean Scores & Off Task Behaviors

Strategy	Off-task	Biology
CB&HO	2.52	65.33
ChromeBK	2.86	50.00
Hands-On	2.65	33.33

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Chapter 13 - The Relationship between Students' Satisfaction and Motivation and their Perceived Learning Outcome in an Online Peer Feedback Module

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Chapter Highlights

- Peer feedback is an effective instructional strategy to improve students' argumentative essay writing, especially in online learning environments.
- This chapter reported the results of s research study which explored students' satisfaction and motivation when engaging with online peer feedback activity and the relationships between students' satisfaction and motivation and their perceived learning in the context of argumentative essay writing.
- Forty-nine graduate students from a Dutch university participated in this study and followed an online module called "Argumentative Essay Writing" for three weeks.
- The findings indicated high satisfaction and motivation among students concerning the designed online peer feedback module.
- The current study's findings showed that students with high motivation and satisfaction perceive a high level of learning when engaging with online peer feedback.
- The findings suggest that online peer feedback is a mediator which can affect students learning outcomes through motivation and satisfaction.

Introduction

With the emergence of new technologies in recent years, increasing attention has been paid to leveraging their potential for improving education at various educational levels, ranging from K-12 (e.g., Guan et al., 2021; Hassanzadeh et al., 2016; Hatami et al., 2016) to higher education (e.g., Abu Talib et al., 2021; Mystakidis et al., 2022). Research findings indicate that information technology provides teachers not only with effective and inflexible means for professional development (e.g., Bragg et al., 2021; Hu et al., 2021), but it also makes it possible for them to design flexible learning environments that are not constrained by time or space (Lai, 2021; Maphosa, 2021). In the technology-based learning environments, students can easily access various learning materials (Mahajan et al., 2020), share and discuss their ideas with other students (Li et al., 2021), and co-construct their knowledge (Farrokhnia et al., 2019).

In recent years, scholarly attention has been paid to using technologies to facilitate peer feedback in educational contexts (e.g., Noroozi et al., 2016, 2018; Valero Haro et al., 2019). Research evidence suggests that peer feedback can improve students' argumentative essay writing (Latifi et al., 2019), foreign language writing (Tian & Zhou, 2020), and domain-specific knowledge gain (Noroozi & Mulder, 2017; Latifi et al., 2021). According to Winne and Butler (1994), the information contained in peer feedback helps the learner to confirm, complement, overwrite, or restructure their domain-specific knowledge, metacognitive knowledge, beliefs, and cognitive tactics. In comparison to the traditional peer feedback, online peer feedback enables students to present and submit their contributions and re-review learning partners' submissions in a more structured way (Lin et al., 2001), allows educators the implementation of various types of scripts and scaffolding peer feedback processes that can guide learners towards a desirable mode of Eom interaction (Noroozi et al., 2016; 2021), and it provides students with the flexibility to modify their feedback through the learning processes (Yang, 2011).

Although scientific literature highlights the importance of online peer feedback for learning, a few studies have shown that online peer feedback can remain at the surface level and may not result in positive impacts on students' learning or even can negatively influence their learning processes (e.g., Cho & Schunn, 2007; Jermann & Dillenbourg, 2003; Tchounikine, 2008). These negative findings could be related to students' satisfaction and motivation with learning

in online contexts. Recent research has shown that students' satisfaction with a learning environment significantly affects their engagement (Kandiko Howson & Matos, 2021) and that learners who are more engaged are more likely to adopt positive behaviors, especially in online learning environments (Liu et al., 2022; Rajabalee & Santally, 2021; Rodríguez-Ardura & Meseguer-Artola, 2016).

Students' satisfaction and motivation also affect their perceived learning in online contexts (Eom, 2015), making them key aspects in evaluating the effectiveness of online learning (Arbaugh & Benbunan-Fich, 2007; So & Brush, 2008). Peer feedback is considered a learning process (Nicol et al., 2014; Noroozi, 2022; Taghizadeh Kerman, Noroozi, et al., 2022), and thus, students' satisfaction with the learning experience that takes place in online peer feedback can play an influential role in the uptake and effectiveness of peer feedback (Mercader et al., 2020). According to scholars, if students are not satisfied with online peer feedback, they might not be willing to take it seriously and implement the received feedback in their works (Taghizadeh Kerman, Banihashem, et al., 2022).

So far, many studies have explored the learning benefits of online peer feedback for students (van Popta et al., 2017) and the relationship between peer feedback and students' success in academic contexts (Huisman et al., 2018; Simonsmeier et al., 2020; Strijbos et al., 2010). However, there is still a gap in understanding how online peer feedback influences students' satisfaction and motivation levels. More importantly, evidence is scarce about the relationship between these two critical variables and students' perceived learning outcomes due to receiving peer feedback in online contexts.

This study aimed to fill in these gaps in the literature by exploring students' satisfaction and motivation when engaging with online peer feedback activity and the relationships between students' satisfaction and motivation and their perceived learning in the context of argumentative essay writing. In this regard, the following research questions are formulated and addressed in this study:

RQ1. To what extent are students satisfied with online peer feedback activity in the context of argumentative essay writing?

RQ2. To what extent are students motivated by online peer feedback activity in the context of argumentative essay writing?

RQ3. What is the relationship between students' satisfaction and motivation with

perceived learning outcomes in argumentative essay writing?

Method

Participants

This research was conducted as part of a larger project at Wageningen University and Research during the academic year 2020-2021. As part of a larger project, one course from the social science domain was selected, and 49 graduate students (female: N = 35, 72 %, male: N = 14, 28%) participated in this research. The course was conducted on the Brightspace platform, and the students were required to follow a module called "*Argumentative Essay Writing*" for three consecutive weeks.

For the first week, students learned the basics of writing an argumentative essay, and they were asked to write an argumentative essay on one of the three provided topics (topic 1: Children and video games, topic 2: Genetically Modified Organisms (GMOs), topic 3: Climate change). For the second week, students were requested to critically review two of their peers' argumentative essays and provide feedback on their essays based on the given criteria. For the third week, students were requested to revise their original essays based on the two feedback sets that they had received from peers. At the end of the third week, students were asked to fill out a survey about their motivation, satisfaction, and perceived learning.

Instrument

A questionnaire with 38 items developed by Mehdizadeh (2008) and adjusted by Noroozi and Mulder (2017) was adapted to assess students' satisfaction and perceived learning experiences. To assess students' motivation, we used a questionnaire designed by Xiao and Lucking (2008) and adjusted by Noroozi and Mulder (2017). This questionnaire consisted of three main sections, and every section contained some subcategories:

- The first section (5 items) assessed students' perceived motivation and enjoyment of peer feedback.
- The second section (17 items) assessed students' satisfaction with three subcategories (Ease of use of the online module, satisfaction with the learning task, and Perceived

fairness of peer feedback), and

- The third section (16 items) collected information on students' opinions on the Perceived learning with tree subcategory (Perceived effects of the domain-specific learning outcomes, Perceived effects of the domain-general learning outcomes, Perceived usefulness of peer feedback).

Procedure

To run this study, a course module called "Argumentative Essay Writing" was designed and embedded in the course within the Brightspace platform. The students followed the module for three consecutive weeks, and for each week, they were asked to complete specified tasks:

- In the first week, students were provided with introductory instructions on how to write an argumentative essay; they were asked to fill out an online survey about their demographic data and write an argumentative essay in English on one of the three provided topics, including
  (a) the long-term impacts of COVID-19 on the environment,
  (b) the role of private actors in funding local and global biodiversity, and
  (c) ban on the use of single-use plastics.
- The course teacher selected the topics based on the given criteria, including that the topic had to be controversial and rather new in the field of environmental economics and environmental policy. We considered the first draft of the essay as the pre-test.
- In the second week, students were asked to review two of their peers' argumentative essays and provide comments on them (30 to 50 words for each argumentation element – see next section) on peers' essay performance based on the given criteria embedded in the FeedbackFruits app within the Brightspace platform.
- In the third week, students were asked to revise their essays according to the two review sets they received from their learning peers and submit the revised version of the essay on the platform.

Analysis

Multiple Linear Regression and Pearson correlation coefficient methods were used to explore the students' motivation and satisfaction in predicting perceived learning outcomes in an

online peer feedback environment. Descriptive statistic methods were also used to summarize the overall evaluation of students.

Results

RQ1. To what extent are students satisfied with online peer feedback activity in the context of argumentative essay writing?

The results showed high satisfaction with online peer feedback activity in the context of argumentative essay writing (M = 3.86, SD =0.56), ease of use of the online module (M = 4.08, SD = 0.77), satisfaction with the learning task (M = 3.80, SD = 0.74), and perceived fairness of peer feedback (M = 3.75, SD = 0.82). Students' satisfaction with ease of use of the online module was at a higher level, and perceived fairness of peer feedback was at a lower level. Also, using overall satisfaction scores, students were divided into three groups. 30.4% of students were unsatisfied, 26.8% moderately satisfied, and 30.4% satisfied.

RQ2. To what extent are students motivated by online peer feedback activity in the context of argumentative essay writing?

Students' overall motivation for online peer feedback in the context of argumentative essay writing was above average (M =3.56, SD =8.2), similar to the result for each item: "I enjoyed giving feedback to my peers' works" (M = 3.71, SD = 0.95), "I enjoyed receiving feedback from my peers on my works" (M = 3.77, SD = 1.02), "peer feedback activities motivated me to engage in learning assignments" (M = 3.48, SD = 0.98), "I felt proud when I receive positive peer feedback on my works" (M = 3.93, SD = 0.98), and "I felt comfortable giving critical feedback to my peers' works" (M = 4.18, SD = 0.72).

RQ3. What is the relationship between students' satisfaction and motivation with perceived learning outcomes in the context of argumentative essay writing?

As shown in Table 1, there was a positive and significant relationship between students' satisfaction and their perceived learning outcomes in two subcategories, i.e., satisfaction with the learning task and perceived fairness of peer feedback. However, there was no relationship between the perceived usefulness of peer feedback with perceived learning. The result also showed a positive relationship between students' satisfaction with the learning task and

perceived domain-specific and general learning outcomes. In addition, a positive and significant relationship was shown between students' motivation and their perceived learning outcomes in three subcategories, i.e., domain-specific, domain-general learning, and perceived usefulness of peer feedback.

Table 1. Relation between Students' Motivation, Satisfaction, and Perceived Learning

	r	p	significant
Relation between motivation and perceived learning			
Perceived effects on the domain-specific learning outcomes	0.42	$p = 0.007$	Yes
Perceived effects on the domain-general learning outcomes	0.60	$p < 0.001$	Yes
Perceived usefulness of peer feedback	0.67	$p < 0.001$	Yes
Relation between satisfaction and perceived learning			
Ease of use of the module	0.17	$p = 0.274$	No
Satisfaction with the learning task	0.63	$p < 0.001$	Yes
Perceived fairness of peer feedback	0.41	$p = 0.009$	Yes
Relation between ease of use of the online module and perceived learning			
Perceived effects on the domain-specific learning	0.03	$p = 0.830$	No
Perceived effects on the domain-general learning outcomes	0.19	$p = 0.245$	No
Perceived usefulness of peer feedback	0.02	$p = 0.878$	No
Relation between satisfaction with the learning task and perceived learning			
Perceived effects on the domain-specific learning	0.66	$p < 0.001$	Yes
Perceived effects on the domain-general learning outcomes	0.72	$p < 0.001$	Yes
Perceived usefulness of peer feedback	0.53	$p< 0.0004$	No
Relation between Perceived fairness of online peer feedback and perceived learning			
Perceived effects on the domain-specific learning	0.103	$p = 0.529$	No
Perceived effects on the domain-general learning outcomes	0.155	$p = 0.155$	No
Perceived usefulness of peer feedback	0.37	$p = 0.020$	Yes

Discussion, Conclusion, and Suggestions for Future Studies

This study explored the role of motivation and satisfaction and perceived learning with online

peer feedback in an online context. The findings indicated that online peer feedback positively affects students' satisfaction, motivation, and perceived learning in the context of argumentative essay writing. These findings align well with previous studies (Barbour & Reeves, 2009; Hsu et al., 2019). Additionally, the findings showed a positive relationship between the motivation and satisfaction of students and their perceived learning outcomes in an online course utilizing peer feedback. This finding is also in line with previous studies showing that student satisfaction is influenced by and connected to motivation for learning (Gunawardena et al., 2010; Shen et al., 2013).

The statistically significant positive correlation between the usefulness and fairness of the peer feedback with the motivation and satisfaction of the students suggests the positive impact of peer feedback on these two main aspects of the course. These results are bolstered by a high overall evaluated score for the fairness and usefulness of peer feedback. These high scores are important indicators for the overall credibility of the reported results relating to the peer feedback. The results also suggest that online peer feedback can be utilized to enhance the learning experience and complement the instructor's efforts to increase students' motivation and satisfaction in argumentative essay writing courses.

Although the current study's findings showed what features of the received feedback could predict students' attitude towards peer feedback in essay writing, it did not explore the role of provided feedback features in students' argumentative essay writing. It would be interesting to explore this in future studies and compare the effectiveness of the received and provided feedback features on students' attitudes towards peer feedback. This can provide insights into the role of the assessor and assessee in the feedback process and its impacts on students' attitudes towards peer feedback in the context of essay writing in higher education. Also, it would be helpful to explore the effect of other factors such as language, nationality, and culture on students' motivation and satisfaction when engaging with online peer feedback.

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Chapter 14 - Assessment in Students' Performance and Behavior towards the Use of Online Platform through Data Analysis

Lenigrace L. Mecias, Thelma D. Palaoag

Chapter Highlights

- This chapter aims to assess the impact of online learning among highschool students of Colegio de Juan de Letran Manaoag.
- The study used descriptive analysis to identify the statistical significant differences of student performance and behavior towards the use of online learning.
- The finding revealed that there were significant differences in students' performance between average grade and year level with respect to their gender.
- There were no significant differences between students' responses based on their gender.
- The implications of these findings have a positive impact in the assessment of using online learning with respect to the year level of students and academic performance.
- A discussion of the broader pedagogical implications should enhance the approach and improve collaboration among students in online learning.

Introduction

Education during the COVID-19 pandemic was the most serious problem and shook the entire world. This situation put a strain on education systems worldwide and forced educators to switch into online learning. Furthermore, exploring the importance of ICT in education has overcome the difficulties and embraced the importance of technology in a lifelong learning (Badali et al., 2022; Lamas, 2016). The adopting of digital learning were gradually reinforced and innovated the learning process to satisfy the quality of education and upgrade pedagogical approaches (Banihashem & Aliabadi, 2017; Dhawan, n.d.).

The implementation of different teaching modalities like online distance learning was modified and is ready to be deployed in the institution to sustain learning at all school levels. Moreover, the online learning environment has helped a diverse student population with a wide variety of learning styles and improved multimodal approaches to help each student attain academic success in their own way (Rebucas Estacio & Callanta Raga Jr, n.d.). To ensure quality of learning, the task of considering the online platform in the online learning environment will help students achieve their academic performance and maintain positive behavior (Mehrvarz et al., 2021). To support the needs of education for the new normal, the online learning environment shows an opportunity to continue the learning process, embrace the challenges, and sustain the needs of students while doing their online learning (Joko et al., 2020; Zwart et al., 2020; Shahali Zadeh et al., 2016).

The online learning model is widely recognized, and regulation is rapidly increasing to meet the needs of students (Khan et al., 2021). It is merely well-defined that an online learning environment should be utilized on different learning devices (e.g., mobile phones, laptops, computers, etc.) and with the aid of internet access (Dhawan, n.d.). It is said that the blended learning modality was convenient to use and considered a relatively inexpensive way of education (Nendra Pratama, 2020; van Alten et al., 2021). Flexibility is another interesting modality of online learning in which teachers and students may communicate at any time, while learners can schedule their time to complete the tasks available online (Dhawan, n.d.).

Learners expect great solutions to their learning processes through the availability of internet access and learning management systems (Ismail & Yin, 2020; Ogange et al., 2018). As such, the emails and social media were easy and accessible for learners to use. On the other hand,

Blackboard is the primary learning management system tool used for online learning at Colegio de San Juan de Letran Manaoag (Rebucas Estacio & Callanta Raga Jr., n.d.).

Technologies are becoming a worldwide procurement tool to embrace innovations, especially in the field of education (Yu, 2021). Blackboard is one of the recommended online learning platforms in most institutions, and the features facilitate the needs of students in their learning process. It is accessible to students and teachers for the activities that are available online. Indeed, it was well-integrated into the subject, and students were encouraged throughout the quarter to utilize the learning content. The internet provides students with online resources and applications (Peng, 2017). Beforehand, students should have the privilege to access the LMS so instructors can interact, guide, and communicate with students anytime, anywhere, and can help individual interests in their learning approach (Davison & Dustova, 2017; Lamas, 2016).

The learning style adopted the synchronous and asynchronous ways of learning to continue education while facing difficulties in the COVID-19 pandemic (Martin & Bolliger, 2018). Furthermore, the Department of Education (DePED) in the Philippines advised schools and students to have good and stable internet connections, which is one of the requirements in the delivery as well as in the learning process (Peng, 2017; Noroozi et al., 2011). Fortunately, this approach was more interactive and responsive in real-time (Lamas, 2016). Learners can work and manage their activities, like writing their research projects, online (Kassarnig et al., 2018). Moreover, students' behavior was incorporated into their performance. However, to measure their attitude, the study used a survey and there were different categories such as experience in the online learning platform, the environment, technical skills, and team collaboration (Rebucas Estacio & Callanta Raga Jr, n.d.).

Furthermore, participation in online classes and the development of technical skills, as well as active collaborations in online learning, were integrated and emphasized to further close the gap in the distance learning method (Dhawan, n.d.). The study focuses on the assessment of students' performance and behavior towards the use of online learning among high school students. This research applied descriptive analysis to determine the impact of online learning and to identify the significant differences in academic performance using online learning among average grades at all grade levels with respect to gender. Additionally, this study also identifies the significant relationship of students' responses with regards to their gender (Joko

et al., 2020; Nendra Pratama, 2020).

These challenges in educational institutions are not only identifying the right technology and using it but also reimagining the essence of education, thereby helping students and academic staff who are seeking guidance for digital literacy (Dhawan, n.d.). Challenges initiate educators, students, and parents to embrace the importance of technology. Thus, the purpose of this study is to strengthen the validity and continuity of online learning due to the uncontrollable increase of the COVID-19 pandemic (Dhawan, n.d.). The aim of this research is to identify the impact of online learning among high school students according to their year level and the significant differences in students' performance between year level and average grade. And to determine if there are significant differences in behavior in online learning based on gender, and to identify the impact of students' behavior on the online platform, online environment, technical skills, and team work.

Methodology

This research employs quantitative design in the data collection and data analysis procedures. The researcher used descriptive analysis for the study in the form of cross-tabulation and reliability analysis. The analysis of variance (ANOVA) was also performed in comparing the variables from the first gradeing period across all grade levels, and an independent sample t-test was explored in comparing the responses of male and female students (Nendra Pratama, 2020) (Martin & Bolliger, 2018). In the study of Florence Martin and Doris (2018), in order to compare two variables, they also used an independent sample t-test and the result was that for female students it was more important than for male students. To identify the categories, an independent sample t test was also executed to retain the sequence of values defined by the average grade =87.625 and > 87.625 which was generated at random. The researcher used MS Excel for the data preprocessing and SPSS to cleanse the data for analysis. Afterwards, reliability analysis was applied to the dataset to identify the properties of measurement scales and the items that compose them, and filter irrelevant records from the dataset. There were five sections or sets in the survey questionnaires that had been distributed to the students.

In this study, a descriptive method in machine learning was explored, and the unsupervised learning approach was used to summarize the value of N=171 as respondents, classify the grade level and gender, and also extract the procedures to emphasize the results of the study.

Initially, the researcher converted the gathered data from the Google form into MS Excel format. Data was sorted and cleansed, then analyzed through the Statistical Package for the Social Sciences (SPSS). To further analyze the data, data visualization was performed, and then reliability analysis was used to test the consistency of the data. Compared variables were also explored and also acquired the significance of variables through the processes of ANOVA and Independent T-test for the validity of single variables. In addition, data visualization was shown through Tableau design.

Participants

This study involves the highschool students of Colegio de San Juan de Letran Manaoag, from Grade 7 to 10. There were 33 students in grade 7 (13 males & 20 females), 33 students in grade 8 (21 males & 12 females), 40 students in grade 9(16 males & 24 females), and 65 students in grade 10 (33 males & 32 females), a total of 171 number of students population in AY 2021-2022 (see Figure 1).

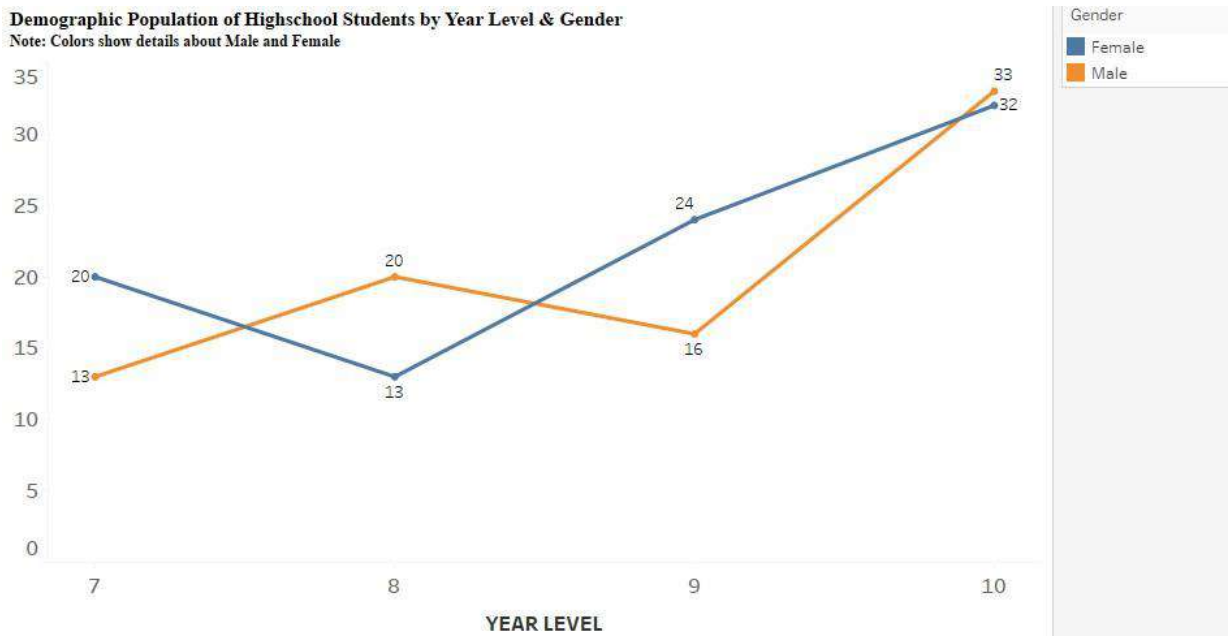

Figure 4. Demographic Information for the Student by Year Level

Testing Materials

The survey questionnaires in this study has been adapted from Fortune, Spielman, and Pangelinan (2011) and was modified some questions which were only applicable in the study.

This survey was used to investigate students' behavior towards the use of online learning.The instrument used in this research was a five-point Likert-scale questionnaire (1-Strongly Disagree, 2-Disagree, 3-Neutral, 4-Agree, 5-Strongly Agree). The survey made them aware that the survey was anonymous and voluntary. The questionnaires consist of four types: For a total of 17 items, (a) learning platform has 6 items, (b) learning environment has 5 items, (c) technical skills has 4 items, and (d) teamwork has 2 items.

To utilize the data, the researcher used a statistical package for the social sciences (SPSS) to test the data and get the results. Meanwhile, data was also interpreted from Tableau for the demographic visualization. MS Excel was also used in this study for organizing the needed data and for the analysis and cleansing of the data for errors. For determining the means and standard deviation, the researcher used a cross-tabulation approach to sort the data that fit into the analysis. Afterwards, the descriptive statistics facilitate the summary of the data.

The percentage distribution of the population by gender showed that there were (52%) of females and (48%) of males (see Table 1). To utilize the needs for the investigation, MS Excel, SPSS, and Tableau helped the researcher identify the results or impact of the online learning.

Table 9.Percentage Distribution of Students by Gender

Gender	Percentile	Total
Male	48%	82
Female	52%	89

The five-point Likert scale was considered an interval scale. The study used mean significant from 1 to 1.8, which means strongly disagree; from 1.81 to 2.60, it means disagree; from 2.61 to 3.40, it means neutral; from 3.41 to 4.20, it means agree; and from 4.21 to 5, it means strongly agree, as shown in Table 2.

Data Analysis

This study is a quantitative research and used descriptive analysis for finding the impact of student's performance and behavior in using online learning. The study applied the following

test to get the reliability analysis for the consistency of data and analysis of variance to test differences of variables like average grade, year level and gender.

Table 10. Likert-scale Interval of the Students' Responses

Likert-Scale Description	Likert-Scale	Likert Scale Interval
Strongly disagree	1	1.00-1.80
Disagree	2	1.81-2.60
Neutral	3	2.61-3.40
Agree	4	3.41-4.20
Strongly Agree	5	4.21-5.00

Data Collection

The grade of students were collected during the first grading period of academic year 2021-2022. Moreover, the categories were significant in gender, with the probabilities of (0.5), the year level, and average grade from the first grading period, the average grade of students in different grade levels was broken down by male and female. Color shows details about grade level. The highest grade among the grade level was from grade 10 female students with the average grade of 88.805. This research use average grade to reflect the students' performance with respect to gender.

The purpose of this study is to assess the performance and behavior of these students by gender in the online learning and evaluate if students were really performing well in their online learning and teachers might improve teaching approach of the students' performance were acquired using the Blackboard's online assessment tool. Part of the survey also included age, gender, and grade level. The survey was designed and administered in Google Form and distributed through social media. The researcher reviewed and modified the survey questionnaires that were only applicable in the study. Furthermore, this survey helped the study reveal the needed information from the students experiencing online learning in the highschool level during the pandemic. Additionally, based on the previous study of Saras Krishnan (2016) the survey was useful and explored the value and impact of online learning mode in hybrid mathematics course and it was revealed that the result was positively significant.

Data Cleansing

After gathering the survey, the researcher collected and combined data from Google form and collected the grades of students from the advisers by grade level. The process of cleaning the data involves removing inaccurate data and transforming it into corrected types of values that might damage the result. The researcher organized the data by identifying the independent variables and dependent variables. also categorized into nominal or ordinal types of data.

Data Processing

Initially, in data analysis, the data description of a dataset containing Likert-type behavior was converted into a five-point scale for analysis. The results of the survey were analyzed using descriptive statistics to get the total respondents by gender and year level, using the following properties such as frequency, mean, and standard deviation to show the data. The use of the independent sample t-test was initiated to test the normality distribution of variables such as grade levels and gender average grades.

Furthermore, the use of SPSS in performing the reliability analysis and for the internal consistency of data was explored. Using analysis of variance to investigate the means of difference between variables such as average grade, grade level, and gender (see Figure 5 and Figure 3).

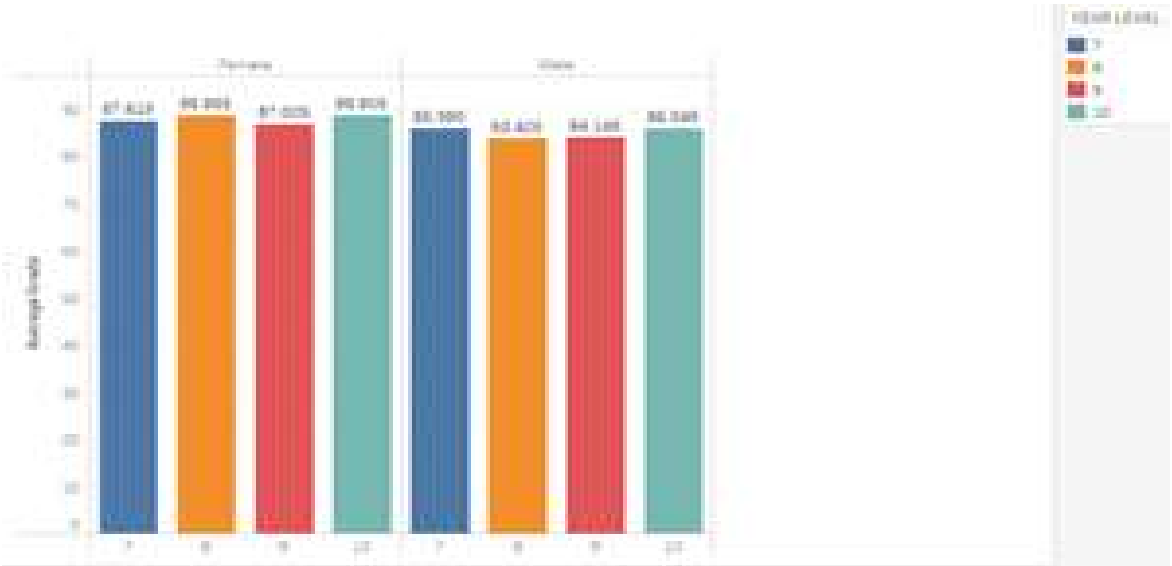

Figure 6. Percentage Distribution of Grades by Gender

The mean grade among the high school students was equal to 86.67, (median=87.63) and (mode=91.75). A minimum grade is 75 and a maximum grade is 92.75. It also shows that the normal distribution revealed through descriptive statistics was valid. Furthermore, grades were illustrated in the histogram with a mean grade of 86.67 in an N=171 total number of students (Kassarnig et al., 2018).

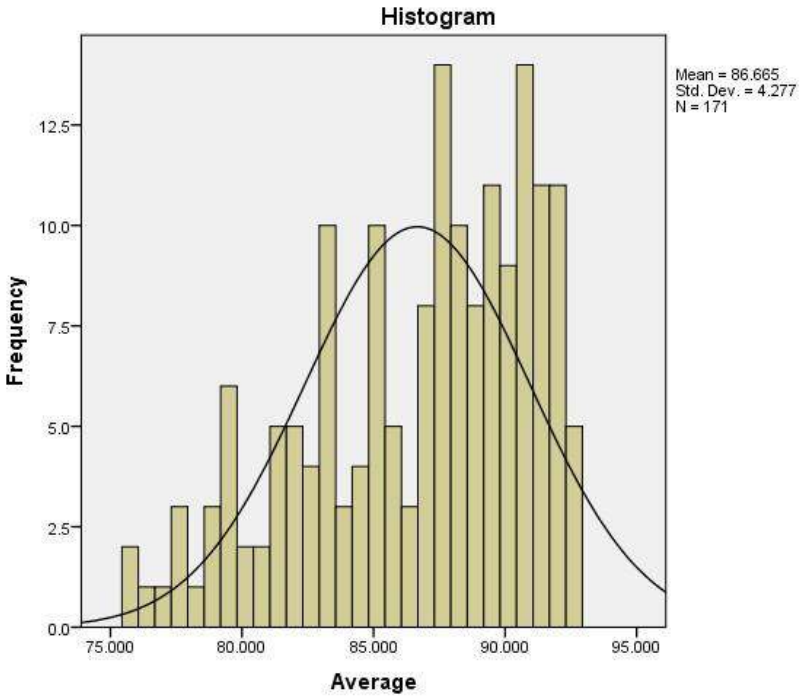

Figure 7. Normal Distribution of Student Average Grade

The average grade of students in different grade levels were broken down by male and female. Color shows the details about grade levels. The highest grade among the grade level was from grade 10 female students with the average grade of 88.805. This research use average grade to reflect the students' performance with respect to gender. The purpose of this study was to determine the impact in the performance and behavior of the students by gender in the online learning and to evaluate if students were performing well in their online learning and enabled them to integrate learning from their teachers online. This study help the teachers be aware of the learning outcome of students and enhance their pedagogical approach.

The researcher had gathered the data right after their first grading period. And students' responses reflect the behavior of students in the online class. Furthermore, this study used statistical test on analysis of variance (ANOVA) to assess students' performance into year levels and compare its variances (Nendra Pratama, 2020). To identify the significant

differences in average grade and year levels with respect to gender, the linear regression was used to plot the relationship between year levels and average. The significant difference between grade levels with their average grade was found valid with a (p-value= 0.000125) in this test the (Fcrit=2.658) was less than the (F=1.61498).

The study found out after the ANOVA test, that the significant differences were identified. However, in male category the results from the given test were, grade 7 with a variance of (17), grade 8 has (33), grade 9 has (13) and grade 10 has (19). For female category, grade 7 has 10 in variance, grade 8 has 12, grade 9 has 19 and grade 10 has 8. However, there were large differences in variance among grade levels. The study used Cronbach's alpha to provide a measure of internal consistency of scale (see Table 3).

Table 11. Analysis of Variance of Students' Performance Based on Grade Levels

	Male				Female			
Level	*C*	*S*	*AVE*	*V*	*C*	*S*	*AVE*	*V*
7	13	1117.9	86	17	20	1752.4	88	10
8	20	1676.5	84	33	13	1155.3	89	12
9	16	1346.4	84	13	24	2088.1	87	19
10	33	2839.6	86	19	32	2841.8	89	8

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	511.4671	7	73.067	4.5195	0.000125	2.066
Within Groups	2635.199	163	16.167			
Total	3146.666	170				

Reliability Analysis

The columns show the general value of Cronbach's alpha (=.89) and whether the data was reliable (Krishnan, 2016). The online learning platform (OLP) consisted of 6 items (=.89) and internal consistency was good. The online learning environment (OLE) subscale consisted of 5 items (=.78) and internal consistency was good. The technical skills subscale consisted of 4 items (=.66) and internal consistency was acceptable. However, the team work

subscale consisted of 2 items (= -1.498) and it denotes that this part of the questions was not supported based on the scale in Cronbach's Alpha (see Table 4).

Table 12. . Likert Scale Internal Consistency of Students' Responses

Statement	N	Items	Cronbach's Alpha	Internal Consistency
Learning Platform	171	6	.89	Good
Learning Environment	171	5	.78	Good
Technical Skills	171	4	.66	Acceptable
Team work	171	2	-1.498	Unacceptable
Total		17	.89	Good

Results and Discussion

The data was carried out from the gathered data through a survey and the average grade of students in the first quarter. The intention of the survey was to determine the students' behavior in the online learning environment upon using the platform, their experiences during synchronous learning, enhance their technical skills and describe their collaboration as a group during online group activity.

Impact in the Students' Performance

The study identified the means and standard deviation of average grade by grade levels with respect to gender. In male category, grade 7 has (M=86, N=13, SD=4.17, grade 8 has (M=84, N=20, SD=5.72), grade 9 has (M=84, N=16, SD=3.64), grade 10 has (M=88, N=23, SD=3.76). In female category, grade 7 has (M=88, N=20, SD=3.11 grade 8 has (M=89, N=13, SD=3.42), grade 9 has (M=87, N=24, SD=4.35 grade 10 has (M=90, N=22, SD=2.40. Hence, the results revealed positive impact on students' performance even among year level and among gender (see Table 5). In this instance, descriptive statistics were needed in the form of tabulation and determine the results from the survey. Independent sample t-test was used to compare the responses of male students with female students. To help understand the conversion of the assessment in behavior, the five point likert-type was used (Nendra Pratama, 2020). In some studies about online learning and student performance, in the study of virtual campus of Maseno University in Kenya, most students who participated in the

study reported that they received instant feedback and motivated to study beyond the normal classroom hours. To identify the impact of online learning among Highschool students according to their grade level with respect to gender, one way analysis of variance was used. To meet the standard learning process, accessibility of online learning platform for the students in the new normal must be updated and accurate. In actual scenario students of CDJDLM used Blackboard as online platform to facilitate the needs in education as a distance learning and able to enable their learning competencies.

Table 13. Means ± Standard Deviation of Students' Performance by Year Levels and Gender

Grade	Male			Female		
Level	Mean	N	SD	Mean	N	SD
Grade 7	86	13	4.17	88	20	3.11
Grade 8	84	20	5.72	89	13	3.42
Grade 9	84	16	3.64	87	24	4.35
Grade 10	88	23	3.76	90	22	2.40

The study measure the sum of all the responses by gender. The male group (N=82) was associated with a mean of students responses numerically diminutive, (M=61.8415, SD=7.94). By comparison, the female group (N=89) was associated with a mean of students responses (M=62.64, SD=9.45) was slightly higher than male. By comparison, the female group (N=89) was associated with a mean of students responses (M=62.64, SD=9.45) was slightly higher that male. To test the hypothesis that the male and female were associated with statistically different in mean, the increase in students' responses were performed through an independent sample t test. The male and female distributions were sufficiently normal for the purpose of conducting a t-test. Additionally, the assumption of homogeneity of variances was tested and satisfied via Levene's *F* test, *F* (169) = 6.52, *p*=.012, (see Table 6).

Table 14. Means Differences Students' Performance by Gender

Sum Of Students' Responses				
Gender	N	Mean	Std. Deviation	Std. Error Mean
Male	82	61.8415	7.94187	.87703
Female	89	62.6404	9.44632	1.00131

The independent samples t-test was associated with a statistically significant effect, t (169) =-.596, p-value=.552. Therefore, the male group were associated with statistically significantly lesser mean than female group in the online learning (see Table 7). The summary of mean score of student's responses from the survey. In terms of the assessment of online learning platform, the students overall response were agree (M=3.91) that the platform was helpful in their study. Students agree that in their current learning environment (M=3.45) situation online was useful and easy way of communicating to their teachers as well as their classmates. Students' regular activities and projects were all perform in digital form, based on the result students were agreed that their technical skills were improved.

Table 15. Independent Sample t-Test in Gender

		Levene's Test for Equality of Variances		t-test for Equality of Means		
		F	Sig.	t	df	Sig. (2-tailed)
Sum	Male/ Female	6.524	.012	-.596	169	.552

However, team work makes the students more challenged due to the type of collaboration and they were neutrally agreed on the difficulties that they encountered during online activities. Likewise from the study of Florence Martin and Doris U. Bolliger that collaboration learner-to-learner interaction were thought of as least important and same with this study (Martin & Bolliger, 2018; Noroozi et al., 2011). In some studies, like Shivangi Dhawan,in their research stated that technical difficulties hinder learning process as well as emotional distress or increased frustration and confusion tend their learners not confident enough to work as a group online. In the study of Gillet-Swan, Jenna (2017), one of the challenges in online learning is the participation of students was in group-work activities which this study had also encountered difficulties and teachers strategized their learning assessment online activities to enhance collaboration among students (see Table 8).

Table 16. Mean Score of Students' Responses in the Online Learning

	Learning Platform	Learning Environment	Technical Skills	Team Work
Mean	4.216	3.7096	3.79096	2.8304
Result	Strongly Agree	Agree	Agree	Neutral

The finding revealed that there were no significant differences in mean in the online learning platform in male (M=4.2, SD=.5515) compare to female (M=4.2, SD=.6403) (see Table 9). In online learning environment (OLE), male students has (M=3.65, SD=.550) compare to female (M=3.76, SD=.519) no mean differences, Technical skills (TECH) (M=3.778, SD=.42630) and in female (M=3.818, SD=.5149) and Team work male (M=2.80 SD=.295) in female (M=2.857, SD=.301).

Table 17. Means Differences of Students Responses Based on Gender

Group Statistics

	Gender	N	Mean	Std. Deviation	Std. Error Mean
OLP	Male	82	4.232	.5515	.0609
	Female	89	4.202	.6403	.0679
OLE	Male	82	3.6545	.55046	.06079
	Female	89	3.7603	.51917	.05503
TECH	Male	82	3.7780	.42630	.04708
	Female	89	3.8180	.51491	.05458
TEAM	Male	82	2.8008	.29565	.03265
	Female	89	2.8577	.30104	.03191

To sum up the result, based on the scale, male students and female students had the same Likert type behavior no significant differences with p-value of .552, this means that the responses among male and female implies same impact in online learning with regards to platform, environment, technical skills and team work collaboration, which means that equal implication from the two groups was satisfied the result.

Based on the students responses from online learning platform (see Table 10), statement 6 stated that the responses of students in using Blackboard as online platform was useful and sufficient in their learning. The mean (M= 4.216, SD=.5978) indicated that the majority of students strongly agreed that online platform was easy to use both by the students and teachers. It also added that in statement 6 (M=4.047, SD=.846), students were strongly agreed that the platform was readily available and accessible as long as there is an internet connection in any devices such as laptop, desktop, mobile phone and the like. In the study of Nendra Pratama, Ujang, the student responses regarding online learning platform has positive

results from their survey using inline platform. This study revealed that online platform has a greater impact to students in their learning, the accessibility of the platform continued to accomplished their obligations and responsibility in their subject matter. Also, in Indonesia studied by (Rasmitadila et al., 2020), during the pandemic, online learning in Indonesia was found to be successful by determining the readiness of technology in line with the curriculum, support and collaboration among its stakeholders.

Table 18. Mean and Standard Deviation of Online Platform

Statements	Mean	SD	Interpretation
1. The online platforms were sufficient to serve the students.	3.965	.825	Agree
2. The online platforms were in excellent condition during the discussion.	3.801	.858	Agree
3. The online platforms were easy to use both by the students and the teachers.	4.012	.874	Agree
4. The online platforms used solicited more engagement from the participants.	3.766	.916	Agree
5. The online platforms used are easy to navigate and use.	3.924	.914	Agree
6. The online platforms used were readily available and accessible.	4.047	.846	Agree
TOTAL	4.216	.5978	Strongly Agree

Students' experiences in the online learning environment based on the responses of students, the highest mean (M = 3.71, SD =.771) (see Table 11), which means that students help them comprehend the resources posted in the online platform and make it easier to meet their needs and easier to communicate with their teachers (Yu, 2021). Both students' satisfaction and academic achievements depend on their prior knowledge and experience in relation to online learning. This research is intended to investigate students' satisfaction and academic achievements in relation to online learning platforms in higher education in Malaysia. (Abuhassna et al., 2020).

The sum of the mean in students' technical skills was equal to (M = 3.7988, SD =.47353), which indicates that the students agreed that their technical skills were improved. The highest

mean of (M = 4.064, SD =.6786) indicated that it was easy for them to submit their homework and activities online and made it easier to communicate with their teachers (see Table 12).

Table 19.Mean, Standard Deviation of Online Learning Environment

Statement	Mean	SD	Interpretation
1. The learning environment helps me comprehend the resource materials online	3.71	.771	Agree
2. An online environment make web site easier for me to communicate with my teachers.	3.386	.9347	Neutral
3. I feel comfortable responding to questions in virtual discussions	3.368	.8738	Neutral
4. The online platform makes it easier to meet my learning needs	3.427	.9198	Agree
5.The online learning environment helps me to learn subject materials better	3.363	.8593	Neutral
TOTAL	3.7096	.53546	Agree

Table 20. Mean, Standard Deviation of Students Responses in Technical Skills

Statement	Mean	SD	Interpretation
1. My technical skills email, Internet have improved since taking the Online Learning	3.906	.8961	Agree
2. Access to the Internet email makes it easier to communicate with my teachers	3.678	.8922	Agree
3. The use of technology Interferes with my ability to accomplish the required Tasks	3.345	.9721	Neutral
4. I value the use of technology for submitting my homework and written activities	4.064	.6786	Strongly Agree
TOTAL	3.7988	.47353	Agree

In addition, 83 (96%) percent were in neutral (M = 3.111, SD =.857) when working as a team in an online learning environment, indicating neither positive nor negative collaboration (see Table 21). Teamwork in online learning has a slightly positive impact on the students in

terms of collaboration in virtual meetings but a negative impact during the actual implementation of the given performance task. Likewise, in the study of Martin, Florence, and Bolliger, Doris U. emphasized that the engagement of students working as a team online was also beneficial but merely challenging for the students as well as teachers. In the literature, it is noted that the ability of collaborations between students and their teacher reduced the perception of separation between learner and educator (Abuhassna et al., 2020).

Table 22.Frequency Table for Team Work or Collaboration

Statement	SD	D	N	A	SA	Total
1.It was difficult to work with my team group because of the mode of team learning	2	17	**80**	58	14	171
2.It was easy to work with my team online because of the online learning environment	7	27	**83**	48	6	171

Conclusion

Online learning plays an important role in education during the pandemic. The massive implementation of online learning was not only in higher education but also in the high school level. However, the delivery mode in education supports and enables the learning process. This study found that online learning has a great impact on students' performance and behavior. The results of this research showed that online learning provides adequate approaches for high school students and motivates their performance with positive behavior. The study implies that an online learning platform was proven to be good and helpful from the responses of the majority of the students. The students' performance revealed a positive impact of online learning from high school students in terms of year level or by gender. The responses of students in online learning toward the use of online platforms help them acquire learning and attend classes regularly and virtually. This study found out that students who were longer exposed to online learning didn't reflect the highest test scores among students, but rather revealed the most active among the year level. Teachers may diverge their teaching not by gender or grade level but through strategizing the students' learning content upon executing their approach, especially during group activity or collaboration among students. Hence, it was realized that technology has a significant role in helping enhance student learning and provide them with easy access to their learning needs online. However, their

learning environment helps them participate in the online platform and makes it easier to communicate with their respective teachers. The continuity of online learning was complemented by the sustainability of quality in education. Hence, the researcher recommended a comprehensive module for collaboration in group activities to increase the psychological interest of students. Online learning is thus important and can assist students in achieving their goals through the Web, which is a convenient tool to facilitate students' needs and is prepared for hyflex learning modality.

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Education, science, and technology disciplines are closely and extensively connected in all formats and levels. The outbreak of COVID-19 has further squeezed this interconnection where the delivery of education in different scientific fields of studies at all education levels is almost impossible without the presence of technology. Today, there is a need more than ever to explore the intersection of education, science, and technology at both administrative and classroom levels. Educational leaders and policymakers should be aware of the requirements (e.g., role of culture, educational governance) for effective teaching and learning in the post-COVID-19 era. Teachers, instructors, and researchers need to be proficient in the way to convey knowledge with effective and innovative adoption of technology (e.g., online peer feedback) to the young generation as they are called "digital natives". This book focuses on addressing and exploring these needs and recommends solutions from multiple perspectives. The book is divided into three sections related to studies on education, science, and technology. While each of the fist two sections includes five chapters, the last section involves four chapters. The chapters' contributors are from the following countries: Albania, Australia, Azad Kashmir, Ghana, Indonesia, Iran, Kazakhstan, Morocco, Philippines, Singapore, the Netherlands, the USA, Tunisia, and Turkey. The diversity of the chapters from 14 different countries brings an international perspective to the book.

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