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A SYSTEMATIC LITERATURE REVIEW ON FACTORS AFFECTING STUDENTS' ONLINE ENGAGEMENT TOWARDS MATHEMATICS

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Abstract

Online learning has become increasingly popular due to the recent COVID-19 pandemic. Learners are expected to learn remotely from home due to the imposed movement control order. However, a major concern pertaining to students' engagement in mathematics, a subject which is considered difficult and challenging, could be undermined by the adoption of this remote learning method. Such perception could make engagement in an online environment, an environment whereby the teacher may not be able to control students directly, difficult. Therefore, it is important to review the article related to find major findings on factors affecting the students' online engagement in mathematics for helping students and teachers adapt to the online learning environment. This study aimed to perform a systematic literature review on the factors affecting students' online engagement in mathematics and the commonly used method in studying the factors. As a result, 20 credible articles from SCOPUS, Web of Science, and ScienceDirect were retrieved using predefined eligibility criteria. The results showed that technology/platform/online teaching strategies and traits were the most important factors that affect students' online engagement in mathematics and case study was the most common method used in studying students' online engagement towards mathematics. Educators and other interested stakeholders should consider and incorporate these factors mentioned in this research to promote engagement in Mathematics subject. Moreover, researchers can easily identify the most effective method based on this research for future research.

Keywords: Mathematics; online engagement; online learning

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Abstrak

Pembelajaran dalam talian telah menjadi semakin popular berikutan pandemik baru-baru ini. Walaubagaimanapun, kebimbangan utama ialah penglibatan pelajar boleh terjejas oleh penggunaan kaedah pembelajaran atas talian memandangkan subjek matematik merupakan subjek yang mereka anggap sukar dan mencabar. Persepsi sedemikian boleh menjadikan penglibatan dalam talian terganggu dan guru mungkin tidak dapat mengawal pelajar secara langsung atau sukar dikawal. Oleh itu, adalah penting untuk mencari penemuan utama tentang faktor yang mempengaruhi penglibatan dalam talian pelajar dalam matematik dalam artikel untuk membantu pelajar dan guru menyesuaikan diri dengan persekitaran pembelajaran dalam talian. Kajian ini bertujuan untuk melaksanakan kajian literatur sistematik berkaitan faktor-faktor yang mempengaruhi penglibatan dalam talian pelajar dalam matematik. 20 artikel yang boleh dipercayai daripada SCOPUS, Web of Science dan Science Direct telah diambil menggunakan kriteria kelayakan yang telah ditetapkan. Kajian semula bahawa teknologi/ platform/ strategi dan sifat pengajaran dalam talian adalah faktor yang paling penting, manakala kajian kes adalah kaedah yang paling umum dijalankan bagi mengkaji penglibatan dalam talian pelajar dalam matematik. Pendidik dan pihak berkepentingan lain yang berminat harus mempertimbangkan dan menggabungkan faktor-faktor yang disebutkan dalam penyelidikan ini untuk menggalakkan penglibatan dalam talian bagi subjek Matematik. Selain itu, pengkaji boleh dengan mudah mengenal pasti kaedah yang paling berkesan berdasarkan penyelidikan ini untuk penyelidikan masa hadapan.

Kata kunci: Matematik; penglibatan dalam talian; pembelajaran dalam talian

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1.0 INTRODUCTION

Online learning has widely become a popular means for learning adopted at all levels of education. Its popularity increased especially after the emergence of COVID-19 whereby many learners were expected to learn remotely due to the introduction of isolation and movement control measures (Capone & Lepore, 2021; Muir et al. 2020; Rizzo, 2021). Despite the rising popularity, many educators and other stakeholders have been majorly worried about students' engagement when undertaking to learn. Their concern is valid as many studies have shown that students' engagement is crucial for positive educational outcomes.

The term "engagement" refers to a person's level of behavioural, cognitive, and emotional participation (Fredricks et al. 2004; Reeve et al. 2004). The approach developed by Fredricks et al. (2004) outlines three categories of cognitive, behavioural, and emotional engagement. In the classroom, behavioural engagement refers to how actively students participate by staying on task, listening, and following directions in a predictable manner. The degree to which students think about a subject, persevere when presented with problems or failures, and self-regulate their learning is referred to as cognitive engagement. Finally, emotional involvement refers to how interested, and enthusiastic students are about being in class and studying the material (Fredricks et al. 2004).

Mathematics is thought to be essential to all elements of society. Despite this, a significant number of students are abandoning mathematics (Cooper, 2014; Lawson & Lawson, 2013). Disengagement in mathematics is not only a contributing factor to reduced participation rates in intermediate and high-level mathematics courses in senior high school and at university, but it is also a factor in the downward trend in middle-year students' mathematical performance (Barrington, 2011). Underperformance and low participation rates have the potential to have long-term negative effects for our society as a whole. As a result, the Covid-19 outbreak may be one of the factors that has a negative impact on students' mathematical performance due to a decrease in student participation.

The level of student engagement can also vary (Martin et al. 2015). For example, students who show high levels of interest (emotional engagement) and ask a variety of questions for clarification (behavioural and cognitive engagement) when introduced to a new mathematics concept one day may show much lower levels of interest and participation when a related concept is presented the next day—possibly due to mastery rather than reduced engagement. Furthermore, students' emotional engagement has been proven to be volatile,

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as earlier experiences with mathematics challenges or dropping grades in early secondary school might severely affect their emotional engagement and have long-term negative consequences for ongoing mathematics studies (Lewis, 2013). As a result, individual student engagement patterns are likely to be changeable or idiosyncratic, with students displaying various types of engagement at varying levels of intensity depending on the activities at hand, prior experiences, or any number of other contextual factors (Martin et al. 2015).

Moreover, the fact that many students have been cited to perceive math as challenging or plain boring necessitates the need for conducting a study that will establish factors affecting student online engagement towards the subject (Fung et al. 2018). Such perception could make engagement in an online environment, an environment whereby the teacher may not be able to control students directly, difficult. Fortunately, some notable literature covering the subject exists. Therefore, it is important to review them and hence establish their major findings.

1.1 Purpose

Considering the challenges associated with students' online engagement towards mathematics and the fact notable literature on the research topic exists, this study aims to perform a systematic literature review that will answer the following research questions:

a) What are the factors affecting students' online engagement towards mathematics?
b) How the students' online engagement level is studied in empirical mathematics education research?

2.0 MATERIALS AND METHODS

2.1 Methods

This study adopted a systematic literature review method to investigate the factors affecting students' online engagement towards mathematics. As the name suggests, the systematic literature review is a high-level organized method of identifying, selecting, and critically appraising literature. The reviewed literature must be covering clearly articulated research topics and questions (Laar et al. 2017). It should not be confused with the ordinary literature review method that applies qualitative, relatively informal, and subjective methods. The formality, systematic, and highly organized manner were the main reasons for utilizing this method in conducting this study. This method ensures the researcher to select past research in an unbiased way that can be replicated by future researchers to come up with almost similar

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findings as those arrived at in this study.

In this study, the systematic literature review was conducted in line with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flowchart (Laar et al. 2017). Even though PRISMA does not act as a tool for checking quality, it contains attributes and guidelines which if followed can ensure the systematic review is reported in a clear and transparent manner. The guideline includes a flow diagram and a checklist. The flow diagram (see Figure 1) covers phases that researchers using PRISMA must follow to develop a systematic literature review. The checklist contains 27 items that an author of a paper must include in a systematic literature review paper that is formatted using PRISMA (Twafik et al. 2019; Laar et al. 2017). The 27 checklist items were considered in the preparation of this study while the flow diagram was the procedure followed to conduct this systematic literature review.

2.2 Selection Criteria

Selection criteria outline both the criteria used to select potential studies (Laar et al. 2017). The inclusion criteria involve selecting studies that were published in credible peer-review journals. To be included the study also needed to have been published within the last 5 years (2017 to 2022). The focus of the study was also expected to be students' online engagement, specifically towards mathematics subject.

2.3 Search Strategy

Search strategy involved using four main keywords, namely online engagement, online learning, distance learning, online education. These search terms were used to retrieve relevant documents from three main databases, namely Scopus, Web of Science, and ScienceDirect. The three databases were selected because of their popularity and credibility as sources of social science research articles. A Boolean search was performed in the databases. Boolean search is a structured search strategy that enables the researcher to define, limit and/or broaden search results by using words such as NOT, OR and Not. A researcher using Boolean search is able to use a search engine in an efficient and maximum way (Scells & Zuccon, 2018).

The researcher performed the Boolean search in each database. TITLE-ABS (("online engagement" OR "student engagement") AND ("online learning" OR "distance learning" OR "online education") AND ("student" OR "pupil") AND ("mathematic" OR "mathematics" OR

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"math" OR "maths")) is the Boolean search performed in Scopus**.** TS= (("online engagement" OR "student engagement") AND ("online learning" OR "distance learning" OR "online education") AND ("student" OR "pupil") AND ("mathematic" OR "mathematics" OR "math" OR "maths")) is the Boolean search performed in web of science. Boolean phrase OR specify the alternative terms the articles should have. While the phrase AND specify the terms article must include in the search result (Scells & Zuccon, 2018). To illustrate, the 'OR' included between Online engagement and student engagement indicate that the result should contain either of the two terms. The phrase 'AND' included between these two terms and online learning OR Distance Learning OR online education indicates that the result must contain at least one of the three terms, namely online learning, distance learning, or online education.

2.4 Selection Process (Study Selection)

The process involved first screening the articles by checking their title and then abstract to confirm they met the specified eligibility criteria. Only one researcher was involved in the screening of the articles. The articles that did not meet this criterion based on their title and abstract were then excluded. Next, the remaining articles were reviewed in full to determine whether their content was in accordance with eligibility criteria. The final list of the selected articles was coded based on authors name, year of publication, study type, data types, and findings.

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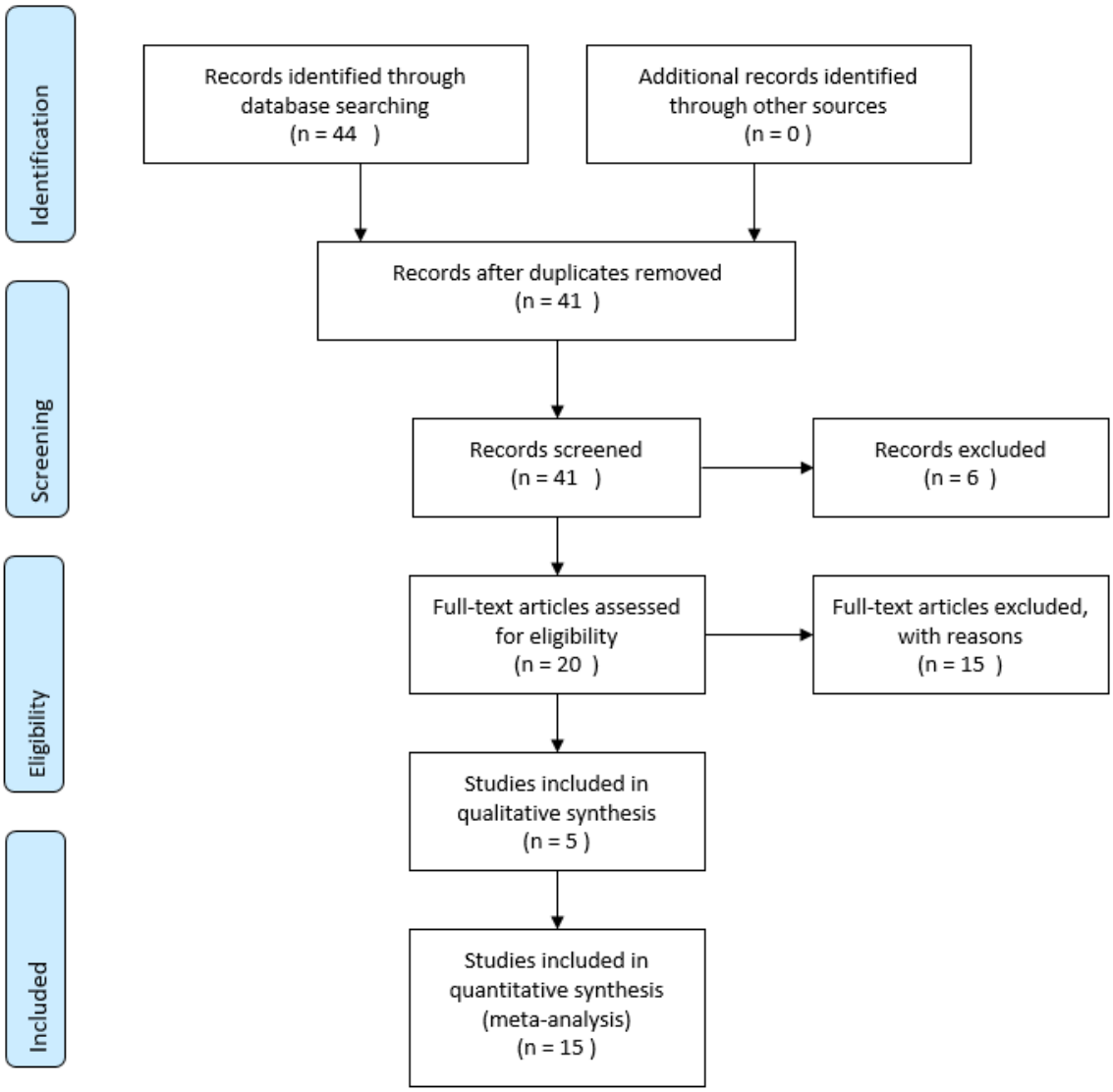

Figure 1. PRISM flowchart

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2.5 Data collection and analysis

Data was extracted by considering the main research question and objective of this systematic review. The research reviewed the data one by one and extracted the finding that appeared to answer the question directly. A content analysis was adopted during the data collection and extraction process.

2.6 Selection risk of bias

This study did not involve utilizing more than two reviewers to minimize the selection risk of bias. Nevertheless, the checklist developed in accordance with clearly defined eligibility criteria reduced the bias and guaranteed only high-quality articles were selected. The approach eliminates the subjective that is often associated with this kind of bias.

3.0 Results and Discussion

3.1 Description of the studies

Table 1 highlights the characteristics of the study selected and reviewed. Qualitative, quantitative, and mixed-method studies were reviewed. 5 studies were purely qualitative. 8 of them adopted a mixed methodology approach, meaning that they utilize both qualitative and quantitative data. The remaining 7 were quantitative in nature. The studies were also of different types, ranging from case study, quasi-experiment, and narratives, among others (See Table 1).

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Table 1. Studies characteristics

Code	Author	Study type	Data type
1.	Lambert & Shuck	Qualitative case study	Qualitative
2.	Thompson & McDowell (2019)	Mixed method Case study	Quantitative and qualitative
3.	Roman et al. (2021)	Case study	Quantitative and qualitative
4.	Lim et al. (2018)	Performance test & Survey	Quantitative
5.	Low & Hew (2020)	Mixed-method	Quantitative and qualitative
6.	Baker & Hjalmarson (2019)	Self-study (Qualitative)	Qualitative
7.	Spitzer et al. (2021)	Secondary research	Quantitative
8.	Muir & Trimble (2020)	Case study	Quantitative
9.	Capone & Lepore (2021)	Experimentation (single case study)	Quantitative and qualitative
10.	Morante et al. (2020)	Case study	Quantitative (Blackboard result) and Qualitative (online discussion)
11.	Raz & Reddy (2021)	Secondary research	Quantitative
12.	Trenholm et al. (2019)	Quasi-experiment	Quantitative
13.	Rizzo (2021)	Narrative	Qualitative
14.	Kundu et al. (2020)	Design-based research (DBR	Mixed method
15.	Boaler et al. (2018)	Randomized study	Quantitative
16.	Fung et al. (2018)	Secondary approach	Quantitative
17.	Fredricks et al. (2017)	Sequential exploratory design	Quantitative & Qualitative
18.	Schuetz et al. (2018)	Quasi-experiment	Mixed methods
19.	Skilling et al. (2021)	Longitudinal study	Qualitative data
20.	Engelbrecht et al. (2020)	Empirical review	Qualitative

3.2 Risk of bias within studies

Publication bias was one of the risks of bias checked by the reviewers in this study. This bias was minimized by ensuring only peer-reviewed articles were included in this systematic research. It was also minimized by relying on articles included in reputable databases, the most notable one being SCOPUS. The methodology used in each paper was counter checked to confirm that it followed a scientific approach, consequently minimizing the bias.

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3.3 Individual results

Table 2 highlights the findings of each of the studies reviewed. Based on the results Table 2 shows, the findings are more focusing on the factors affecting students' online engagement in mathematics. Thus, the findings are also focusing on how the students' online engagement is studied in empirical mathematics education research. Only those findings that were directly related to the research question of this study were included. The research methodology utilized to reach the findings included in Table 2 was highlighted in Table 1. The result of the individual study is highlighted in Table 3.

Table 2. Results and findings of individual studies

Code	Author	Findings & Concepts
1.	Lambert & Shuck (2021)	1. Difficulty in supporting math students remotely 2. Difficulty in promoting self-regulation remotely 3. Emotional consideration and affective learning dimension are crucial for promoting student online engagement towards math
2.	Thompson & McDowell (2019)	1. Convenience & Flexibility 2. Satisfaction leads to engagement 3. Timely & Open communication
3.	Roman et al. (2021)	1. Access to technology and centralized platform affect engagement 2. Teachers awareness and affective teaching strategies is necessary to promote student engagement
4.	Lim et al. (2018)	1. Training to use online tools could enhance student engagement and increase learning outcome
5.	Low & Hew (2020)	1. Entertaining online teaching (flipped & gamification) promotes engagement and learning of maths
6.	Baker & Hjalmarson (2019)	1. Student-student interaction and student-content interaction promotes student engagement during online math learning
7.	Spitzer et al. (2021)	1. Student engagement in online learning changes over time 2. Chances of decreasing over time are notably high
8.	Muir & Trimble (2020)	1. Social, Managerial and technical facilitation increase the presence and active involvement of instructors consequently motivating and enhance online engagement of math learners.
9.	Capone & Lepore (2021)	1. Student engagement is affected by the situation necessitating it and the distance learning method adopted 2. Adaptive e-learning method can enhance engagement and outcome
10.	Morante et al. (2020)	1. Student gender could influence engagement levels 2. Student personality affects engagement 3. Student engagement in terms of time spent online affected mathematical learning outcome
11.	Raz & Reddy (2021)	1. Student engagement statistically influence marks attains from mathematical assessment

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		2. Online courses that create sense of community and regularly assessing and improving course can improve online engagement and consequent learning outcome
12.	Trenholm et al. (2019)	1. Using online teaching strategies, particularly live recording video at the expense of physical teaching reduces student cognitive engagement.
13.	Rizzo (2021)	1. Student engagement could be boosted by using digital strategies and tools that promote student-student and student-teacher communication
14.	Kundu et al. (2020)	1. Blended learning (combining online and offline) teaching strategies was likely to boost student engagement
15.	Boaler et al. (2018)	1. Student mind set about their math abilities enhance their online engagement
16.	Fung et al. (2018)	1. Student interest and openness towards problems had high impact on overall engagement and math outcome.
17.	Fredricks et al. (2017)	1. Motivational and contextual factors have significant impact on student engagement towards maths
18.	Schuetz et al. (2018)	2. Student independence in using technology and providing feedback enhance engagement of the maths student
19.	Skilling et al. (2021)	1. Believe about math and career aspiration are top factor promoting online student engagement in math.
20.	Engelbrecht et al. (2020)	1. Student-driven approach (pull process) enable engagement and learning of maths online

3.4 Overall results

Table 3 highlighted the factors of the student online engagement towards mathematics. Based on the table, the results show technology, platform and online learning strategies were mentioned by four articles. The factor of technology, platform and online learning strategies is the highest number of studies mentioned from other factors.

There are some factors mentioned by two number articles which are support, student-student interaction and situation necessitating online learning. Thus, we can conclude that the students' surroundings are also the main factors in online engagement. However, other factors such as emotional and affective consideration, convenience, flexibility, open communication, access to technology, teacher awareness, entertaining, student-teacher interaction and training on tech use were mentioned by one article only.

It is important to note that some articles also mentioned more than one factor. The results of the second question, "How are students' online engagement studied in empirical mathematics education research?" are included in Table 4.

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Table 3. Factors mentioned in studies

Main Factors	Number of studies (n)
Support	2
Emotional and Affective consideration	1
Convenience	1
Flexibility	1
Open communication	1
Access to technology	1
Technology/Platform/online strategies traits	4
Teacher awareness	1
Entertaining	1
Student-student interaction	2
Student-teacher interaction	1
Training on tech use	1
Time	1
Situation necessitating online learning	2
Student's Gender	1
Student's personality	1
Sense of community	1
Blended learning	2
Student mind set	2
Student interest	1
Openness towards problem-solving	1
Motivational	1
Student independence	1
Feedback loop	1

Table 4 provides results regarding how students' online engagement in empirical mathematics education is studied in research. The table indicates that the case study approach (n=6) is the most popular method for studying online engagement in empirical mathematics. This shows that a process of research into the development of a particular person, group, or situation according to a period of time is the suitable method to approach this research. Next, the second highest number of research methods followed by secondary research (n=3), and followed by quasi-experiment (n=2).

Thus, there are other research methods that have been used for this case study which are performance test and survey, self-study, experimental, narrative, design- based research, randomized study, sequential exploratory design, longitudinal and empirical review. However, it is worth noting most of the methodology was similar. They were differentiated by only slight modifications.

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Table 4. Methods of studying online engagement in Mathematics

Research method	Number of studies (n)
Case study	6
Performance test & Survey	1
Self-study	1
Secondary research	3
Experimental	1
Quasi-experiment	2
Narrative	1
Design-based research	1
Randomized study	1
Sequential exploratory design	1
Longitudinal	1
Empirical review	1

4.0 DISCUSSION

In relation to the first objective, which is to evaluate factors of student online engagement towards mathematics, this review identified a total of 24 critical factors. Technology/platform /online strategies used were the most cited factor (n=4). When it comes to the second objective, which was to examine how students' online engagement is studied in empirical mathematics education research, this review established that the case study method (n=6) was the most common way of studying student online engagement in mathematics subjects.

The findings are consistent with other studies conducted to investigate overall student engagement when learning online. Despite the subject student is undertaking, past studies suggest that the strategies, platform and technology used are likely to promote engagement due reasons such as entertainment value (Choi, 2018), perceived ease of use (Jung & Lee, 2018), and ability to support the learning process, (Xu et al. 2018), just to mention a few. Past studies have also indicated that case study is a popular method of investigating student engagement because it allows the researcher to follow up on the lived experience of the student (Han & Xu, 2021).

The findings of this review are credible because they were retrieved using a well-articulated selection protocol. The selection criteria protocols ensured that the researcher relied on only high-quality evidence. However, not using multiple reviewers may increase its risk of bias.

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5.0 CONCLUSION

This study has practical and research-related implications. For practice, this study has provided factors that affect student engagement. Educators and other interested stakeholders should consider and incorporate these factors to promote engagement. In terms of research, this study has highlighted the most common method of performing similar research. Researchers can thus easily identify the most effective method, based on popularity, or the neglected method (that is the method not used, and adopt them for future research.

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7.0 REFERENCES

Baker, C. K., & Hjalmarson, M. (2019). Designing purposeful student interactions to advance synchronous learning experiences. *International Journal of Web-Based Learning and Teaching Technologies (IJWLTT)*, *14*(1), 1-16.

Barrington, F. (2011). Australian mathematical sciences institute interim update on year 12 mathematics student numbers. Melbourne: Australian Mathematical Sciences Institute.

Capone, R., & Lepore, M. (2021). From distance learning to integrated digital learning: A Fuzzy cognitive analysis focused on engagement, motivation, and participation during COVID-19 Pandemic. *Technology, Knowledge and Learning*, 1-31.

Choi, G. Y. (2018). Learning through digital storytelling: exploring entertainment techniques in lecture video. *Educational Media International*, *55*(1), 49-63.

Cooper, K. S. (2014). Eliciting engagement in the high school classroom: A mixed-methods examination of teaching practices. *American Educational Research Journal*, *51*(2), 363-402.

Engelbrecht, J., Llinares, S. & Borba, M.C. (2020). Tawfik, G. M., Dila, K. A. S., Mohamed, M. Y. F., Tam, D. N. H., Kien, N. D., Ahmed, A. M., & Huy, N. T. (2019). A step by step guide for conducting a systematic review and meta-analysis with simulation data. *Tropical medicine and health*, *47*(1), 1-9. Transformation of the mathematics classroom with the internet. *ZDM Mathematics Education* 52, 825–841 (2020).

Received: 27 September 2022, Accepted: 17 May 2023, Published: 30 June 2023
https://doi.org/10.17576/ajtlhe.1501.2023.04

Fredricks, J. A., & Eccles, J. S. (2002). Children's competence and value beliefs from childhood through adolescence: growth trajectories in two male-sex-typed domains. *Developmental psychology*, *38*(4), 519.

Fung, F., Tan, C. Y., & Chen, G. (2018). Student engagement and mathematics achievement: Unraveling main and interactive effects. *Psychology in the Schools*, *55*(7), 815-831.

Han, Y., & Xu, Y. (2021). Student feedback literacy and engagement with feedback: A case study of Chinese undergraduate students. *Teaching in Higher Education*, *26*(2), 181-196.

Jeong, J. S., & González-Gómez, D. (2021). A STEM course analysis during COVID-19: A Comparison study in performance and affective domain of PSTs between F2F and F2S flipped classroom. *Frontiers in Psychology*, 3352.

Jung, Y., & Lee, J. (2018). Learning engagement and persistence in massive open online courses (MOOCS). *Computers & Education*, *122*, 9-22.

Koss, L. (2021). Crowdsourcing solutions in the online mathematics classroom. *International Journal of Mathematical Education in Science and Technology*, 1-7.

Lambert, R., & Schuck, R. (2021). “The wall now between us”: Teaching math to students with disabilities during the COVID Spring of 2020. *The Asia-Pacific Education Researcher*, *30*(3), 289-298.

Lawson, M. A., & Lawson, H. A. (2013). New conceptual frameworks for student engagement research, policy, and practice. *Review of Educational Research*, *83*(3), 432-479.

Lewis, G. (2013). A portrait of disaffection with school mathematics: The case of Anna. *Journal of Motivation, Emotion, and Personality*, *1*(1), 36-43.

Lim, W., Son, J. W., Gregson, S., & Kim, J. (2018). An examination of high school students' online engagement in mathematics problems. *International Journal of Web-Based*

Received: 27 September 2022, Accepted: 17 May 2023, Published: 30 June 2023
https://doi.org/10.17576/ajtlhe.1501.2023.04

Learning and Teaching Technologies (IJWLTT), *13*(2), 1-15.

Lo, C. K., & Hew, K. F. (2020). A comparison of flipped learning with gamification, traditional learning, and online independent study: the effects on students' mathematics achievement and cognitive engagement. *Interactive Learning Environments*, *28*(4), 464-481.

Martin, A. J., Papworth, B., Ginns, P., Malmberg, L. E., Collie, R. J., & Calvo, R. A. (2015). Real-time motivation and engagement during a month at school: Every moment of every day for every student matters. *Learning and Individual Differences*, *38*, 26-35.

Morante, A., Djenidi, V., Clark, H., & West, S. (2017). Gender differences in online participation: Examining a history and a mathematics open foundation online course. *Australian Journal of Adult Learning*, *57*(2), 266-293.

Muir, T., Douglas, T., & Trimble, A. (2020). Facilitation strategies for enhancing the learning and engagement of online students. *Journal of University Teaching & Learning Practice*, *17*(3), 8.

Raza, S. H., & Reddy, E. (2021). Intentionality and players of effective online courses in mathematics. *Frontiers in Applied Mathematics and Statistics*, *7*, 2.

Reeve, J., Jang, H., Carrell, D., Jeon, S., & Barch, J. (2004). Enhancing students' engagement by increasing teachers' autonomy support. *Motivation and emotion*, *28*(2), 147-169.

Rizzo, O. G. (2021). Making good of a pandemic: A Long-distance remedial summer course in calculus. *Education Sciences*, *11*(7), 327.

Roman, T. A., Brantley-Dias, L., Dias, M., & Edwards, B. (2021). Addressing student engagement during COVID-19: Secondary STEM teachers attend to the affective dimension of learner needs. *Journal of Research on Technology in Education*, 1-29.

Scells, H., & Zuccon, G. (2018, June). Generating better queries for systematic reviews. In *The 41st International ACM SIGIR Conference on Research & Development in Information*

Received: 27 September 2022, Accepted: 17 May 2023, Published: 30 June 2023
https://doi.org/10.17576/ajtlhe.1501.2023.04

Retrieval (pp. 475-484).

Schuetz, R. L., Biancarosa, G., & Goode, J. (2018). Is technology the answer? Investigating students' engagement in math. *Journal of Research on Technology in Education*, *50*(4), 318-332.

Skilling, K., Bobis, J., & Martin, A. J. (2021). The "ins and outs" of student engagement in mathematics: shifts in engagement factors among high and low achievers. *Mathematics Education Research Journal*, *33*(3), 469-493.

Spitzer, M. W. H., Gutsfeld, R., Wirzberger, M., & Moeller, K. (2021). Evaluating students' engagement with an online learning environment during and after COVID-19 related school closures: A survival analysis approach. *Trends in Neuroscience and Education*, *25*, 100168.

Tawfik, G. M., Dila, K. A. S., Mohamed, M. Y. F., Tam, D. N. H., Kien, N. D., Ahmed, A. M., & Huy, N. T. (2019). A step by step guide for conducting a systematic review and meta-analysis with simulation data. *Tropical medicine and health*, *47*(1), 1-9.

Thompson, V. L. & McDowell, Y. L. (2019). A case study comparing student experiences and success in an undergraduate course offered through online, blended, and face-to-face instruction. International Journal of Education in Mathematics, Science and Technology (IJEMST), 7(2), 116-136.

Trenholm, S., Hajek, B., Robinson, C. L., Chinnappan, M., Albrecht, A., & Ashman, H. (2019). Investigating undergraduate mathematics learners' cognitive engagement with recorded lecture videos. *International Journal of Mathematical Education in Science and Technology*, *50*(1), 3-24.