



Academic Resilience in Chemistry during Covid-19: A Systematic Review

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Abstract: The number of difficulties experienced by students in online learning during a pandemic such as lack of focus and motivation due to stress, students experience a decline and involvement in learning. Some students stated the lack of access to technology and the environment was not conducive to learning. Students who cannot overcome academic difficulties are familiar with academic resilience. This study aimed to review articles on student academic resilience during the COVID-19 pandemic in chemistry lessons. This research is systematic research using the PRISMA method. The systematic review used articles from the range 2020-2023 published in PubMed, Google Scholar, and Science Direct. A total of 4 articles on the resilience of students studying chemistry during the COVID-19 pandemic met the inclusion criteria. The results showed that journals discussing student resilience in studying chemistry during the COVID-19 pandemic were still limited. However, from this literature research, it turns out that academic resilience is considered capable of maintaining learning success in students during the COVID-19 pandemic.

Keywords: Academic Resilience; Chemistry Learning; Covid-19, Systematic Review

Introduction

The COVID-19 pandemic has brought about changes that have had a significant impact on the education process in Indonesia. Daniel (2020) stated that the COVID-19 pandemic poses major challenges to the education system and all stakeholders in it, such as educational institutions, teachers, and students. Zalite & Zvirbule, (2020); Antonopoulou et al. (2021), the COVID-19 pandemic has brought educational institutions to a halt with unprecedented changes so that digital learning preparation is required. This is done to prevent the increasingly widespread spread of the coronavirus (COVID-19) so that educational institutions must switch from face-to-face learning to online learning. The change from face-to-face learning to online learning that occurred during the pandemic was a sudden one. This allows online learning conditions during the pandemic to not be supported by students' readiness to undertake it so students find it difficult in the learning process. UNESCO Indonesia reports that the application of

online learning has an impact on the social and educational aspects of the younger generation (Fatimah & Mahmudah, 2020; Doheny et al., 2020).

The ability to rise in the face of a problem is something that individuals need to have at this time. This capability is needed during a pandemic, considering that this problem is serious and requires quick action to handle it. The ability to face a problem can be called resilience. Resilience is an individual's ability to remain strong and able to face and overcome the problems or difficulties that befall him (Ayu et al., 2017). When studying at school, a student also needs resilience in facing obstacles or challenges. Students' ability to face academic challenges and obstacles is called academic resilience. According to Cassidy (2016), academic resilience is an individual's ability to increase educational success even in difficult situations. Rojas (2015), academic resilience is the ability to face difficulties, stress, or pressure in the academic environment. Academic resilience means that students achieve good educational outcomes despite facing

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adversity. Furthermore, Bustam et al. (2021) interpret academic resilience as an individual's ability to increase success in education even though they are experiencing difficulties in their academic field. The results of several research have stated that resilience is very much needed in facing the Covid-19 pandemic (Ramadhan & HamiDY, 2021; Lau et al., 2020; Sari et al., 2020). Resilience makes one's life stronger. This means that resilience will enable a person to successfully adapt in dealing with unpleasant conditions, social, and academic developments, and even the intense pressure inherent in today's world (Desmita, 2005; Steinhardt & Dolbier, 2008).

On the other hand, Nordstokke & Colp (2014), academic resilience was created to offer greater prediction and assessment of resilience research that is closely related to individuals. Even when students experience challenging or threatening situations, students who have academic resilience can turn stressful events into opportunities for their growth and advantage. Resilience is a concept that focuses on the strength and optimal functioning of students (Mwaura et al., 2018). Resilient students tend to maintain motivation and academic performance regardless of challenging or stressful conditions that put them at risk. Even when students experience challenging or threatening situations, students who have academic resilience can turn stressful events into opportunities for their growth and advantage. When a student uses his internal and external strengths to overcome negative and stressful experiences and hinder the learning process he can adapt well and carry out academic demands optimally (Hendriani, 2018).

High school (SMA) students are teenagers who in their development experience a transition period from children to adults. Sawyer et al., (2018) stated that adolescence is a phase of life that stretches between childhood and adulthood. Adolescence includes elements of biological growth and a major role in social transition, both of which have changed over the past centuries. Chemistry is one of the subjects taught in high school (SMA). Chemistry subjects are the basis of science and technology which have important potential for humanity, including for students at school (Akin & Folorunso, 2014). During the COVID-19 pandemic, students in the learning process were affected by psychological impacts, such as the change in the learning system from face-to-face learning to online learning, the large number of chemistry assignments given by teachers, difficulties in completing chemistry assignments caused by student misunderstandings and low student motivation to learn. The results of research conducted by Rohimat (2021) state that online chemistry learning is less effective. This can be seen from the small percentage of students who are satisfied or very satisfied

with the learning carried out, the many obstacles experienced, and the tendency of the majority of students to choose completely offline learning. Likewise, Muhali et al. (2021) that the online chemistry learning system in the even semester of the 2019/2020 academic year during the COVID-19 pandemic was less effective. This is because the perception of 50% of chemistry education students gave a negative response to every answer regarding the effectiveness of online learning. Arni et al. (2022) show that the problems that occur in basic chemistry learning include: first, students have difficulty understanding the learning topics presented by the teacher. Second, students feel unmotivated to learn. Third, students have not mastered basic chemistry learning topics. Therefore, students need academic resilience when learning chemistry online.

As has been stated, the problems or difficulties that befall a person are unique and may be different for each individual in terms of the learning process. Mwangi et al. (2015), suggested that resilience can significantly influence students' school and life outcomes, including academic achievement. Oke et al. (2016), students who have resilience maintain high levels of achievement and performance despite stressful events and conditions. Resilience, a multidimensional construct, is one of the most important personal factors influencing academic achievement and is the ability to overcome the most difficult problems and tolerate and overcome the most disastrous events, complex situations, and pitfalls. Therefore, resilience is needed by individuals in various areas of life, for example in the family, work environment, and academic environment. The role of academic resilience in good educational outcomes is enormous and involves strategic planning and detailed practices involving the entire school community to help vulnerable young people achieve better outcomes than their circumstances predict (Schofield & Bates, 2016).

Academic resilience research is very necessary and important for students to carry out. Therefore, the purpose of this research is to review articles about students' academic resilience during the COVID-19 pandemic in chemistry learning. The research results show that there are still limited journals discussing the academic resilience of students studying chemistry during the COVID-19 pandemic. However, this literature review is expected to provide information on how comprehensive research on student academic resilience during the COVID-19 pandemic can motivate and make students' chemistry learning successful.

Method

This research is a systematic review using the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-analyses) method which is carried

out systematically by following the correct stages or research protocol. Moher et al. (2018), stated that systematic review is one method that uses reviews, studies, structured evaluations, classifications, and categorizations from previously produced evidence. The steps in implementing a systematic review are very well planned and structured so this method is very different from the method which is just to convey a literature study. Figure 1 exhibits a flow diagram that reflects the systematic review strategy adhering to the PRISMA (2009) Guidelines (Alshutwi et al., 2019).

Literature Search Process

The first, in April 2023, uses a computerized literature search, the PubMed electronic database, Google Scholar, and Science Direct. The combined search terms used were: "resilience learning during a pandemic", and "academic resilience learning chemistry during a pandemic". Articles are filtered by title, abstract, and keywords or by all text fields, followed by full article reviews to identify the studies included in this literature review. Next, we determined a date range from April 9th, 2023, to June 18th, 2023, hoping to include all studies reporting on the subject of academic resilience to chemistry during the COVID-19 pandemic.

Eligibility Criteria

Inclusion and exclusion criteria were set to ensure that the 4 results obtained were the relevant study set for the systematic. The studies included in this systematic were selected using the following inclusion criteria: 1) population: students or adolescents; 2) academic resilience in chemistry during the COVID-19 pandemic; 3) surveys, quantitative, qualitative, mixed-methods studies, cross-sectional studies, case reports; 4) report data on resilience results during the pandemic from schools/universities/colleges; 5) all studies written in English and published between March 2020 - May 2023.

Data Collection and Synthesis

Finally, taking into account the inclusion and exclusion criteria, four articles were included in the systematics. We read the articles carefully and highlighted students' academic resilience to chemistry during the COVID-19 pandemic reported by schools and universities. The extracted variables included publication time, number of participants/respondents, research design, data analysis, and key results. Next, we report the problems faced by students in chemistry during the COVID-19 pandemic so that conclusions are drawn.

Results

Literature searches were found on 3 search engines, namely Pubmed, Google Scholar, and Science Direct.

From the results of a literature search on 3 search engines, namely Pubmed, Google Scholar, and Science Direct with predetermined keywords, 375 types of literature were obtained with details of 13 kinds of literature on Pubmed, 358 literature on Google Scholars, and 4 kinds of literature on Direct Science. Then the literature was filtered using the publications of the last 3 years discussing the academic resilience of students studying chemistry during the Covid-19 pandemic, getting 4 articles that matched the inclusion and exclusion criteria. More clearly can be seen in Figure 1. The literature consists of four studies (Siddique et al. (2021); Chikendu et al. (2021); Johnson et al. (2021); and Ramachandran & Rodriguez. (2020) where all publications are in English and published between March 2020 and May 2023. The country of publication is Pakistan, Nigeria, the United States of America, and so on. The stages of the literature search are described in the Figure 1.

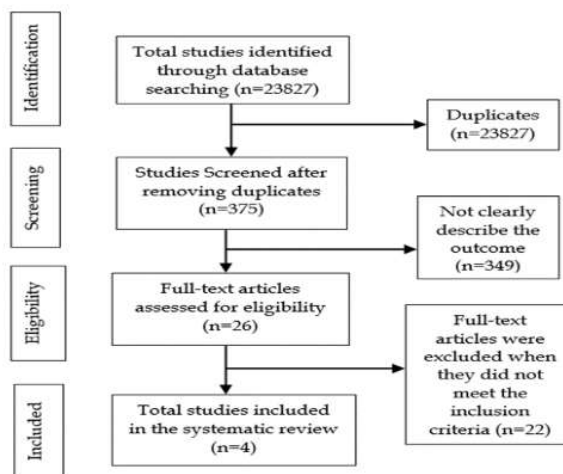


Figure 1. Systematic review strategy based on PRISMA (2009) Guidelines

Result and Discussion

The outbreak of the COVID-19 virus has implemented learning in high schools in the 2021-2022 school year not carried out as it should, which is usually done face-to-face directly into online-based learning. This is done to prevent the spread and transmission of COVID-19 in the education sector. The change from face-to-face learning to online learning during this pandemic is sudden. This of course allows online learning currently not supported by the readiness of students to live it. Cao et al. (2020) revealed that sudden academic changes in national and international universities cause severe effects of anxiety and psychological stress in students' lives. Although social distancing interventions can effectively slow the spread of infection, they also

increase students' social isolation, affecting their psychological well-being and mental health (Bavel et al., 2020). Not surprisingly, the COVID-19 crisis prompted students to experience feelings of depression, anxiety, stress, loneliness, confusion about the future, loss of hope, and even suicidal thoughts (Elmer et al. 2020; Putra et al. 2020).

Raghunathan et al. (2022) state the same thing that the COVID-19 pandemic has caused major changes in the world. One aspect of the pandemic is its impact on the education system. Shifts that occur suddenly without any prior warning. Nevertheless, the education system must continue to survive and show resilience. Resilient systems can cope and succeed in dealing with change. For the education sector, the COVID-19 pandemic is a phenomenal change event and a warning to the world of education. The measure of resilience in education has three main aspects, namely people, technology that facilitates the process, and the process environment. In this case, what is the focus of attention is the student's ability to survive difficult times such as during the COVID-19 pandemic. Students in the learning process are expected to be able to independently find solutions for how they can survive, or in the field of psychology, it is known as resilience. Utami (2020) stated that every individual is born with the ability to be resilient so resilience is not something spectacular because it is a process that every individual experiences. This means that basically, every individual has resilience capabilities. According to Martin & Marsh (2006) emphasize that students who are academically resilient are able to effectively face four situations, namely setbacks, challenges, adversities, and pressure.

In the context of online learning, academic resilience can help students to adapt to the changes that occur. Sari and Suhariadi (2019) found that strong academic resilience will make students have a commitment to face various changes in their academic lives. Furthermore, academic resilience helps students overcome difficulties in online learning, which in turn increases satisfaction with online learning. Liu et al. (2016) reached similar conclusions regarding the importance of physical health, emotional support, and resilience as factors that enhance psychological well-being among students. Likewise, Eva et al. (2020) students who have a high level of resilience tend to have a high level of resilience and subjective well-being as well, meaning they are able to regulate their emotions better in addition to controlling the internal stress caused by online learning. In line with this, Sarmiento et al. (2021) shows that students who have a high level of resilience in situations of confinement are highly adaptable to change, face the challenges posed by periods of isolation, see the bright side, and feel able to rise from difficult situations. They see themselves as

strong individuals capable of facing the challenges posed by confinement and seeing the bright side. Most of them also feel able to act with balance, decision-making, and clear goals despite any adverse situations they may experience

For several literacy studies related to online learning problems, among others, a study conducted (Muflih et al. 2020) found that the lack of experience in using online devices in learning activities was a separate obstacle for students in the learning process. In addition, there is no readiness to participate in online learning, as well as several factors, are identified as being a source of obstacles for students in participating in online learning. The literature study conducted (Hart, 2012) found several factors that hinder students from participating in online learning, these factors include the auditory learning style model applied in online learning which makes it difficult for students to process verbal information conveyed, difficulty accessing resources online learning and difficulties in communicating with teachers. In a study, students were found to be not sufficiently prepared to balance their work, family, and social lives with their study life in an online learning environment (Parkes et al. 2014). Thus, many difficulties must be faced by students, and of course, this will have an impact on the sustainability of education. The number of difficulties experienced by students in online learning needs attention because otherwise, it will endanger the continuity of education. In conditions of rapid change like today, a student needs to have the skills and abilities to respond to every difficulty adaptively. The individual's ability to be able to respond to and overcome academic difficulties is known as academic resilience (Kumalasari & Akmal, 2020).

A systematic review is a method of all relevant research results related to a particular research question, topic, or phenomenon of concern (Kitchenham, 2004). Retrieval of research data using a systematic review method, namely through an internet search (PubMed, Google Scholar, and Science Direct). The results obtained from searching on the internet amounted to 4 journals that matched the criteria. There have been many research themes on academic resilience published in scientific journals, but there is still very little about the academic resilience of students studying chemistry during the COVID-19 pandemic. Therefore, it is necessary to review the journals related to this theme.

The first source of literature is research from Siddique et al. (2021). This study aims to identify differences in resilience based on gender and academic flow in students' chemistry learning in 10th grade. Grade 10 chemistry students face several problems during the learning process, especially in Pakistan during the COVID-19 pandemic. Chemistry is considered a complex subject (Iqbal et al. 2009). So, it takes time to

identify the problem and its solution. In this context, it is necessary to find out how students overcome learning problems and bounce back (resilience) to solve problems in chemistry. Learning problems are primarily the capacity to recover quickly from adversity. It is a tremendous challenge for chemistry teachers to improve students' resilience and academic achievement by applying various teaching methods to chemistry. In this COVID-19 situation, it will take time to show a clear view of the current situation in the context of resilience and self-efficacy (Austin & Gregory, 2021; Walsh, 2020). Age and gender may be stated as two of the factors that contribute to resilience among traumatized individuals (Sambu & Mhongo, 2019). The results showed that in resilience regarding gender, both male and female students had insignificant differences in resilience; there is no difference between them (Siddique et al. 2021). However, from various resilience factors, male students have higher resilience than female students. In line with that, (Sujadi et al. 2021) revealed that there are differences in the level of resilience between men and women which are known from resilience scores. A study attempted to examine the effect of gender and student resilience levels; research proves that male students have higher resilience than girls (Erdogan et al., 2015). Then a study on the effect of age and gender on resilience in trauma refugees in Kenya revealed that men are more resilient than women (Sambu & Mhongo, 2019). However, not all relevant studies reveal that men are more resilient than women (Isaacs, 2014). The results of previous studies tend to be mixed, no research or opinion can confirm that women have lower resilience than men or vice versa. Resilience is multidimensional and is made up of several constructs.

The next source of literature is research from Chikendu et al. (2021). This study focuses on academic motivation and resilience which are correlated with student achievement in chemistry. The study concluded based on the findings that motivation and academic resilience bear a significant influence on students' achievement in chemistry. High motivation and academic resilience are needed to attain high achievement scores in chemistry. Resilience, a multi-dimensional construct, is one of the most essential personal factors influencing academic achievement and it is the ability to pass the hardest problems and tolerate and overcome the most disastrous events, complex situations, and pitfalls (Oke et al. 2016). The ability to succeed in dealing with school-based setbacks is likely to be influenced by several interrelated factors (Ungar & Leibenberg, 2011) including motivation to continue learning after the pandemic. The need to pursue investigations in this direction is because chemistry as a science subject poses challenges to learners. There is also the problem of inadequate and well-equipped

laboratories and a worrying student population. Chemical consumables are also expensive and require teachers to improvise. This condition together with the individual difficulties faced by students demands the need to have high motivation and academic resilience if they are to achieve good performance. The observed significant relationship between motivation and achievement in chemistry can be attributed to the fact that motivation leads students to study with a genuine interest in a particular field for its own sake. Highly motivated students are energetic, independent, and competitive and find themselves restricted in learning. A high level of motivation, therefore, can give students the idea that they can thrive in academic exams, and with such ideas, they seek help where they have no ability or cannot understand concepts, just so that they can become successful. The significant relationship observed between academic endurance and achievement in chemistry is that resilient students strive to meet academic demands despite facing diverse challenges. Students with high academic resilience adapt to behaviors that can help them succeed in facing academic struggles. It could be said that the academic mind of tough students is always positive. They accept the challenge and see it as a stepping stone to growth. The students having overcome certain academic challenges use that as motivation to tackle future challenges. This is why study findings reveal that academic motivation and resilience significantly predict achievement in chemistry. This study's findings align with the findings of Oke et al. (2016) who revealed that in all groups studied, academic resilience was significantly correlated with academic achievement. The study findings also support the findings of Mwangi et al. (2015) that academic resilience is significantly correlated with academic achievement in female dormitories, male student days, mixed students, and male student dormitories.

Research from the third literature source is that of Johnson et al. (2020). This study aims to maintain a high-quality curriculum for its students while balancing the well-being of students and faculty. The findings in the study showed that when students were involved in virtual Zoom classes, many students chose to turn off their webcams in general chemistry lessons. Based on quantitative data (76%) of students said it was difficult to maintain focus in a virtual setting. From the qualitative data, students often attribute their difficulty concentrating to a lack of physical separation between work and leisure time, especially for many students forced to work in their bedrooms and beds. Students also experience decreased performance and motivation due to a lack of accountability from peers and/or instructors. Academic resilience denotes the capacity of students to overcome acute and/or chronic education-related

difficulties through adaptive responses in three domains: cognitive, affective, and behavioral (Martin, 2013). Cassidy (2016) said the resilience process emphasizes individual efforts to rise from adversity, return the situation to a new normal, and integrate cognitive-affective, adaptive, and non-adaptive behavior. Academic resilience can help students overcome and competently manage academic stressors.

Research from the latest literature source is research conducted by Ramachandran & Rodriguez (2020). This study discusses the efforts taken in teaching large-scale organic chemistry courses remotely amid the COVID-19 pandemic. The main challenge that students face in distance learning is the lack of focus and motivation due to stress about the ongoing pandemic and disruption in their environment due to unavoidable and difficult family and life situations. Another important factor to consider when building a fair course is economic inequality. Some students stated a lack of access to technology and an environment that was not conducive to learning. Finally, we recommend that course instructors explicitly address mental health issues early in their course and direct students to helpful online resources for managing them. However, students benefit the most from watching a combination of live lectures and recorded live lectures, as it allows them to reflect on and speed up the material being studied while taking good notes, as well as working through problem sequences as a group in their discussion/recitation sections. Students also indicated that additional exercises such as ungraded homework worksheets were beneficial to their learning. Resilience is needed to be able to cope with the stresses of the COVID-19 pandemic and return to normal functioning levels. Resilience is very important to face today's challenges together at the community level, including in the field of education (Vinkers et al. 2020). Resilience is defined as a concept of resilience with an emphasis on how educational programs can foster student resilience. The results of a review of academic resilience in chemistry during the COVID-19 pandemic are briefly listed in Table 1.

Based on the literature review that has been carried out, it is known that there are still limited journals discussing student resilience in studying chemistry during the COVID-19 pandemic. Therefore, further studies are needed on academic resilience to study chemistry during the COVID-19 pandemic. Academic resilience is needed by students to overcome difficulties in learning chemistry in the face of the Covid-19 pandemic. Resilience in the field of education is considered to be able to effectively deal with setbacks, and pressures in the academic environment. In the current state of pandemic disruption or disaster, a meaningful online environment is the first 'point of destination' towards resilience, even if online space

alone is an alternative to face-to-face activities (delivery of lectures, readings, and assessments) can encourage a unique approach, to improve student involvement and maintain communication with lecturers (Dohaney et al. 2020). Mallick & Kaur (2016) revealed that academic resilience is an important part of successfully facing academic challenges and encourages student motivation and success. Students who show hard work can solve problems, see difficulties as opportunities, adapt learning methods, look for other learning resources, and avoid negative responses. This behavior is often considered a sign of academic resilience (Cassidy, 2016). Due to changes in learning methods in schools, academic resilience has become important and students need to stay connected to learning processes and methods to achieve learning success. Resilience is not just an outcome, but also a process for students, and students must continue to achieve high academic results despite having a high-risk background (Morales & Trotman, 2011).

Conclusion

Academic resilience is a personal assessment process in facing the challenges of learning situations and is a student's effort to respond to the difficulties associated with the COVID-19 pandemic they are experiencing. Academic resilience through the learning process is an important factor in avoiding academic failure and achieving success in learning. On the other hand, online learning readiness is an alternative learning method that requires cognition, affection, motivation, and decision-making in student learning situations through the use of the internet and other media such as Zoom, Google Meet, and others. Self-management during the online learning process requires students to take initiative and self-control in directing the learning experience. The attitude of students in online learning readiness is an important component to ensuring online learning can run effectively during the pandemic. The limitation of distance learning becomes a challenge for students to be able to survive and achieve new adaptations. Thus, academic resilience is considered capable of maintaining motivation and learning success in students during the COVID-19 pandemic.

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Author Contributions

D.A as the main author created the concept or idea for the article, designed the method used, conducted research from several journals by the theme of the article analyzed the data,

and wrote the article; H. S and E. W. who always provides direction and guidance regarding the review of this article, starting from planning the review and conducting a content analysis on the article as a whole.

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Conflicts of Interest

The authors declare no conflict of interest.

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