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# Heroe's model: Case study to reduce students' learning loss and anxiety

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**Abstract**

The spread of COVID-19 in all countries is forcing a change from face-to-face learning to online learning. Of course, the implementation of online learning cannot be separated from the obstacles and threats of decreasing the quality of education, one of which is the threat of learning loss and anxiety. This study aims to see and reduce learning loss and learning anxiety in higher education through the application of Heroe's math online learning model. This study is a qualitative descriptive study using diagnostic tests, self-development tests, self-rating anxiety scale test, self-assessment questionnaires and interviews as data collection instruments. Data analysis used technical triangulation. The results showed that with the application of Heroe's math online learning model there were no learning loss symptoms and showed a decrease in students' anxiety levels. The results of this study have an important meaning that the need for handling and adaptation to learning barriers due to changes in the learning environment is not certain.

Keywords: Anxiety, higher education, Heroe's model, learning loss.

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## 1. Introduction

The first wave of COVID-19 attacks in Indonesia in early March 2020 provided a drastic change in the implementation of learning by switching from face-to-face conventional lectures to online learning. This change has of course occurred in almost all countries affected by COVID-19. The COVID-19 pandemic has had a major impact on work and academic life in higher education (Aristovnik, Kerzic, Ravselj, Tomazevic & Umek, 2020), which includes the learning process and the provision of academic administration services. The spread of COVID-19 poses a challenge to higher education on a large scale since the use of learning technology (Liguori & Winkler, 2020). As a result, almost all affected countries have shifted teaching programmes in the form of online distance learning (Shawaqfeh et al., 2020). The transition of face-to-face lectures to online learning has certainly been responded to by every university for the sake of continuous learning. This is following the findings of research which state that university teaching staff and public relations provide very important support to students at universities during a pandemic (Aristovnik et al., 2020) in the form of accelerating adaptation to the educational process by fully depending on available online platforms to deliver lectures, exams, assignments and other necessary teaching and learning activities (Shawaqfeh et al., 2020).

Previous studies have stated that the challenges of online learning in Indonesia are quite diverse. There are universities with lecturers who have limited experience with implementing applications for online learning (Melvina, Lengkanawati, Wirza, Alicia & Yulmiati, 2020). The cost of buying an Internet quota is quite expensive (Bahasoan, Ayuandiani, Mukhrom & Rahmat, 2020). This is exacerbated by the difficulty of obtaining an Internet signal in some areas (Bahasoan et al., 2020). In many homes, especially for low-income families, students do not have access to the Internet, adequate learning tools and a quiet dedicated place to study (Dorn, Hancock, Sarakatsannis & Viruleg, 2020). There are also limitations in the presentation of teaching materials (Irfan, Kusumaningrum, Yulia & Widodo, 2020). These obstacles occur because indeed most higher education institutions are faced with sudden changes and are not ready to switch to online teaching to continue teaching and learning activities and motivate students when social distancing is implemented (Marinoni, Land, Van & Jensen, 2020). It is interesting to study further whether the above-mentioned obstacles that arise can cause learning loss to occur in students.

The term learning loss refers to the loss of specific or general knowledge and skills or a decrease in academic progress, most commonly due to extended gaps or discontinuities in student education (States, n.d). The extension of the gap and the absence of student involvement are currently happening because students are studying at home as a result of school closures. School closures have caused disproportionate learning loss among students in several American states (Dorn, Hancock, Sarakatsannis & Viruleg, 2021). It is indicated that the symptoms and threats of learning loss in Indonesia appear along with the reduced intensity of teacher–student meetings as a result of the application of distance learning. In Indonesia, a survey by the Ministry of Education and Culture stated that 20% of schools nationally stated that some students did not meet competencies or experienced learning loss (Putra, 2021). It was also reported that 68% of 11,306 teachers stated that 50% or more students did not meet the expected competency standards while studying from home (Hidayat, 2021). In detail, the teachers who stated that most students met the competency standard were only 31.9%. Then, 47.6% of the teachers stated that 50% of the students met competency standards. And 20.6% of the teachers stated that only a small proportion of the students met competency standards (Hidayat, 2021). The extension of learning activities at home is certainly a serious threat to learning loss.

Psychological impacts cannot be avoided from the implementation of learning at home. Previous research has noted the various mental health consequences are experienced in response to COVID-19, including stress, depression, anxiety, feelings of panic, feelings of hopelessness, frustration, feelings of hopelessness, struggles with suicidal ideas and behaviours, insomnia, ease, offense, emotional exhaustion, sadness and symptoms of traumatic stress (Turmaud, 2020). Another study states that students in China show high anxiety about COVID-19 (Wang & Zhao, 2020). This is reinforced by the results of a study which state that students who were evaluated during the pandemic period showed that the pandemic had a negative psychological effect on students in the form of significantly higher levels of anxiety, depression and stress, compared to students in previous normal times (Maia & Dias, 2020). The results of the study show that emergency health problems have a psychological impact on students (Cao et al., 2020), which include anxiety, fear and worry (Mai et al., 2011). The results of these studies state that anxiety is the dominant impact that arises as a result of the COVID-19 pandemic.

The problem here is that there is a serious threat regarding the potential for learning loss and prolonged anxiety to students, especially university students, as a result of distance learning which cannot be avoided due to the pandemic. This problem is very important to be studied and resolved because if it is allowed to drag on, it will not only degrade individual competencies but also the quality of the nation's education as a whole. It is not impossible that there will be a lost generation, hindered personality, psychological development and apathy due to prolonged despair.

In contrast to previous studies that have discussed the obstacles and impacts of distance learning during a pandemic, this study examines how to reduce the negative impacts (learning loss and anxiety) of distance learning while still considering the obstacles that are as minimal as possible. Research problems will be answered by applying appropriate learning. This study offers a learning model called Heroe's math online learning model which will be described in the next section.

## 2. Theoretical framework

The framework in this study is intended to create a rationale based on the theory and results of previous research so that a solid learning model is obtained so that it can be applied to an appropriate learning environment. Previous research has suggested the need for research activities directed at developing an online learning model that can be applied to all disciplines (Adedoyin & Soykan, 2020). The learning model developed refers to the framework of the following: 1) learning is carried out online which is generally divided into asynchronous and synchronous learning; 2) the use of an appropriate technology platform, in this case, the Zoom application, Google Classroom and WhatsApp are used and 3) feedback to increase emotional engagement between teachers and students.

There are three terms of learning implemented during the current pandemic, namely distance learning, e-learning and online learning. Distance learning refers to efforts to provide access to learning for those who are geographically distant (Moore, Dickson-Diane & Galyen., 2011) and differences in location between teachers and students (Dede, 1996) by using computer media (Moore, 1990). e-Learning refers to the use of Internet technology to deliver learning (Pastore, 2002) in the form of web-based, web-distributed or web-capable (Nichols, 2003) where learning content can also be delivered in a CD-Room (Benson et al, 2002) and also includes audio and video recordings, satellite broadcasts and interactive TV (Ellis, 2004). Online learning is a new development version of distance learning which uses several technological devices for material development (Fry, 2001) which delivers learning through Internet technology intermediaries (Moore et al., 2011) which ensures connectivity, flexibility and the ability for multiple interactions (Ally, 2004; Hiltz & Turoff, 2005; Oblinger & Oblinger,

2005). Although presented in different terms, researchers agree that there is a relationship between the three, and this is in line with the thoughts of Moore et al. (2011) who concluded in their research that experts believe there is a relationship between distance learning, e-learning and online learning even though the terminology is conveyed in different ways. This study uses the term online learning.

There are two types of online learning, namely synchronous and asynchronous (Hrastinski, 2008). Asynchronous is understood as learning that allows teachers and students to connect even though they are not online or at different times and places, usually facilitated by e-mail and discussion boards (Hrastinski, 2008). Synchronous is understood as real-time learning, where teachers and students meet and go online simultaneously. This learning is facilitated by videoconferencing and chat (Hrastinski, 2008). In practice, these two types of online learning are not completely separate from each other but are used together according to the interests and optimisation of the desired learning outcomes. Teachers can implement asynchronous learning by sending teaching materials, via e-mail, other technology platforms or using a learning management system (LMS), to students which can be accessed at any time. Furthermore, teachers and students use synchronous learning in the form of face-to-face virtual videoconferencing to confirm and review material that has been previously distributed.

Bao (2020) suggests the principles of online learning that have a high impact on learning: (a) high relevance between online instructional design and student learning; (b) effective delivery of online instructional information; (c) adequate support provided by faculty and teaching assistants to students; (d) high-quality participation to increase the breadth and depth of student learning and (e) contingency plans to deal with unexpected online educational platform incidents.

Previous studies have shown the effectiveness of using technology in online learning. Students like the rich technological resources and easy accessibility of information offered by the Internet to inspire them to study mathematics (Marpa, 2020). Innovative solutions leveraging technology can help bridge the education gap during uncertain circumstances such as the current pandemic (Chick et al, 2020). This Internet technology-assisted learning solution can be carried out by developing and distributing learning content with online learning applications that are currently widely available.

Other studies have also evaluated the impact of using WhatsApp in learning, and the results show that the use of various messaging applications can improve student learning outcomes because it is easy, fun and multifunctional (Amry, 2014; Bahasoan et al., 2020; Cetinkaya, 2017; Gasaymeh, 2017; Saragih & Ansi, 2020; Yensy, 2020).

Online learning causes teachers and students to be isolated, thereby negating emotional involvement in learning. The Zoom application is very suitable to be used to answer these challenges. This is based on previous research which states that zoom is very suitable for teaching. The Zoom™ webinar platform is more effective for the design of online programme delivery (Emm, Chishester, Restanio, Kratsch & Bishop, 2020) including learning programmes. The use of an online platform such as Zoom™ can bring together a wider audience and encourage students to thrive in the classroom with lots of peer-to-peer teaching and learning collaboration (Buheji & Ahmed, 2020).

Current technological developments make it easier to carry out synchronous learning with the various video call or video conference applications. Chat, in the previous sense, was categorised as synchronous learning. In general, chat is currently mostly carried out with message-sharing applications, although the LMS platform also provides chat facilities. Chats in learning practices, with various messaging applications, private chat, group chat and chat on the LMS application, are not immediately responded to by students or teachers at the same time. This leaves enough time lag for

responses to emerge. Based on this, researchers argue that chat through message-sharing applications needs to be categorised separately. Researchers use the term semi-synchronous to express learning that is carried out at the same time or not because of the time lag in message responses from teachers and students. In this case, chat deserves to be categorised into that type. In this study, chat is intended to build an emotional involvement between teachers and students. Thus, chat functions as a provider of feedback. Feedback in learning is needed because feedback has a strong influence on student learning and achievement (Hattie & Timperley, 2007). From a cognitive perspective, feedback is often considered a source of information needed to improve a task (Wisniewski, Zierer & Hattie., 2020).

One of the popular and highly recommended learning approaches for student learning in the K–12 sector, as well as in higher education, is the flipped classroom (Strelan, Osborn & Palmer, 2020a). It has been stated that the flipped classroom approach can significantly improve students' mathematics learning achievement (Wei et al, 2020). In principle, the flipped classroom takes the homework teaching model and reverses it, so that the content that is usually presented in class has been studied by students at home (outside class time); then in the classroom, students are involved in active learning where teacher guidance is very important (Strelan, Osborn & Palmer, 2020b). Conceptualisation of flipped classrooms as a series of pedagogical approaches shows (1) moving most of the teaching of material information delivery outside the classroom; (2) utilising class time for active learning activities and enhancing social relationships and (3) requiring students to complete activities before and/or after class to get the full benefits from work in the classroom (Abeysekera & Dawson, 2015). Learning in this study was carried out by modifying the flipped classroom approach with the aim of taking advantage of its application. Modifications have been made by using applications such as Zoom, WhatsApp and Google Classroom, which previously research stated had a positive impact on student learning outcomes. This modification resulted in a learning model called Heroe's math online learning model. This learning model is named after the researcher who developed it. The model structure is shown in Figure 1. The peculiarity of this model is that it only uses three digital applications, namely Google Classroom, Zoom Meeting and WhatsApp. This model combines three types of online learning at once, namely asynchronous, synchronous and semi-synchronous.

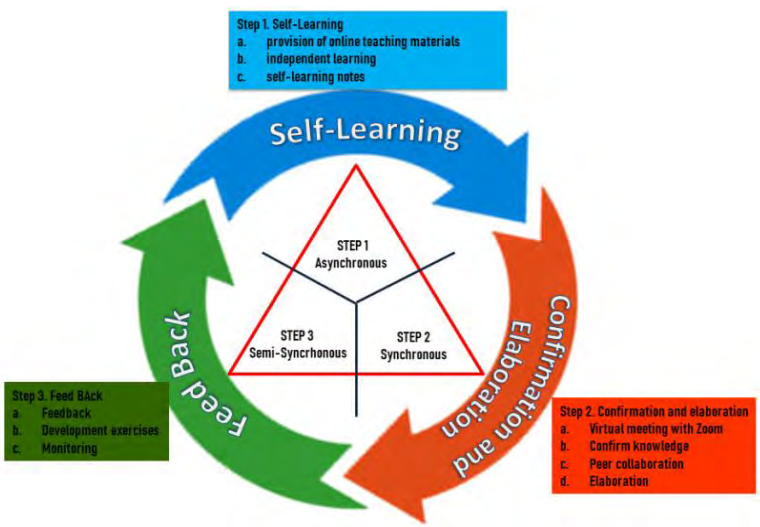


Figure 1. Heroe's Math Online Learning Model

Step 1. Self-learning. This step aims to develop students' reasoning power and thinking skills that are used to understand the material shared by the teacher. In this step, it is carried out asynchronously because the teacher and students are not immediately present at the same time. This step is carried out with a learning strategy: provision of online teaching materials, independent learning by students and preparation of self-learning notes. Teaching materials are provided by the teacher in soft copy files (.docx, .ppt or .pdf) on Google Classroom. The teaching materials are then downloaded and studied independently by students. Independent learning is very possible because students are equipped with prerequisite materials, as well as measuring the level of thinking and reasoning skills. Students make study notes that represent their understanding of the material being studied independently.

Step 2. Confirmation and elaboration. In this step, the teacher and students meet face-to-face virtually with the Zoom application to review the material that has been previously shared. Students have the opportunity to confirm whether their understanding is correct or not. If true, there will be reinforcement and if it is still wrong then re-understanding. This step aims to avoid misunderstanding of the concept. With the breakout room facility, students collaborate in small groups to solve, investigate and elaborate on problems given as a form of developing understanding. Discussions can be carried out using the shared whiteboard so that the results of the discussion can be presented in written form that can be seen by all members. Then, the students returned to the main room to have a class discussion. Students take turns delivering the results of the discussion on the share whiteboard screen so that they can be seen and get rebuttals, corrective input and corrections if an error occurs.

Step 3. Feed Back. Feedback is carried out semi-synchronously using the WhatsApp application. Feedback aims to allow students to discuss freely, confirm and review previous material. The application of understanding the concept of the material that has been studied is carried out in the form of giving assignments, where each student is free to ask questions and express opinions, both in the form of text, sharing images and sharing files on the application. The teacher monitors as well as provides reinforcement, feedback and responses to discussions that occur in group chat. Monitoring and providing feedback also function as a form of interaction so that emotional and social bonds between lecturers and students can be well established.

The formulation of the research problems are as follows: 1) Can Heroe's math online learning reduces symptoms of learning loss in students? 2) Is there a decrease in student anxiety after learning with Heroe's math online learning? The positive impact of solving these research problems is that it can increase student participation in both independent learning and collaborative learning, increase digital literacy and economically reduce the financing of expensive Internet quota purchases.

## 3. Methods

### *3.1. Research design*

This research is a qualitative descriptive study that aims to examine the extent to which the application of Heroe's math online learning can reduce the negative impact caused by the implementation of distance learning. The negative impact discussed in this study was limited to reducing the symptoms of learning loss and student academic anxiety. This research was conducted in the first semester between August 2020 and January 2021 in the Multivariate Calculus course.

Learning loss symptoms would be assessed by analysing student achievement during the learning process by looking at assignment scores, mid-semester exam scores and final semester exam scores. Learning loss was also assessed using a self-assessment questionnaire. Anxiety was measured by the

self-rating anxiety scale (SAS) which was adopted from Zung (1971). Confirmation of the symptoms of learning loss and anxiety was carried out using an online written interview.

### *3.2. Subjects*

The research subjects were third-semester students, as many as 87 students, consisting of 28 men and 59 women. The subjects aged between 20 and 21 years who are from various social statuses. The subjects came from various regions such as Purworejo, Kebumen, Banjarnegara, Wonosobo, Magelang, Banyumas, Cilacap and Purwokerto. The subjects were selected because they had experienced face-to-face conventional learning in the first semester. When COVID-19 attacked Indonesia, the subjects were already in the second semester. Under these conditions, it was expected that the subjects can provide a proper assessment of the learning being carried out. Interviews were conducted on 10 randomly selected subjects.

### *3.3. Research instruments*

The research instruments used in this study were tests, self-assessment sheets and SAS. The test was used to assess the score for the assignment, the mid-semester test and the final semester test. The test was organised into two parts: the first part as a diagnostic test and the second part as material development. The diagnostic tests were used to see if there was a learning loss. The diagnostic test consists of 20 multiple-choice tests. The content validity of the diagnostic test was assessed by three experts. The results of the assessment indicated that the diagnostic test met the criteria for content validity. The average score of the three experts' assessment was 3.7 (maximum score 4.0). Reliability test obtained $r = 0.875$, which is categorised as having very high reliability.

The self-development test consists of five essay questions. Each of these tests is given at the midterm exam and final exam. The content validity of the test instruments used in the mid-semester and final-semester exams was also assessed by three experts. The average research score of the three experts was 3.8 (maximum score 4.0). The reliability index on the midterm test was $r = 0.785$ and the reliability index on the final semester test was $r = 0.846$. The self-assessment questionnaire serves to measure the extent to which students experience learning with Heroe's math online learning model. Including the assessment, in this case, was to see whether students got a learning experience that matches their expectations.

The SAS serves to measure student anxiety levels. This questionnaire is given to students at the beginning and end of learning so that they can provide an assessment and feel the difference in anxiety levels before and after learning with the given learning model. Interviews were conducted in the form of written interviews online. The interview serves to confirm and dig deeper about learning loss and student anxiety.

### *3.4. Data analisys technique*

The data obtained from the results of the tests, questionnaires and interviews were analysed with the stages of data reduction, data presentation and conclusion. The triangulation technique was used to ensure the validity of the data. The data are described in the form of statistical tables which are then analysed to describe the findings obtained.

## 4. Results

### *4.1. Implementation of Heroe's model*

Heroe's math online learning model is implemented in three stages: stage 1: independent learning which is carried out asynchronously; stage 2: confirmation and elaboration which is carried out synchronously; and stage 3: feedback which is carried out semi-synchronous.

Step 1. Self-learning. At this stage, soft copies of teaching materials are distributed on Google Classroom in .ppt, .docx or .pdf formats. Students learn the material independently and make self-learning notes. These self-learning notes serve as a representation of students' thoughts after studying the material given. Self-learning notes are written in the form of material summaries or retraining of sample questions and solutions presented in the teaching material. Self-learning notes are the main points of this stage, which guarantees students' understanding of the material (Figure 2).

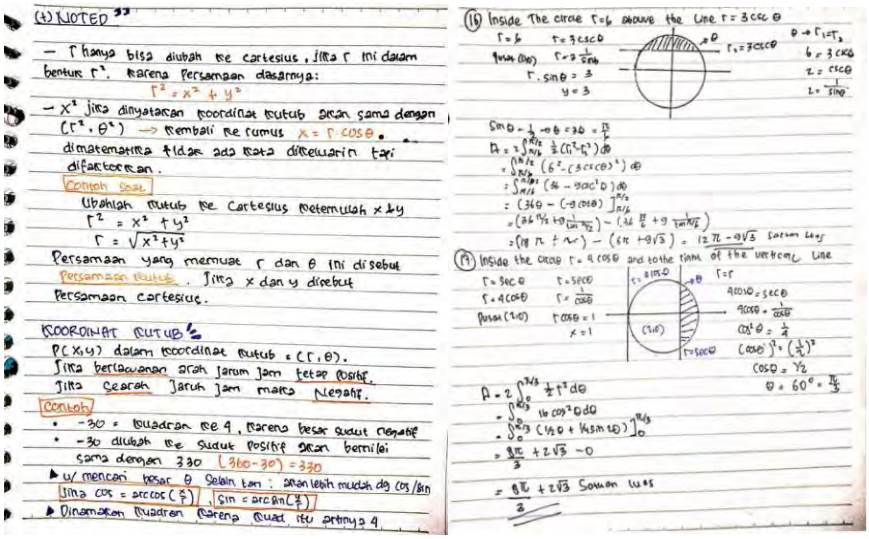

Figure 2. Self-learning note

Step 2. Confirmation and elaboration. At this stage, a virtual face-to-face meeting on the Zoom cloud meeting application is carried out. Meetings are held in a structured manner according to the class schedule set by the university. At this stage, a review of the material from the lecturer is carried out, as well as confirming what the previous students have understood and learned. This stage is very crucial because if there is a misunderstanding of the concept, then at this stage there is justification. If students have shown a good understanding of the concept, then this stage also functions as reinforcement. At this stage, students' concerns about not understanding the material can be minimised. In the video conference display during the lesson, it appears that students show facial gestures that show a positive attitude due to this confirmation

In the breakout room facility, elaboration activities are carried out by dividing the class into several groups assigned to solve the questions given. Lecturers can move from room 1 to another room to facilitate and manage discussions. When the group discussion ends, students return to the main room for class discussion. This stage ends with giving students independent assignments to do at home (Figure 3).

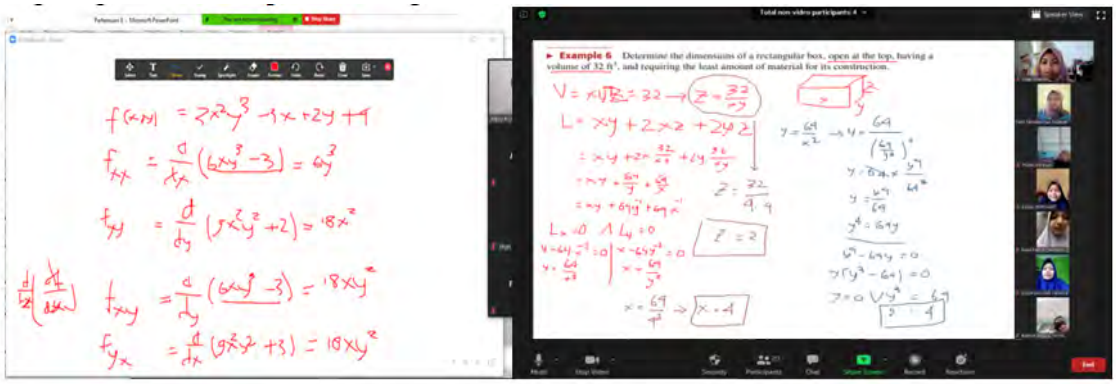

Figure 3**.** Discussion with share whiteboard screen facility

Step 3. Feedback. At this stage, feedback is provided as well as monitoring student learning activities. Monitoring and feedback are carried out in the form of chatting on the WhatsApp group (Figure 4).

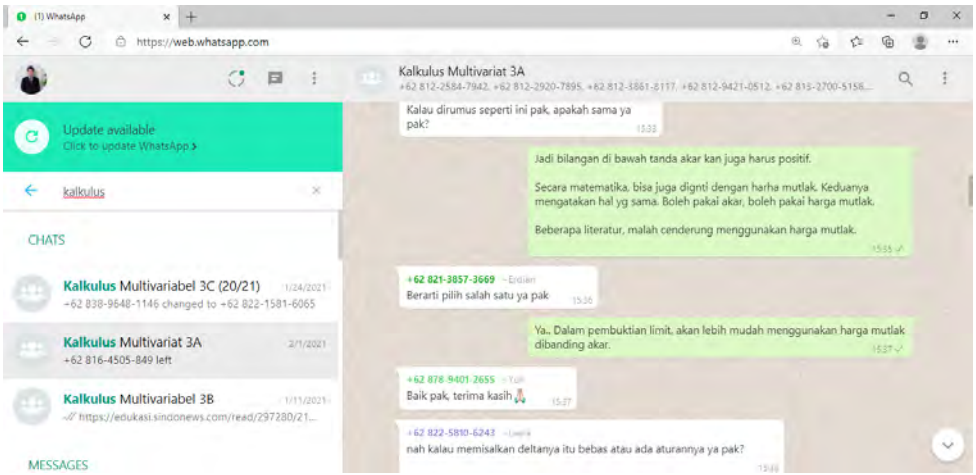


Figure 4. Chat discussion and learning monitoring

In general, the application of Heroe's math online learning goes well following the expectations of model development. The application of the model also did not experience any significant obstacles other than general obstacles such as signal difficulties.

### *4.2. Assignment, diagnostics test, and self-development test*

Students were given five assignments after each chapter had been taught. The assignment was collected via a Google Form. The results of the assignment assessment are shown in Figure 5.

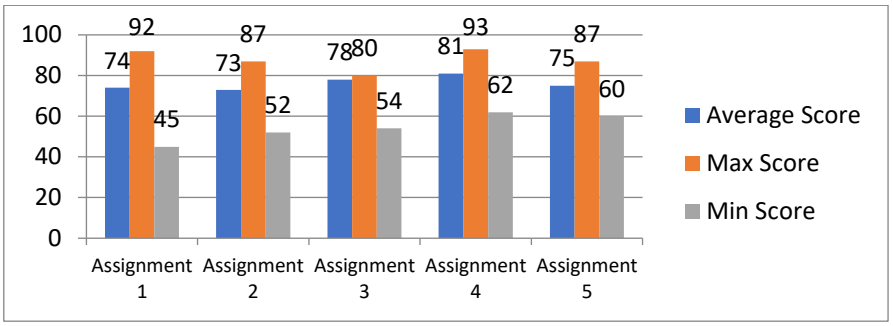


Figure 5. Graph of Assignment assessment score

The graph in Figure 5 provides information that student assignment scores do not show bad results. Overall, the average score for the assignment score was 76. This score could be categorised as a good score. However, out of a total of 87 students, some students did not submit their assignments; the number was less than 6%. After further examination, the incidence of students who did not collect assignments occurred randomly. For example, student X in the first assignment did not collect, but on the next assignment collected. This means that the incidents of not collecting assignments did not occur systematically or deliberately. Assessments were also carried out in the mid-semester examination and the final semester examination. The results of the two assessments are shown in Figure 6.

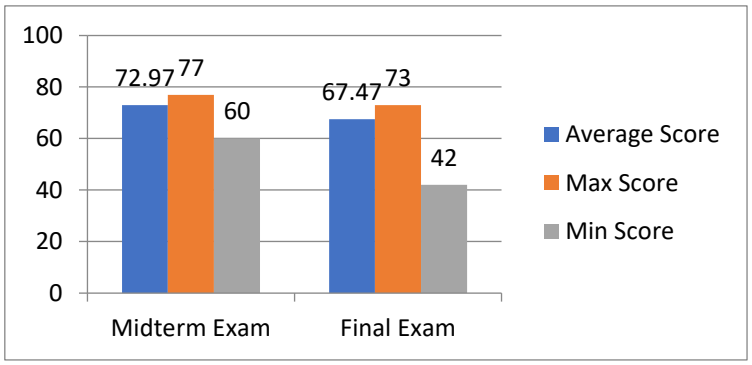


Figure 6. Description graph of midterm exam and final exam

Figure 6 provides information that the exam score performance is not bad either. This achievement decreased by about 5% from the previous year's value. However, if it is seen from the results of the final score or achievement index obtained, of course this achievement is not too bad. Student achievement index can be seen in Figure 7.

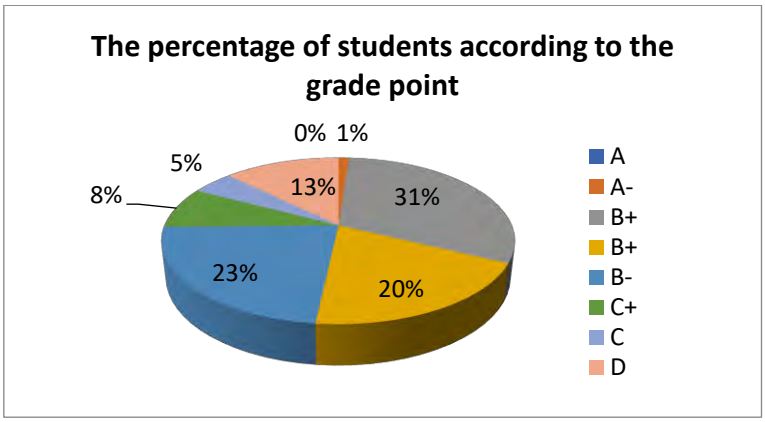


Figure 7. Percentage of students grade index

Figure 7 shows that 87% of the students passed this course. This passing percentage fell by 6% compared to the previous year. This means that more students did not pass this course than in the previous year. Furthermore, the comparison of student graduation is seen based on the completion of diagnostic tests and self-development tests. The diagnostic tests can be used as a reference for the presence or absence of learning loss.

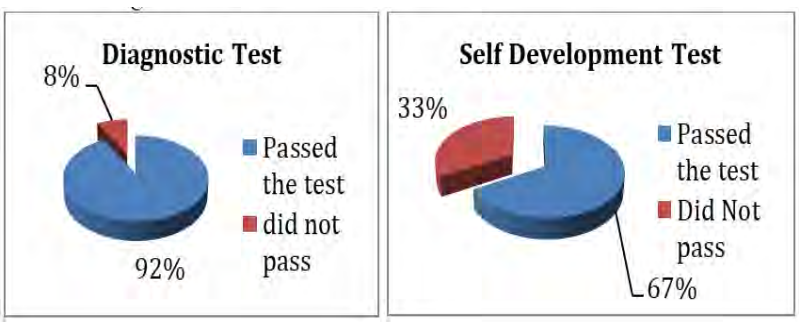


Figure 8. Percentage of passing on diagnostic tests and self-improvement tests

Figure 8 shows that 8% of the students did not pass the diagnostic test. This shows that most students have mastered the minimum competencies required in this course. Meanwhile, in the self-development test, 67% of the students passed. This shows that not many students can apply material concepts and develop them to solve problems of high complexity and difficulty.

Based on the acquisition of assignment scores, middle exam scores, final exam scores and seeing the results of the student achievement index, there are no learning loss symptoms found. Thus, this learning model can reduce learning loss which is a threat to prolonged online learning.

### *4.3. The self-rating anxiety scale*

Student anxiety was measured by the SAS. The anxiety test was conducted twice before and after learning with Heroe's math online learning model to see whether there was a decrease in anxiety. Table 1 shows the results of the student anxiety test.

Table 1. The Self-rating anxiety scale results

| No | Statements | Students percentage | | | |
|---|---|---|---|---|---|
| | | Before | | After | |
| | | Male | Female | Male | Female |
| 1 | I felt more nervous and anxious than usual. | 54% | 76% | 36% | 63% |
| 2 | I was scared for no reason at all. | 64% | 80% | 43% | 68% |
| 3 | I get angry easily or panic. | 29% | 64% | 36% | 42% |
| 4 | I felt like I was falling apart and falling to pieces. | 50% | 75% | 29% | 59% |
| 5 | I feel like everything is fine and nothing bad will happen. | 89% | 68% | 104% | 80% |
| 6 | I felt my arms and legs tremble. | 29% | 51% | 29% | 36% |
| 7 | I was troubled by headaches, neck and back pain. | 14% | 14% | 14% | 8% |
| 8 | I feel weak and tire easily. | 79% | 88% | 57% | 78% |
| 9 | I feel calm and can sit still. | 82% | 81% | 100% | 88% |
| 10 | I can feel my heart beating fast. | 14% | 36% | 11% | 27% |
| 11 | I get dizzy when I get distracted. | 54% | 63% | 29% | 37% |
| 12 | I experience fainting or feel faint. | 0% | 3% | 0% | 0% |
| 13 | I can breathe in and out easily. | 93% | 88% | 100% | 93% |
| 14 | I felt numbness and tingling in my fingers and toes. | 11% | 20% | 7% | 10% |
| 15 | I am troubled by stomach upset or indigestion. | 14% | 27% | 7% | 17% |
| 16 | I have to empty my bladder frequently. | 64% | 54% | 36% | 32% |
| 17 | My hands are usually dry and warm. | 71% | 61% | 86% | 88% |
| 18 | My face got hot and blushed. | 54% | 73% | 43% | 64% |
| 19 | I fall asleep easily and sleep well. | 86% | 73% | 96% | 90% |
| 20 | I had nightmares. | 7% | 27% | 4% | 17% |
| | average | 48% | 56% | 43% | 50% |
| | Total average | 52% | | 47% | |

The average percentage of the student anxiety assessments in Table 1 shows a decrease in the intensity of student anxiety by about 12% after learning with Heroe's online mathematics learning model compared to before. Table 1 also shows that almost all indicators of student anxiety statements have decreased by 2%–17%. These results indicate a decrease in student anxiety.

### *4.4. Quezionare and interview*

The self-assessment questionnaires are given with the aim that students can assess and measure their learning experience and the results obtained during their learning with Heroe's math online learning model. The self-assessment questionnaire was arranged with a rating scale of 1–5. Table 2 shows the average results of the questionnaire.

Table 2 shows that students have a good assessment of themselves during learning. Students feel comfortable with the learning model applied. The table also provides information that students feel that they have not lost their learning experience and have decreased anxiety.

Interviews were conducted to see the extent to which student responses related to the implementation of the learning model, in particular associated with learning loss and anxiety. The results of the interview obtained the following information: 1) students were worried about their

learning outcomes; 2) students were greatly helped by the application of Heroe's math online learning model because they felt they were given space to be directly involved in learning, during independent learning, confirmation and elaboration, and getting feedback on their learning assignments; 3) students' anxiety gradually decreased as learning progressed from one meeting to the next; 4) students felt quite capable of understanding the material well; 5) students enjoyed the learning process because they felt well monitored by the lecturer; 6) students changed the anxiety they had previously felt with a more optimistic attitude; 7) students felt comfortable with the application of learning models during lectures and 8) even though they experienced low signal and Internet quota constraints, students felt helped by sharing material and chats so they can catch up.

Table 2. Self-assessment questionnaire result

| No | Statements | Average score |
|---|---|---|
| 1 | I feel comfortable during learning. | 4,3 |
| 2 | I feel I can understand the material very well. | 4,2 |
| 3 | I feel that I have no problems during learning. | 3,7 |
| 4 | I feel that I have the same learning opportunities, both online learning, and independent learning. | 4,4 |
| 5 | I don't feel lost in the learning experience. | 4,6 |
| 6 | I feel more optimistic about the given study assignments. | 3,7 |
| 7 | I feel more confident. | 3,8 |
| 8 | I felt less anxious. | 4,2 |
| 9 | I believe excessive anxiety is not good for my progress in learning. | 4,4 |
| 10 | I believe there is a need for a change in attitude in these conditions. | 4,2 |
| | Average total score | 4,15 |

Assessment of student satisfaction related to the implementation of learning with Heroe's math online learning model is shown in Figure 9.

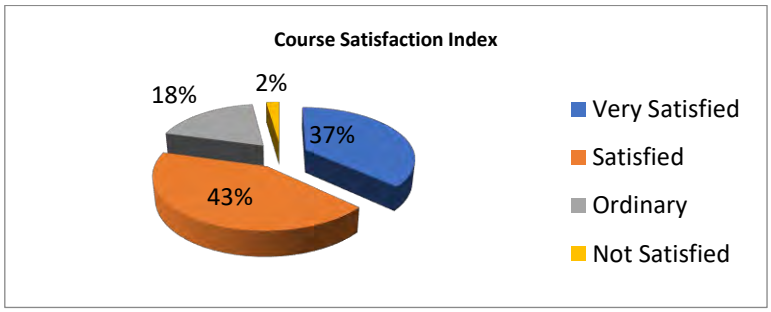


Figure 9. Graph of course satisfaction index

The results of this assessment indicate that 80% of the students feel happy and satisfied with the learning model being implemented.

## 5. Discussion

Previous research has suggested that there are obstacles during distance learning. Of course, these obstacles should not be detailed and put forward without proper handling. As a result of focusing on these obstacles, without realising it, there will be a bigger negative impact, namely the emergence of learning loss and increased anxiety in students. This study seeks to reduce this impact by applying a learning model called Heroe's math online learning model.

The data obtained from this study indicate that the symptoms and threats of learning loss do not occur as well as decrease anxiety. The results of the assignment scores indicate a positive impact on students' abilities in understanding course material. Students can apply and understand the material to complete given tasks. This is in line with the results of a research which shows that there is a positive impact felt by students through assigning lecturers' assumptions (Sirait, Arhas & Supriyanto, 2019). The positive attitude shown by students for being able to complete the assigned task explains that students do not experience learning loss symptoms. This is reinforced by the average assignment score which reaches 76. If there are symptoms of learning loss, of course, the average assignment will not reach that score.

The assessment at the end of the semester, which increases the value of the assignment, the middle semester examination and the final semester exam also show no symptoms of learning loss. Thirteen students failed to pass (13%). This number is counted to be quite small and naturally occurs in all courses, even face-to-face lectures. This success depends on the attitude and a high sense of responsibility during the lesson. Heroe's math online learning model focuses on involving students to have learning responsibilities and to develop their abilities independently. This is the key to the successful application of the learning model during the COVID-19 pandemic. This is in line with the results of the study which states that students who have high expectations have the drive to be responsible for their learning so that they can show good results at the end of the semester (Nicholson, Putwain, Connors & Hornby-Atkinso, 2013).

The study results also show that Heroe's math online learning model can reduce the impact of excessive anxiety as a result of prolonged virtual learning. This learning model is able to provide comfort so that it raises students' optimism during learning. Students receive support from lecturers and peers during learning, both during the confirmation and elaboration stages, as well as feedback on the WhatsApp group. As a result of this support, students do not hesitate to ask questions and ask for further explanations if they are left behind. Support like this has an impact on reducing anxiety and worry about learning failure for each student. This is in line with the findings of previous studies which say, 'Social support not only reduces psychological stress during a pandemic but also changes attitudes regarding forms of social support and methods of seeking help' (Cao et al., 2020). Other research also states that social support is negatively correlated with student anxiety (Thompson, McBride, Hosford & Halaas., 2016), meaning that when higher social support is given to someone, their anxiety will decrease.

The results of this study provide an important meaning, i.e., the application of an appropriate learning model can reduce the negative impact during distance learning. Student anxiety that is prolonged and not handled will have a more severe impact on the overall learning outcomes. Previous research has stated that anxious students will experience cognitive deficits, misunderstanding of information and memory blocking (Vitasari, Herawan, Wahab, Othman & Sinnadurai, 2010). Anxiety about future learning outcomes leads to poor mathematics achievement and low perceptions of math abilities (Wang, Rimfeld, Shakeshaft, Schofield & Malanchini, 2020). The serious impact due to anxiety is not impossible to cause learning loss. The results of this study are very important because Heroe's

math online learning model can provide social support in the form of creating a learning environment that can suppress student anxiety so that the symptoms of learning loss can be resolved.

The impact of the application of massive open online courses (MOOCs) on online learning can change students' ideas about mathematics and they are potential so that they can improve their mathematics achievement (Boaler, Dieckmann, Nunez, Sun & Williams., 2018). In line with this research, the results of this study also illustrate that the application of Heroe's math online learning model can change the way students think by focusing on learning objectives and not being busy with the existing learning barriers. It is proven by the emergence of confidence, optimism, getting rid of anxiety and a significant change in learning methods, so that it affects the learning outcomes at the end of the semester. If this change in thinking can take place continuously in all aspects and all subjects, it is believed that it can affect the way in which students view the future.

In general, this research is limited to the application of models in reducing the impact of learning loss and student anxiety. Furthermore, this research opens the door for further research, making the results of this study a basis for developing similar learning models with different goals. It is also necessary to conduct an in-depth study of other psychological impacts that arise due to learning barriers, if there are any negative sides that can arise due to online learning and so on.

## 6. Conclusion

It was previously known that the obstacles that occurred during distance learning in the era of the COVID-19 pandemic had a negative impact on learning at universities, some of which were threats of learning loss and anxiety. To overcome this impact, it is necessary to handle the form of providing appropriate learning. This study offers Heroe's math online learning model which is developed by emphasising a balance between independent learning and face-to-face virtual learning. This model itself runs in three steps: step 1: independent learning which is carried out asynchronously; step 2: confirmation and elaboration which is carried out synchronously; and step 3: feedback which is carried out in a semi-synchronous manner.

The results showed that Heroe's math online learning model can reduce the impact of learning loss symptoms and anxiety on students. Most of the students have demonstrated the minimum ability of the specified competencies and almost half have shown mastery of the additional specified competencies. Students no longer feel anxious and can be involved in a whole learning experience. The combination of synchronous, semi-synchronous and asynchronous appropriately can increase the involvement and participation of students individually and as a whole class in order to obtain a suitable learning experience. The results of this study are important to expand and strengthen previous knowledge and provide recommendations that the main thing that must be considered in online learning is the availability of teaching material content and the creation of a learning environment that encourages each student to experience learning, both individually and in class. Therefore, online learning needs to focus on developing and providing teaching material and content and not on developing the technology used. Technology cannot run alone to maximise a student's potential, but it still requires the role of the teacher as a mediator, facilitator and motivator so that students can learn properly. In online learning, you must pay attention to self-regulated learning by providing ample opportunities for students to study teaching materials independently by utilising learning resources that are currently accessible from anywhere to strengthen the understanding of the material. Class activities need to be designed in such a way as to create a collaborative and participative atmosphere. Through collaborative and participative learning, students' cognitive abilities will further develop in line with social activities carried out during learning.

## 7. Recommendations

The results of the study recommend that teachers should focus on developing teaching materials and creating a learning environment. Technology is not able to stand alone to support the success of students in the learning process. Heroe's math online learning model is still limited to a case study on a limited subject. It is necessary to do an empirical test involving more subjects. Other researchers can also develop models using other applications according to the needs of teachers and students.

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## References

Abeysekera, L., & Dawson, P. (2015). Motivation and Cognitive Load in the Flipped Classroom: Definition, Rationale and a Call for Research. *Higher Education Research & Development*, 34, 1-14. https://doi.org/10.1080/07294360.2014.934336

Adedoyin, O. B. & Soykan, E. (2020). Covid-19 pandemic and online learning: the challenges and opportunities. *Interactive Learning Environments,* 1–13. doi:10.1080/10494820.2020.1813180

Ally, M. (2004). Foundations of educational theory for online learning. In Terry (Ed.), *The theory and practice of online learning* (2nd ed., pp. 3–31). Athabasca, AB: Athabasca University. Retrieved from http://desarrollo.uces.edu.ar:8180/dspace/bitstream/123456789/586/1/Theory%20and%20Practice%20of%20online%20learning.pdf#page=227

Amry, A. B. (2014). The impact of WhatApp mobile social learning on the achievement and attitudes of female students compared with face to face learning in the classroom. *European Scientific Journal, 10*(22), 116–136. Retrieved from http://eujournal.org/index.php/esj/article/view/3909

Aristovnik, A., Kerzic, D., Ravselj, D., Tomazevic, N. & Umek, L. (2020). Impacts of the COVID-19 pandemic on life of higher education students: a global perspective. *Sustainability (Switzerland), 12*(20), 1–34. doi:10.3390/su12208438

Bahasoan, A. N., Ayuandiani, W., Mukhram, M. & Rahmat, A. (2020). Effectiveness of online learning in pandemic COVID-19. *International Journal of Science, Technology & Management*, *1*(2), 100–106. doi:10.46729/ijstm.v1i2.30

Bao, W. (2020). COVID -19 and online teaching in higher education: a case study of Peking University . *Human Behavior and Emerging Technologies, 2*(2), 113–115. doi:10.1002/hbe2.191

Boaler J., Dieckmann, J. A., Perez-Nunez, G., Sun, K. L. & Williams, C. (2018) Changing students minds and achievement in mathematics: the impact of a free online student course. *Frontiers in Education, 3*, 26. doi: 10.3389/feduc.2018.00026

Buheji, M. & Ahmed, D. (2020). Implications of Zoom and Similar Apps on 'Flip-class' outcome in the new normal. *International Journal of Learning and Development, 10*(3), 1. doi:10.5296/ijld.v10i3.17374

Cao, W., Fang, Z., Hou, G., Han, M., Xu, X., Dong, J. & Zheng, J. (2020). The psychological impact of the COVID-19 epidemic on college students in China. *Psychiatry Research, 287*(March), 112934. doi:10.1016/j.psychres.2020.112934

Cetinkaya, L. (2017). International review of research in open and distributed learning the impact of Whatsapp use on success in education process. *International Review of Research in Open and Distributed Learning, 18*(7), 1–8.

Chick, R. C., Clifton, G. T., Peace, K. M., Propper, B. W., Hale, D. F., Alseidi, A. A. & Vreeland, T. J. (2020). Using technology to maintain the education of residents during the COVID-19 pandemic. *Journal of Surgical Education, 77*(4), 729–732. doi:10.1016/j.jsurg.2020.03.018

Dede, C. (1996). The evolution of distance education: Emerging technologies and distributed learning. *The American Journal of Distance Education, 10*(2), 4–36.

Dorn, B. E., Hancock, B., Sarakatsannis, J. & Viruleg, E. (2020). *New evidence shows that the shutdowns caused by COVID 19 could exacerbate existing achievement gaps.* Retrieved from https://www.mckinsey.com/industries/public-and-social-sector/our-insights/covid-19-and-student-learning-in-the-united-states-the-hurt-could-last-a-lifetime

Dorn, B. E., Hancock, B., Sarakatsannis, J. & Viruleg, E. (2021). *The pandemic has set back learning for all students, but especially for students of color. evidence-based acceleration approaches can help*. Mind the gap: COVID-19 is widening racial disparities in learning, so students need help and a chance to catch up. New York, NY: McKinsey

Ellis, R. (2004). Down with boring e-learning! Interview with e-learning guru Dr. Michael W. Allen. *Learning circuits*. Retrieved from http://www.astd.org/ LC/2004/0704_allen.htm

Emm, S., Chishester, L., Restanio, C., Kratsch, H. & Bishop, C. (2020). Determining if ZoomTM is an approprotae social distancing education tool during COVID-19. *Journal of The NACAA*. 15(2). Retrieved from https://www.nacaa.com/journal/index.php?jid=1151

Fry, K. (2001). E-learning markets and providers: Some issues and prospects. *Education+ Training, 43(*4/5), 233–239. doi:10.1108/EUM0000000005484.

Gasaymeh, A.-M. (2017). University Students' use of Whatsapp and their Perceptions Regarding its Possible Integration into their Education. *Global Journal of Computer Science and Technology, 17*(1), 1–11.

Hattie, J. & Timperley, H. (2007). The power of feedback. *Review of Educational Research*, *77*(1), 81–112. doi:10.3102/003465430298487

Hidayat, W. P. (2021). Tanda-tanda Siswa Alami Learning Loss Sudah Tampak. Retrieved from https://www.validnews.id/Tanda-tanda-Siswa-Alami--i-Learning-Loss--i--Sudah-Tampak-xYd.

Hiltz, S. R. & Turoff, M. (2005). Education goes digital: The evolution of online learning and the revolution in higher education. *Communications of the ACM, 48*(10), 59–64, doi:10.1145/1089107.1089139

Hrastinski, S. (2008). Asynchronous and synchronous e-learning. *Educause Quarterly, 31*(4), 51–55.

Irfan, M., Kusumaningrum, B., Yulia, Y. & Widodo, S. A. (2020). Challenges during the pandemic: use of E-Learning in mathematics learning in higher education. *Infinity Journal, 9*(2), 147. doi:10.22460/infinity.v9i2.p147-158

Liguori, E. & Winkler, C. (2020). From offline to online: challenges and opportunities for entrepreneurship education following the COVID-19 pandemic. *Entrepreneurship Education and Pedagogy, 3*(4), 346–351. doi:10.1177/2515127420916738

Maiaa, B. R. & Dias, P. C. (2020). Ansiedade, depressão e estresse em estudantes universitários: o impacto da COVID-19. *Estudos de psicologia (Campinas)* [online]*, 37*, e200067. Epub May 18, 2020. ISSN 1982-0275. doi:10.1590/1982-0275202037e200067

Marpa, E. P. (2020). Technology in the teaching of mathematics: an analysis of teachers' attitudes during the COVID-19 pandemic. *International Journal on Studies in Education, 3*(2), 92–102. doi:10.46328/ijonse.36

Marinoni, G., Land, H. Van & Jensen, T. (2020). *The impact of covid-19 on higher education around the world IAU global survey report*. Retrieve from https://www.iau-aiu.net/IMG/pdf/iau_covid19_and_he_survey_report_final_may_2020.pdf

Mei, S.L., Yu, J.X., He, B.W. & Li, J.Y., (2011). Psychological investigation of university students in a university in Jilin province. *Medical Society (Berkeley), 24*(05), 84–86.

Melvina, Lengkanawati, N. S., Wirza, Y., Alicia, D. & Yulmiati. (2020). EFL learners' view on online learning implementation during COVID-19 outbreaks. *Advances in Social Science, Education and Humanities Research 4th Sriwijaya University Learning and Education International Conference, 513*, 351–357.

Moore, M. G. (1990). *Background and overview of contemporary American distance education. Contemporary issues in American distance education* (pp. xii-xxvi). New York: Pergamon Press.

Moore, J. L., Dickson-Deane, C. & Galyen, K. (2011). E-Learning, online learning, and distance learning environments: are they the same? *Internet and Higher Education, 14*(2), 129–135. doi:10.1016/j.iheduc.2010.10.001

Nichols, M. (2003). A theory of eLearning. *Educational Technology & Society, 6*(2), 1–10.

Nicholson, L., Putwain, D., Connors, L. & Hornby-Atkinson, P. (2013). The key to successful achievement as an undergraduate student: confidence and realistic expectations? *Studies in Higher Education, 38*(2), 285–298. doi:10.1080/03075079.2011.585710

Oblinger, D. G. & Oblinger, J. L. (2005). Educating the net generation. *EDUCAUSE*. Retrieved from http://net.educause.edu/ir/library/pdf/pub7101.pdf

Pastore, R. (2002). Elearning in education: an overview. In D. Willis, J. Price & N. Davis (Eds.), *Proceedings of SITE 2002-Society for Information Technology & Teacher Education International Conference* (pp. 275–276). Nashville, TN: Association for the Advancement of Computing in Education (AACE). Retrieved February 16, 2021, from https://www.learntechlib.org/primary/p/10519/

Putra, I. P. (2021). *Pandemi, Kemendikbud Akui Terjadi Learning Loss di Sekolah*. Retrieved from Pandemi, Kemendikbud Akui Terjadi Learning Loss di Sekolah - Medcom.id

Reeves, T. C., Benson, L., Elliot, D., Grant, M., Holschuh, D., Kim, B., … Loh, C. S. (2002). Usability and instructional design heuristics for e-Learning evaluation. In Philip, B. & Samuel, R. (Eds.), *Proceedings of World Conference on Educational Multimedia, Hypermedia and Telecommunications 2002* (pp. 1615–1621). Presented at the World Conference on Educational Multimedia, Hypermedia and Telecommunications (EDMEDIA). Chesapeake, VA: AACE.

Saragih, E. M. & Ansi, R. Y. (2020). *Efektivitas Penggunaan Whatsapp Group Selama Pandemi COVID-19 Bagi Pelaku Pendidik*. Prosiding Seminar Nasional Multidisiplin Ilmu Universitas Asahan, September, 207–212.

Shawaqfeh, M. S., Al Bekairy, A. M., Al-Azayzih, A., Alkatheri, A. A., Qandil, A. M., Obaidat, A. A., … Muflih, S. M. (2020). Pharmacy students perceptions of their distance online learning experience during the COVID-19 pandemic: a cross-sectional survey study. *Journal of Medical Education and Curricular Development*, *7*, 238212052096303. doi:10.1177/2382120520963039

Sirait, E. J. M., Arhas, S. H. & Suprianto, S. (2019). the influence of assignment of lecturers at school (ALS) program on students learning motivation in Tarakan City. *Jurnal Ad'ministrare, 6*(1), 79. doi:10.26858/ja.v6i1.9983

States, U. (n.d.). *Learning loss definition*. Retrieved from https://www.edglossary.org/learning-loss/

Strelan, P., Osborn, A. & Palmer, E. (2020a). The flipped classroom: a meta-analysis of effects on student performance across disciplines and education levels. *Educational Research Review, 30*(April 2019), 100314. doi:10.1016/j.edurev.2020.100314

Strelan, P., Osborn, A. & Palmer, E. (2020b). Student satisfaction with courses and instructors in a flipped classroom: a meta-analysis. *Journal of Computer Assisted Learning, 36*(3), 295–314. doi:10.1111/jcal.12421

Thompson, G., McBride, R. B., Hosford, C. C. & Halaas, G. (2016). Resilience among medical students: the role of coping style and social support. *Teaching and Learning in Medicine,* (2):174–182. doi: 10.1080/10401334.2016.1146611. PMID: 27064719.

Turmaud, D. R. (2020). The psychological impact of COVID-19: new research provides insight into the psychological impact of COVID-19. Retrieved from https://www.psychologytoday.com/us/blog/lifting-the-veil-trauma/202009/the-psychological-impact-covid-19

Vitasari, P., Herawan, T., Wahab, M. N. A., Othman, A. & Sinnadurai, S. K. (2010). Exploring mathematics anxiety among engineering students. *Procedia – Social and Behavioral Sciences, 8*(5), 482–489. doi:10.1016/j.sbspro.2010.12.066

Wang, C. & Zhao, H. (2020). The impact of COVID-19 on anxiety in Chinese University students. *Frontiers in Psychology, 11*, 1168. doi: 10.3389/fpsyg.2020.01168

Wang, Z., Rimfeld, K., Shakeshaft, N., Schofield, K. & Malanchini, M. (2020). The longitudinal role of mathematics anxiety in mathematics development: issues of gender differences and domain-specificity. *Journal of Adolescence, 80*(March), 220–232. doi:10.1016/j.adolescence.2020.03.003

Wei, X., Cheng, I. L., Chen, N. S., Yang, X., Liu, Y., Dong, Y., … Kinshuk. (2020). Effect of the flipped classroom on the mathematics performance of middle school students. *Educational Technology Research and Development*, *68*(3), 1461–1484. doi:10.1007/s11423-020-09752-x

Wisniewski, B., Zierer, K. & Hattie, J. (2020). The power of feedback revisited: a meta-analysis of educational feedback research. *Frontiers in Psychology, 10*, 3087. doi: 10.3389/fpsyg.2019.03087

Yensy, N. A. (2020). Efektifitas pembelajaran statistika matematika melalui media whatsapp group ditinjau dari hasil belajar mahasiswa (masa pandemik COVID 19). *Jurnal Pendidikan Matematika Raflesia, 05*(02), 65–74. Retrieed from https://ejournal.unib.ac.id/index.php/jpmr

Zung, W. W. K. (1971). A rating instrument for anxiety. *Psychosomatics, XII*, 371–379. Retrieved from anxiety screener v1 (mentalhealthprofessionalsinc.com)