STUDENTS' STRATEGIES USING DIGITAL TECHNOLOGY TO SUPPORT SELF-REGULATED LEARNING IN LEARNING CALCULUS 1

Ni Kadek Ayu Indah Mahandari[1], Deshinta Puspa Ayu Dwi Argaswari[2]
[1]Sampoerna University, [2]Sampoerna University
* Corresponding Author. Email: indahmahandari34@gmail.com

ABSTRAK

Penelitian ini bertujuan untuk menjelaskan bagaimana mahasiswa Universitas Sampoerna menggunakan teknologi digital untuk mengatur strategi belajarnya sendiri dalam pembelajaran Kalkulus 1 selama pembelajaran daring. Penelitian ini menggunakan deskriptif kualitatif. Populasinya adalah mahasiswa Sampoerna University yang mengambil mata kuliah Kalkulus 1 pada saat pembelajaran daring. Penelitian ini menggunakan instrumen Yot-Dominguez dan Marcelo, dan Model Zimmerman SRL untuk menganalisis strategi belajar mandiri siswa dengan menggunakan teknologi digital. Hasilnya menunjukkan para siswa menggunakan alat komunikasi untuk mencari dukungan sosial melalui pesan instan seperti WhatsApp dan alat konferensi digital seperti Zoom, Google Meet, dan Microsoft Teams. Kemudian, para siswa memanfaatkan teknologi lain untuk mengatur dan mengubah melalui kalkulator ilmiah online seperti Lab Simbol, Geogebra, Kalkulator Desmos, Kalkulator Aljabar dan Trigonometri, dan pemindai digital (Cam Scanner dan Office Lens). Selain itu, mereka cenderung mencari informasi tentang alat repositori seperti Canvas, Youtube, Instagram, TikTok, dan Blog. Selain itu, para siswa menggunakan alat penilaian untuk memverifikasi pemahaman mereka melalui Youtube, Khan Academy dan Paul's Notes. Selain teknologi digital yang disebutkan di atas, siswa juga memanfaatkan beberapa teknologi digital dalam penggunaan sesekali.

Kata Kunci: Pembelajaran mandiri, teknologi digital, Kalkulus 1

ABSTRACT

ABSTRACT

This study aims to explain how Sampoerna University students use digital technologies to self-regulate their learning strategy in learning Calculus 1 during online learning. This study uses descriptive qualitative. The population are students of Sampoerna University who took Calculus 1 during online learning. This study use Yot-Dominguez and Marcelo instrument, and Zimmerman SRL Model to analyse students' self-regulated learning strategy using digital technology. The result shows the students utilize communication tools for seeking the social support through instant messaging like WhatsApp and digital conferencing tools such as Zoom, Google Meet, and Microsoft Teams. Then, the students utilize other technology to organize and transform through online scientific calculator such us Symbol Lab, Geogebra, Desmos Calculator, Algebra and Trigonometry Calculator, and digital scanner (Cam Scanner and Office Lens). Furthermore, they tend to searching for information on the repository tools such as Canvas, Youtube, Instagram, TikTok and Blogs. Moreover, the students use assessment tools to verify their understanding through Youtube, Khan Academy and Paul's Notes. Other than the digital technologies mentioned above, students also utilize several digital technologies in occasional use.

Keywords: Self-regulated learning, digital technology, Calculus 1.

How to Cite: Mahandari, N. A., & Argaswari, D. P. (2023). Students' Strategies Using Digital Technology to Support Self-Regulated Learning in Learning Calculus 1. *Histogram : Jurnal Pendidikan Matematika, 7*(2), 96-105.

I. INTRODUCTION

Self-regulated learning is a high-intensity exercise that utilizes several areas of the brain. This activity needs total concentration and focus, self-reflection and self-awareness, a readiness for change, genuine self-control, and acceptance of accountability for one's own growth (Zimmerman, 2001, 2002; Zimmerman & Schunk, 20011). That required task is essential to learning mathematics. William Collage (2016), emphasizes college mathematics learning for fundamental concepts, problem-solving skills, effective communication, and self-regulated learning strategies. At the university level, student with SRL are more likely to take initiative, practice their skills on assignments, and put effort toward academic objectives (Miller et al., 2011). According to Zimmerman et al. (1996), one of the key benefits of employing the self-regulation process is that it facilitates better learning and increases one's sense of control over the learning process.

Considering living in the digital era, technologies may make it easier to build this self-regulation cycle. According to Kitsantas and Dabbagh (2011), software technologies, such as communication tools, tools for exchanging resources and experiences, and social network tools, offer a lot of promise for promoting self-regulation. In the wake of the recent COVID-19 Pandemic, the use of digital technology in education has grown even more institutionalized. These digital tools have caused a paradigm shift in the entire educational system. It acts as an educator, a reviewer, and an active creator of information in addition to sharing knowledge. The development of instructional technology has made life easier for students (Haleem et al., 2022). According to Adedoyin (2020), online learning is the process of developing educational materials, providing instruction, and managing courses using the Internet and other important digital technologies. Digital technologies open up new learning opportunities and possibilities that support the development of self-regulation skills (Bernacki et al., 2011; Schneckenberg et al., 2011). According to Valentn et al. (2013), the relationship between SRL techniques and technologies may even be incidental.

This research aims to study self-regulated learning strategies using digital technology in the context of Sampoerna University students learning Calculus 1. The reasons for choosing this context are, that Calculus 1 is the fundamental subject providing provision for university students to learn the next advanced material. Furthermore, many mathematics educators believe that learning Calculus 1 needs specific conditions and

attitudes as it cannot be set as rote and procedural learning. Especially in this era: the pandemic era promotes the use of digital technology as well as the search for innovative answers to everyday issues since online learning gives students the chance to learn on their own time.

II.   METHOD

This research seeks to find out how Sampoerna University students use digital technology to self-regulate their learning strategy in learning Calculus 1 during online learning. To address the objective of this study, a qualitative descriptive was used as the research method on this study. The qualitative data analysis referred to the student's responses to the open-ended question on the instrument of SRL to provide case insight on analysis: How do Sampoerna University students use digital technology to self-regulate their learning strategy in learning Calculus during online learning. The qualitative data that researcher collected was analyzed by following steps: data reduction, data display stages, and conclusions or verification. After valid data had been obtained from the test results, observations, and interviews, data reduction was carried out. The researcher will conduct verification or conclusion by drawing inferences from the data collected in the field, including the data from the researcher's initial investigation and the data collected when conducting research that has been displayed as text in data displays.

III. RESULTS AND DISCUSSION

A. Result

The data collections and findings shows how the university students use the digital technologies to learn Calculus 1 during online learning. The findings will be explain based on the group of digital tools in the Zimmerman.

a) Communication tools

Students use digital technology communication tools such as instant massaging; WhatsApp to ask for or give information about Calculus 1 through chat or short calls. There are two strategies for how the students utilize WhatsApp; material and problem discussion and management classroom. WhatsApp helps the students find assistance from friends and lecturers, such as asking for the solution to the problem given and related material.

"On WhatsApp, I make groups for lecturers and friends too...So I will ask my friend's first, and if they do not understand, then ask the lecturer...If I can answer, I will try to answer. If I do not know, I will give it to the lecturer" (P1).

Next, students utilize WhatsApp as a place to support class management, such as asking for a schedule, a reminder of the due date.

"... Giving reminders about the due date through the WhatsApp group. As for communication, I have a WhatsApp group with friends and also lecturers*" (P3)*

Secondly, the other kind of communication tool usually used by students is web conferencing tools such as Zoom, Google Meet, and Microsoft Teams. These tools support students' SRL, which is seeking social assistance through class or group discussions. Based on the interview, this tool has some features, such as a share screen, video call, voice call, and chat, that can help students to do the discussion effectively.

"...outside of class, I usually meet through google meet, to discuss the tasks in demos. In calculus 1 class, there is online learning activity called a Desmos activity and the questions in there need to be done. My friend and I usually discuss the questions on google meet, we take turns sharing screens and looking at each other's work" (P2).

Based on the answers from the informants above, it is known that many communication tools, such as WhatsApp and Web Conferencing Tools, can help students perform SRL strategies, which are social support or seeking assistance when learning Calculus 1 during online learning.

b. Repositories tools

First, specifically in the record review strategies, several variations of digital technology were used, such as LMS (Learning Management System), Instagram, and WhatsApp. Reviewing the work that has been uploaded, checking the modules, and sharing the information are the students' learning strategies while using the repository tool.

Furthermore, the students utilize the LMS (Learning Management System) used by Sampoerna University, namely Canvas and Microsoft Teams. They utilize the LMS

managed by the lecturer to review the work that has been collected into the system or recheck the modules that have been uploaded. A different type of repository tool which is Instagram is used by students to share information such as material, tasks, and all information related to Calculus 1.

> *"* I use Instagram, it's specifically for college accounts. So there the focus is on sharing materials, assignments, or anything related to lectures" (P4).

The other kind of repositories tools used by the students is WhatsApp. Even though WhatsApp is a communication tool, it can be used for record review. Based on the interview, WhatsApp makes it easier to check back on her work or to review the problems she has solved via mobile phone simply. As is known, WhatsApp is an application that is available on all types of smartphones. Secondly, the strategy carried out by students using repository tools is searching for information. The first repository tool used to search for information mentioned is Youtube. Based on the interview, the students utilize Youtube to search for tutorial step by step for solving the problem and the explanation of the Calculus 1 concept. The second repository tool for searching for information is the Website, specifically people's works uploaded to the website. Based on the interview, the students mentioned that they are looking for Calculus 1 information on the website. The third repository tool for searching for information is Canvas. Based on the interview, learning materials, including modules, e-books, pdfs, and related links, are uploaded by lecturers in the LMS, which helps students to get the information they want to find. The last repository tool for searching for information in Social Media such as Instagram and TikTok. The students utilize Instagram and Tiktok to seek information about tips and trick-solving problems in Calculus 1.

> "I have also been on Instagram and TikTok to learn Calculus 1. It's more about looking for explanations or tips and tricks or easy ways to do calculus or work on problems. There are short videos like that. I can search there" (P4).

Based on the interview quotes from the informants, it can be concluded that the repositories tool can help students in implementing SRL strategies which are record review

and search for information. There are many repositories tools, such as Canvas, Instagram, TikTok, Youtube, Blogs, and WhatsApp.

c. Social Network

First of all, based on the interview, using a social network such as Instagram helps students find social support, such as receiving other attention about related situations in Calculus 1 through updating Instagram stories or posting current situations. P3 mentioned, *"I often post stories after a quiz or exam, and then there are some friends who respond"* (P3)

Second, the students mentioned that social networks helped them in implementing the SRL strategy that is searching for information. Base on the interview, the kind of social network that is used is also Instagram. The students utilize Instagram to find information, tips and tricks about Calculus 1 through posted images or short videos.

d. Production and Storage Tools

Organizing and transforming is a strategy that shows instructional materials have been moved around on purpose or covertly by students to enhance learning. The use of digital technology production and storage tools for organizing and transforming is described in the quoted interview.

The first production and storage tool for organizing and transforming is Google Drive. In the result of the interview, the students utilize Google Drive as a place to store and organize their file for themselves and their friends, and looking for friends work by the access given. Besides, the students use the Google Drive features (Google Doc, Spreadsheet, Google Slide, etc) to support their learning in making notes related Calculus 1. The second production and storage tool for organizing and transforming strategy is Canvas. Since Sampoerna University uses Canvas for its LMS, Canvas as Learning Management System helps students organize their learning activities, especially in learning Calculus 1 during online learning. In the interview result, P3 explains why he utilizes Canvas as support in organizing and transforming his learning, *"Canvas because we can upload our work there and can be seen back to the canvas) (P3).* Third, the production and storage tools that support the SRL strategy, which is organizing and transforming, is File Explorer. The students utilize Windows Explorer to store and organize their work and

file. "To organize my Calculus 1 files, I used windows explorer. I organize the files into folders. For example, the big folder Fall 2021, then inside there is Calculus 1" (P2).

Last but not least, the production and storage tool that supports students learning through organize and transform strategy is WhatsApp. The students utilize WhatsApp as temporary and intermediary storage from cellphone storage to laptops. Based on the interview, they create a WhatsApp group that only consists of 1 person which is him/herself. P2 mentioned how she utilizes WhatsApp to support this activity,

> "...instead of transferring files using USB, so I created a group whose members are myself. I sent the files on my cellphone, such as scan results and files from friends in the WhatsApp group, and downloaded them to my laptop using WhatsApp Web. So I can study and collect assignments using a laptop" (P2).

Another technology mentioned to support organizing and transforming strategy in SRL is digital scanner tools such as CamScanner and Office lens. Because Calculus 1 is in online learning mode, all assignments and projects are submitted online to each lecturer. Therefore, based on the interview, they need a digital scanning tool to send their hand-written assignments to the lecturer online. The following quotes are the interview result with the students who stated that Digital scanners support them in organizing and transforming their learning in Calculus 1.

"I use Camscanner to scan the answers on the paper I write" (P1).

e. Social Markers

The result of the interview shows that the use of social markers in SRL is very rare, and almost all students never use them. The social markers tool is untapped by Calculus 1 students. Apart from getting e-books and other resources from lecturers, they are not yet receiving written projects related to Calculus 1.

f. Multimedia Resources

The multimedia resource used by most students is Video. Based on the interview, most of the videos come from Youtube, Khan Academy, and Bing Video. The students utilize Youtube, Khan Academy, and Bing Video to listen to the explanation related to Calculus 1 and the description of how to solve Calculus 1 questions. The other kind of

multimedia resource utilized for supporting the SRL strategy, which is rehearsing and memorizing, is a photo or image. Based on the interview result, mostly the image is found on Google, or it calls Google image. The students utilize Google images to seek other work uploaded to google web, to see graphs and the formulas related to Calculus 1. Based on the answers of all informants above, it can be seen that using multimedia resources to assist the SRL strategy is Memorization.

> "I find photos on Google image, I usually use it to see a list of formulas. Sometimes, I prefer images because it's easier to see them. If it is an article, it might take a little longer because there is still a lot of writing" (P6).

g. Assessment Tools

Based on the interview result, Youtube Video is the assessment tool used to support self-assessment in learning Calculus 1 during online learning. The students utilize Youtube videos to self-assessments by searching the Youtube video that discusses related Calculus 1 problems. When a question or a problem appears, they try to do it by themselves first and then crosscheck the answer provided by the creator

> *"*...several times I used videos on Youtube. For example, I was looking for material problems, for example how to find the derivative of a trigonometric function, and in most Youtube videos they will give an example problem first and then give time for pause. Sometimes when I work on the problem, I pause first" (P3).

The Second assessment tool used to support students' self-assessment is Khan Academy. Based on the interview, Khan Academy helps the students to do self-assessment through the various problem related to Calculus 1 provided by Khan Academy and the step to solve its problem. Paul's Notes is the third assessment tool that helps self-evaluate the SRL strategy. Based on the interview, Paul's Notes is a website to do self-assessments that provide many Calculus 1 problems, and the answer kay complete with the step on step how to solve each problem.

> *"*....I use Paul's Notes, this is a Paul's Note website. This website contains several questions about Calculus 1. Besides, under the question, there is a click button to see the solution to its question. So the answer has not appeared directly, meaning

we are asked to do it first and then if you want to see the answer or check the answer, just click the button. The good thing about Paul's Notes is that explain in detail step by step the solution of the problem" (P3).

The quoted answers from all research informants above show that assessment tools such as Youtube Video, Khan Academy, and Paul's Note support the student's self-assessment. The students utilize those technologies by solving the problem given by themselves and then do a crosschecking with the answer key is given.

h. Internet

The internet tool students use to organize and transform their learning is a digital Translator that translates the term or sentences related to Calculus 1 that they do not understand into the term they know. Digital scientific calculators such as Symbol Lab, Geogebra, Desmos Graphing Calculator, Algebra Calculator, Trigonometry Calculator, and Scientific Online Calculatoare part of the Internet that help students to translate an equation into the simplest equation. The students utilize the digital scientific calculator to help them to find the answer to specific problems, find the step by step on how to solve the problem and find the visualization of graphs on each function related to Calculus 1.

"I use te Symbolab calculator, on my phone and on my laptop. So this Symbolab can calculate limits, integrals, and others step by step. Because calculus 1 learns functions, I also use a Geogebra graphing calculator to visualize functions" (P1).

The technology used varies greatly, such as the next informant's statement, P3, who uses a different type of technology HypetiaCreat to support his SRL in learning calculus 1. Based on the interview, the students utilize these tools as an addon on Google to input mathematics equations on Canva, Google Slide, and other production tools. *"...I have also used Hypetiacreat, a kind of add-ons tool to enter formulas or equations in Canva"* (P3).

Secondly, the Web Browser is the most mentioned that support the SRL strategy, seeking information. The students utilize the Web Browser to support their learning by seeking the solution of the problem and the concept of Calculus

The students seek the solution to the Calculus 1 problem in a web browser by directly copying the problem and searching for the example of a practice question on a

specific topic. The students use the internet to search for Calculus 1 concepts such as terms, properties, and formulas and explain Calculus 1 specific topics. The strategy of finding its concept is by typing specific topics or sub-topic that they want to find on the search engine. Based on the answers from all informants above show, the students utilize the Internet to support their learning through organizing and transforming and searching for information related to Calculus1.

i. Management tools

Most of the students rely on the Canvas set by the lecturer and specific applications such as Notion and Quick Notes. Based on the interview, students utilize Canvas and the particular application for self-observation.

First of all, the students use Canvas to support their self-observation, such as looking for the assignment's due date so that they know what they must do first based on urgency. Furthermore, the students use the following management tools: Notion, Google Calendar, and Quick Notes. The students utilize this digital technology to do self-observation by taking notes of their academic schedule and to-do list.

"...I use quick notes to list assignments and pin them on my laptop desktop" (P2).

"I use Google Calendar to enter the assignment schedule and notifications for alerting, the notion is a special app for writing to-do lists and I usually use it if I'm lazy to type or lazy to write down, usually I immediately take a photo of the lecturer's notes, then enter the Notion. So it's like my note" (P4).

Management tools such as Canvas, Notion, Google Calendar, and Quick Notes ad tools help them keep records and monitor themselves, especially in learning calculus 1. The students utilize those management tools by self-observation, especially by keeping their academic activities online according to the timeline.

B. Discussion

The result shows what and how the digital technologies used to incorporate the SRL strategies to learn Calculus 1. The students agree and use communication tools to support the students in performing the SRL strategy, which is Social Support in learning Calculus 1 during online learning. Relating to the findings from DeFilippis et al. (2022) regarding

Covid-19, organizations made communication trade-offs in response to the pandemic, increasing meeting and email activity in terms of frequency and number of people included. This also applies to distance learning, making student-to-student and student-to-teacher interactions dependent on digital communication tools.

Second, digital technology has a significant frequency of use by students as a repositories tools. Based on the interview result, most students use the repositories tools to search for information. This enthusiasm of the students in seeking information through digital technology repositories. This statement is supported by other findings that said students embark on a richer and more independent learning experience made possible by digital technologies (video, blogs, presentations, etc.). Students enjoy using digital resources to study or prepare for classes (Gorissen et al., 2012).

Subsequently, digital technology used by most students is an assessment tool. Based on the interview, students do self-assessments using Youtube, Khan Academy, and Paul's Notes. Through these tools, the students have various ways of utilizing digital technology to help their learning through self-assessment. This statement correspondent with Kearns (2012), who discovered that assessment tool methods were especially effective online. Projects, portfolios, self-assessments, peer evaluations, peer evaluations with feedback, timed tests and quizzes, and asynchronous discussions were all included.

When focusing on social networks, such as Twitter and Facebook requires design changes to be more structured to facilitate Students' SRL activities. According to Yot-Dominguez and Marcel (2017), social network technology is extensively used by students in daily life. They are hesitant to use it for learning, though, as they do not. View it as a tool with significant educational potential.

Moving on to using Social Markers, which are still unfamiliar to math learners, especially Calculus 1. Therefore, from the student's perspective in the interview, information about Calculus 1 can not be instantly obtained from scientific journals in social markers. As stated by the respondent of this study, P6 chose not to use social markers "Very rarely, because I usually find pages and pages while I'm looking for just one question. I think it takes too long to search even longer than doing the questions. So I don't prefer to use it" (P6). This statement points to Generation Z wanting fast and efficient things, indirectly affecting their learning style and SRL. This statement coincides with the opinion

of Cuza (2019), which stated that Gen Z has a passion for technology, is quick and efficient, and has a unique learning style for online channels.

On the other hand, Internet search engines, or databases are use by students searching for information. These coincide with those identified by Yot Dominguez and Marcelo (2017) as the resources students generally want to use in their studies. These findings align with other studies (Gallardo et al., 2015). Web search engines are among the most often utilized technologies for casual learning circumstances or university academic life.

Furthermore, multimedia resources such as video, photo, and audio are digital technology that supports SRL strategies such as record review, memorization, and saving records. Based on the interview result, multimedia resources support the SRL strategy of rehearsing and memorizing. In the interview, students mentioned the role of multimedia resources in learning Calculus 1 during online learning. Student P3 stated, "... It is very helpful because Youtube have the voice of the person who is describing it directly, rather than just reading it" (P3). This argument is supported by Ganan et al. (2014), who state that multimedia resources take things a step further by bringing knowledge to the student more interactive and personal. Using video, audio, interaction, and other multimedia resources boosts motivation and engagement in learning while improving content comprehension.

Finally, the last two digital technologies are Production and Storage and Management Tools. Based on the interview, both of these technologies refer to personal management, which is in the SRL strategy developed by Zimmerman classified into organizing and transforming and keeping records and monitoring. Emotional management is the strategies grouped in this factor refer to student time and information management: the need to have immediate access to the most recently published information in sources of interest, to rely on material produced by teachers to help them when studying, to solve proposed academic activities most efficiently and appealingly possible, and to distribute the time available for this and studying. Although the percentage of students who did not use these two digital technologies exceeded 50%, based on the interviews conducted, many ways mentioned how these two digital technologies helped students learn Calculus 1 during online learning. Istiqomah et al. (2021) strengthen that idea in their research about self-management in online learning. One of them is the following quote, "Using self-

management software is one method that students can use to manage their academics. Numerous applications are available today for keeping track of daily schedules—for example, Google applications such as the Google Calendar" (Istiqomah et al., 2021).

IV. Conclusion

Based on the result regarding how Sampoerna University students use digital technology to self-regulate their learning strategy in learning Calculus 1 during online learning, the students have several ways and several digital technologies are utilized. 1) Students utilized communication tools to support their learning by seeking social support through instant messaging, such as WhatsApp, and web conferencing tools, such as Zoom Meeting, Google Meet, and Microsoft Teams. 2) Students utilize repositories tools to support their learning by record review (uploading a work or task and referring back to that when needed) through Canvas, Instagram, and WhatsApp, and by searching for information through Canvas, Youtube, Instagram, TikTok, and Web or Blog. 3) Students utilized social network tools to support their learning by searching for social support (sharing their thoughts so that they can receive support from others who see it) through Instagram and by searching for information (some short video tips and tricks on solving Calculus 1 efficiently) through Instagram and TikTok. 4) Students utilize production and storage tools to support their learning through social support (commenting on other work, making the information more organized) through File Explorer, Google Drive, and Canvas. 5) Students need a strategy for utilizing social markers. 6) Students utilize multimedia resources to support their learning by rehearsing and memorizing (seeing the related content of Calculus 1, for example, problem discussion and a list of the formula or Calculus 1 properties) through videos and images by visiting Youtube Video and Google Images. 7) Students utilize assessment tools to support their learning by doing self-assessment or self-evaluation through Youtube, Paul's Note, and Khan Academy by practicing the question given. 8) Students utilize the Internet to support their learning by organizing and transforming (translating information) through Google Translator and searching for information related to Calculus 1 through the Web. 9) Students utilize the management tools to support their learning by organizing and transforming (making concept ideas) through Canvas and Quick Notes and by keeping records and monitoring (observing their academic activity and performance) through Notion and Google Calendar.

REFERENCES

Anohina. (2005). A. Analysis of the terminology used in the field of virtual learning. Journal of Educational Technology & Society, 8 (3): 91-102

Artino, A. (2007). R. Self-regulated learning in online education: A Review of the Empirical Literature. International Journal of Instructional Technology and Distance Learning, 4(6). Retrieved from http://www.itdl.org/ Journal/Jun_07/article01.htm.

Cuza, I. Alexandr. (2019). Generation Z and Learning Style (A Case Study). www.seaopenresearch.eu/Journals/articles/SPAS_21_12.pdf

Dabbagh, N., & Kitsantas, A. (2012). Personal learning environments, social media, and self-regulated learning: A natural formula for connecting formal and informal learning. Internet and Higher Education, 15(1), 3–8. doi:10.1016/j.iheduc. 2011.06.002.

DeFilippis, E., Impink, S.M., Singell, M. *et al. (2022)* The impact of COVID-19 on digital communication patterns. *Humanit Soc Sci Commun* 9, 180. https://doi.org/10.1057/s41599-022-01190-9

Istiqomah, N., Yunikawati, N. A., & Irwansyah, M. R. (2021). *Self-Managed Learning in Online Learning*. Retrieved from file:///C:/Users/Win10/Downloads/125966746.pdf.

Kearns, L. R. (2012). Student Assessment in Online Learning: Challenges and Effective Practices. *Journal of Online Learning and Teaching*. Retrieved from https://jolt.merlot.org/vol8no3/kearns_0912.pdf.

Miller, R. L., Amsel, E., Kowalewski, B. M., Beins, B. C., Keith, K. D., & Peden, B. F. (Eds.). (2011). Promoting student engagement (Vol 1): Programs, techniques and opportunities. Retrieved from http://teachpsych.org/ebooks/pse2011/index.php.

Yot-Domínguez, C., & Marcelo, C. (2017). University students' self-regulated learning using Digital Technologies. *International Journal of Educational Technology in Higher Education*, *14*(1). https://doi.org/10.1186/s41239-017-0076-8.

Zimmerman, B. J. (1989). A social cognitive view of self-regulated academic learning. Journal of Educational Psychology, 81(3), 329–339.

Zimmerman, B. J. (1998). Developing self-fulfilling cycles of academic regulation: An analysis of exemplary instructional models. In D. H. Schunk, & B. J. Zummerman (Eds.), Self-regulated learning. From teaching to self-reflective practice, (pp. 1–19). New York: The Guilford Press.

Zimmerman, B. J., & Schunk, D. H. (2011). Self-regulated learning and performance. In B. J. Zimmerman, & D. H. Schunk (Eds.), Handbook of self-regulation of learning and performance, (pp. 1–12). New York: Routledge.