



# Self-blended learning and self-regulated learning models in developing the quantitative skills in statistics

<sup>1</sup>Diwata D. Ona & <sup>2</sup>Delon A. Ching

## Abstract

Innovative instructional methods for diverse learners have emerged as a response to the persistent global public health crisis such as the self-regulated and self-blended model. This study used descriptive research design. The 30 Grade 11 respondents were selected through purposive sampling technique. Findings showed that the respondents strongly agree on the statements of description provided for the self-blended learning material. However, the respondents practiced self-regulated learning to some extent only. Scores in the pre-test and post-test of the respondents before and after exposure to self-blended learning showed significant differences along the following subscales: knowledge, analysis, concepts and application and calculation and accuracy. On the other hand, scores of the respondents on calculation and representation and communication were not statistically significant.

**Keywords:** *blended learning, diverse learners, innovative instructional methods, self-blended learning, self-regulated learning, statistics*

## Article History:

*Received: December 27, 2023*

*Accepted: January 25, 2024*

*Revised: January 4, 2024*

*Published online: January 28, 2024*

## Suggested Citation:

Ona, D.D. & Ching, D.A. (2024). Self-blended learning and self-regulated learning models in developing the quantitative skills in statistics. *Management, Education & Innovation Review*, 1(1), 39-56. <https://doi.org/10.53378/meir.01244>

## About the authors:

<sup>1</sup>Corresponding author. MaEd – Mathematics. Department of Education. Secondary School Teacher II.

Email: [diwata.ona@deped.gov.ph](mailto:diwata.ona@deped.gov.ph)

<sup>2</sup>EdD. Laguna State Polytechnic University. Professor and Research Director. Email: [delon.ching@lspu.edu.ph](mailto:delon.ching@lspu.edu.ph)



© The author (s). Published by Institute of Industry and Academic Research Incorporated.

This is an open-access article published under the Creative Commons Attribution (CC BY 4.0) license, which grants anyone to reproduce, redistribute and transform, commercially or non-commercially, with proper attribution. Read full license details here: <https://creativecommons.org/licenses/by/4.0/>.

## Introduction

The persistent global public health crisis has had a lasting impact on the field of education, leading to the emergence of innovative instructional methods for diverse learners. In contrast to the pre-pandemic era, where classroom-based instruction dominated, the pandemic necessitated the implementation of various learning mechanisms. Throughout the height of the public health crisis, the advantages and disadvantages of each learning modality were carefully examined. As the world now grapples with the aftermath of the pandemic, previous instructional approaches are being reconsidered for future use, potentially even on a permanent basis. Blended learning, with its numerous benefits for learners, has the potential to become an enduring part of the instructional landscape. Among its different types, self-blended learning offers learners the opportunity to study independently, reducing their reliance on traditional learning methods. This approach can be particularly beneficial for subjects like Mathematics, which often evoke anxiety among students due to its numerical nature.

In the context of senior high school education, statistics and probability constitute a vital part of the curriculum, acting as a prerequisite for various research-based subjects at that level. Mastering the basic concepts of these subjects is essential for understanding statistical aspects of research. However, since mathematics-related subjects tend to provoke anxiety among many students, exploring new instructional approaches could prove fruitful. By implementing a self-blended learning approach, teachers can facilitate more meaningful learning experiences in statistics and probability. Given the negative attitudes and poor performance commonly observed among students in this subject, it is crucial to address this challenge and improve the situation. The lack of confidence in solving statistical problems, stemming from the subject's mathematical content, contributes to students' negative attitudes and underperformance. Extensive research indicates that students often experience fear and anxiety when it comes to mathematics, which may also extend to statistics and probability. This phenomenon has been exacerbated during the pandemic, leading to a noticeable decline in students' performance across all subjects, including statistics and probability. Self-blended learning has the potential to alleviate such conditions by empowering learners to take charge of their education through self-determination and independent learning, as facilitated by this instructional approach.

In response to these challenges, educators have made efforts to implement innovative strategies within the classroom aimed at addressing the learning gaps in statistics and probability. Many educators have undertaken initiatives to enhance students' attitudes and performance in this subject, thoroughly investigating the underlying factors and reasons. Some have implemented innovative approaches with the expectation of improving performance and fostering positive attitudes. However, certain areas within statistics and probability pose difficulties for learners, including topics such as permutation, combination, probability, and random variables. Moreover, students often struggle to establish connections between the subject and other disciplines, such as research and economics. Even graduate students face challenges in identifying specific statistical tools for their research problems.

This study does not focus on identifying the various factors that affect statistics learning; rather, it proposes an innovative approach to address the aforementioned issues. In addition to examining the impact of self-blended learning on performance, the study also emphasizes the significance of self-regulated learning in the post-pandemic era. Research suggests that self-regulated learners are more capable of applying practical learning concepts within the classroom. Individuals with a high level of self-regulation tend to have positive self-perceptions, effectively resolve conflicts with peers, and exhibit resilience when confronted with problems, difficulties, and failures. Furthermore, they perform better in various learning activities.

This study sought to determine the effectiveness of the self-blended model in understanding quantitative skills in statistics and the level of self-regulated learning of students. Specifically, this answered the following questions:

1. How is the self – blended learning model described when it comes to: learning experience; learning outcomes; effectiveness and efficiency; user friendly; and congruence?
2. What is the level of self-regulated learning of students when it comes to: goal setting; environmental structuring; task strategies; task management; help seeking; and self-evaluation?
3. What is the performance of the student-respondents before and after exposure to self-blend model on quantitative skills assessment in terms of: knowledge; calculation; analysis; and quantitative reasoning; concepts and applications; calculations and accuracy; representations and communication?

4. Is there a significant difference between the pretest and posttest performance of the student-respondents before and after exposure to self-blend model on quantitative skills assessment?

## Methodology

**Research design.** The study employed a descriptive research design. Descriptive, as defined by Calderon (2012), involves a purposeful process of gathering, analyzing, categorizing, and summarizing data on prevailing conditions, practices, beliefs, trends, and causality, with appropriate and accurate interpretation aided by statistical method. Furthermore, it describes the respondents' perception on the extent or limit of effectiveness of the self-blended/self-regulated learning materials when it comes to learning experience, learning outcomes, effectiveness and efficiency, user friendly and congruence of the developed material. Additionally, self-regulated learning of the respondent was also illustrated when it comes to goal setting, environmental structuring, task strategies, time management, help seeking, and self-evaluation. Moreover, performance of the respondents after applying the intervention strategy was described based on quantitative skills assessment in statistics and probability when it comes to knowledge, calculation, analysis, and quantitative reasoning.

**Respondents of the study.** The respondents in this study were 30 Grade 11 students purposively selected from Dolores Macasaet National High School during the academic year 2022-2023. These students were exposed to novel approaches known as self-blended learning and self-regulated learning.

**Sampling technique.** This study employed a purposive sampling technique in selecting the respondents. The selection was based on the learner's academic performance in statistics and probability as reflected in their report cards which fits the goal of the study in giving the learners intervention strategy. This was complemented by Nikolopoulou (2022) who described purposive sampling as a technique used by a researcher based on discernment as to which people will give the most information to help in meeting the study's objective.

**Research instrument.** The researcher developed a pre-test and post-test assessing the quantitative skills in statistics and probability. The pre-test and post-test were adapted-modified questionnaires from the modules provided by the Department of Education during

the pandemic period. Both tests include 24 multiple choice questions to assess the respondents' quantitative skills when it comes to knowledge, calculation, and analysis and 2 problem solving questions assessing quantitative reasoning. Specifically, there were 8 questions under knowledge, 8 questions under calculations, and 4 questions under analysis. For quantitative reasoning, a rubric was developed to measure the said component with regards to concepts and applications, calculations and accuracy, and representation and communication with 4 as the highest score per criterion. On the other hand, the self-regulated learning survey questionnaire was adopted from the study of Barnard et al. (2009). It utilized a 4-point Likert scale composed of six categories, i.e. goal setting, environmental structuring, task strategies, time management, help seeking, and self-evaluation, with five questions each. Additionally, another adapted 4-point Likert Survey questionnaire was utilized to assess the perception on the extent or limit of effectiveness of the self-blended/self-regulated learning materials developed for the study with five areas, i.e. learning experience, learning outcomes, effectiveness and efficiency, user-friendly, and congruence, with five questions each as well. To ensure the appropriate distribution of questions, the instrument followed a table of specifications. Before administering the instrument to the respondents, it underwent validation by Master Teachers and Head Teacher of the Mathematics Department and selected English teachers for language structure and critique.

**Research procedure.** The researcher, firstly, sought permission to conduct the study from relevant authorities, including the Office of the Laguna State Polytechnic University Graduate School and Applied Research, Thesis Adviser, the Members of the Panel, the Schools Division Superintendent of Quezon Province, and the School Principal. The study proceeded after obtaining the necessary approvals. Supplemental activities were prepared as intervention strategy of the study. These activities underwent review and approval by Master Teachers and the Head Teacher before implementation in the classroom. The supplemental activities were distributed weekly for one month to the identified respondents. Short meetings were conducted every Friday to provide simple instructions and retrieve previous materials. After four sessions, post-test was conducted, and survey questionnaires were distributed. The collected data were tabulated, analyzed, and interpreted to draw conclusions and provide recommendations based on the findings.

**Statistical treatment of data.** The study employed various statistical tools to address the research questions posed in this study. Descriptive analysis was conducted to examine the

level of self-regulation skills, using measures such as mean and standard deviation. To analyze the performance of students in the quantitative skills assessment based on the pretest and posttest scores, frequency and percentage were utilized, accompanied by appropriate descriptors. To investigate whether there is a significant difference in the pretest and posttest scores of the students, a paired t-test was employed as an inferential statistical tool.

## **Findings**

### ***Respondents' Description of Self-Blended Learning***

Based on the data gathered, the respondents strongly agree about the statements that describe self-blended learning according to learning experience with the overall mean of 3.69. Specifically, the respondents strongly agree that SRL/SBL material is appropriate and suited to their vocabulary and comprehension needs with a mean of 3.89. The obtained result, indicating a mean score of 3.6, demonstrates that the SRL/SBL material aligns effectively with students' reading vocabulary and comprehension, thereby establishing its suitability. This infer that the aforementioned result contributes significantly to the overall outcome, which has a mean score of 3.69. Therefore, the SRL/SBL material, tailored to students' reading vocabulary and comprehension, plays a crucial role in achieving the overall positive result. It reinforces the effectiveness and suitability of the material in enhancing students' learning experience and academic performance. In addition, the tasks and learning activities provided in the material are adaptable and can be used individually with both mean of 3.71 interpreted as strongly agree. Lastly, the material is competency-based and suited to students' ability with mean of 3.63 and 3.63 respectively (interpreted as strongly agree. The results imply that the material is well-crafted and fit to what the students need in the subject.

The material developed and utilized in the classroom is viewed as something with worth, however, this is such lesser degree in terms of being interesting and sense of expectations. The University of Dundee (n.d) discussed that self-blended learning helps improve students' performance. Here the learners are given a free hand to manipulate or to deal with their own learning at their own pace. This is an important aspect of learning because students are not pressured to accomplish tasks given to them. However, there are instances where lack of motivation may exist in this type of set up. According to Medrano (2022) in the pandemic times where students are just confined in their houses to study, a lot of problems

came in terms of submission, quality and honesty in work. Many students were not able to submit on time because of many distractions along the way such as household chores, family day to day business and the like.

The SRL is generally effective and efficient based on the results. This may also mean that they found differentiated activities in terms of developing mathematical skills, literacy and values. In the work or discussion of Ornia (2021) about the self-learning modules of the Department of Education, there are many activities that learners should deal with. However, there are activities that need strong teacher's guidance for them to be understood well by the students.

The SBL material is user-friendly. The self-blended model offers flexibility, enabling students to pursue education in areas that may otherwise be inaccessible to them, such as students from high-risk environments or working individuals aiming to obtain a college degree (viewsonic.edu.com, 2022). In instances where a school lacks qualified teachers for certain subjects, remote teaching methods, such as Zoom sessions or pre-recorded educational videos, can be employed to deliver the content (viewsonic.edu.com, 2022). One of the main advantages of the self-blend model is its flexibility, as it caters to students at risk of failing subjects while also providing opportunities for additional learning and specialization (EFA, 2020). Furthermore, it is a cost-effective approach compared to hiring additional teachers for specialized subjects, making it a viable option for delivering comprehensive subject content (Burns, 2021).

The results imply that the SBL material contains congruent activities suited to learners' needs. More so, it could be gleaned that the material followed the competencies prescribed in the MELCS. This learning model, known as self-blended learning, enables students to take control of their learning by combining various learning experiences that extend beyond the offerings of a traditional school setting (EFA, 2020). It is particularly advantageous for students seeking additional learning opportunities in specific fields not available in their institution, as well as those pursuing advanced placement courses (EFA, 2020). The self-blend model heavily relies on online learning, allowing students to access and complete courses outside the confines of a physical classroom, such as at home or in an internet cafe with computer network access (viewsonic.edu.com, 2022).

The respondents' description of self-blended learning that proved that self-blended learning is highly manifested garnering an average mean of 3.65 and 0.878 standard

deviation in all the given subscales. This goes that blended learning provided students with new method of learning, in which students felt freedom and other form of interaction around them using the provided learning materials. These results are consistent with most of the previous studies indicating the effectiveness of the blended learning as (Maccon, 2016) and (Al-Rimawi, 2014).

### ***Level of Self-Regulated Learning***

The results imply that students do not have that high level of self-regulated practice in terms of their studies. Cesario (2022) discussed in her paper that students of today possess qualities different from the students' generations back. In this time of technological advancement, many students rely on it. Information is always readily available in just one click of fingers that whatever they need can be gotten instantly. This is one of the reasons why learners of today are weak in setting goals about their academic journey (Maningas, 2022).

In terms of setting goals of learning, on the other hand, it can be thought of as the standards that regulate an individual's actions (Schunk, 2001). In the classroom, goals may be as simple as earning a good grade on an exam, or as detailed as gaining a broad understanding of a topic. Short-term attainable goals often are used to reach long-term aspirations. For example, if a student sets a long-term goal to do well on an exam, then he or she also may set attainable goals such as studying for a set amount of time and using specific study strategies to help ensure success on the exam. Self-regulated learners do not try to accomplish every task on their own, but rather frequently seek help from others when necessary. What sets self-regulated learners apart from their peers is that these students not only seek advice from others, but they do so with the goal of making themselves more autonomous. Teachers can promote positive help seeking behaviors by providing students with on-going progress feedback that they can easily understand and allowing students opportunities to resubmit assignments after making appropriate changes.

The results show that the respondents exhibited different forms of structuring in terms of their learning environment according to their preferences. This shows that each individual possesses characteristics that are unique to each other. No two individuals are exactly the same and this is also true when it comes to the way they want to learn. There are students who want a noise-free setting in order that he will absorb everything about learning. On the



other side, there are learners who are accustomed to music and to some extent-noise whenever they are engaged in any learning activity. Based on the results of the study, it could be deduced that these learners want an environment that is conducive to their own learning. Actually, they make it themselves. Distractions hamper learning development. Once it exists in a learning environment, goals and objectives may be compromised (Magpantay, 2018). It could also be gleaned that learners create and find their own environment to which they could comfortably learn. Teachers have to be aware of these findings so that they could be of help in creating a meaningful environment for learners. Teachers don't have to impose the kind of environment they themselves want for learners. Take note that every person has his/her own context by which they could do things. Teachers just have to discover them for learners have their own way to voluntarily learn.

Respondents' manifestation of practicing majority of the indicators to a low extent may be considered a sign of mismanaging or not doing tasks in the classroom. If these are practiced diligently, a possible improvement in the performance may be manifested among students. In the work of Magpantay (2022), students may perform better if they do extra efforts in their academic endeavors. If there are no extra efforts and the students will just do what their teachers provide, a milestone in quality education is impossible to achieve or to attain. In support, Wolters (2018) said that self-regulated learning concerns the application of general models of regulation and self-regulation to issues of learning especially within academic contexts. Self-regulated learning is an active, constructive process whereby learners set goals for their learning and then attempt to monitor, regulate, and control their cognition, motivation, and behavior, guided and constrained by their goals and the contextual features in the environment.

The results may mean that the respondents, although not that high in terms of managing tasks, still do them to some extent. This result is similar to the work of Magsino (2020) where she found out that self-regulated learning concerns the application of general models of regulation and self-regulation to issues of learning especially within academic contexts. Self-regulated learning is an active, constructive process whereby learners set goals for their learning and then attempt to monitor, regulate, and control their cognition, motivation, and behavior, guided and constrained by their goals and the contextual features in the environment.

The results imply that respondents ask assistance or help on a moderate scale only. They do not practice asking help to a very high extent may be because of their tendency to become independent. According to Gardner (2011), learners of the 21<sup>st</sup> century are characterized as independent. This means that they want to explore knowledge of their own with little assistance of others.

The results show that respondents rely on others to determine how and what they are learning. In terms of internalizing or reflecting on themselves, they practice it to a low extent. It is important for these respondents what other people say about their performance on specific tasks or discipline. The results are somewhat similar to the work of Zumbunn et al. (2021) who said that self-regulated learning (SLR) is recognized as an important predictor of student academic motivation and achievement. This process requires students to independently plan, monitor, and assess their learning. However, few students naturally do this well. Self-regulated learning is a process that assists students in managing their thoughts, behaviors, and emotions in order to successfully navigate their learning experiences. This process occurs when a student's purposeful actions and processes are directed towards the acquisition of information or skills. Generally, models of SRL are separated into phases. One popular cyclical model discusses three distinct phases: Forethought and planning, performance monitoring, and reflections on performance. During the forethought and planning phase, students analyze the learning task and set specific goals toward completing that task. When students learn unfamiliar topics, however, they may not know the best ways to approach the task or what goals might be the most appropriate.

The respondents' level of self – regulated learning having 2.91 mean and 0.76 standard deviation resulting to practice to some extent level. Zimmerman et al. (1994) concluded in their study that self-regulated learning occurs when learners take the initiative to set learning goals and then monitor, adjust, and evaluate their cognition, motivation, emotion, behavior, and environment to achieve them. However, individual factors of learners have a significant impact on self-regulation. Given the mean and standard deviation above, for subscales; help seeking and self – evaluation, the respondents do practice it for some extent only. In addition, understanding students is essential because the teacher will begin to determine the suitable scheme and the form of learning and assessment relevant to the student and the condition of the students.

### ***Pretest and Posttest Performance of the Students***

The findings suggest that the self-blend model effectively supports the development of students' analytical skills. In summary, the results indicate that the implementation of the self-blend model holds promise for enhancing students' quantitative skills in areas such as knowledge, calculation, and analysis. These findings highlight the potential effectiveness of the self-blend model as an instructional approach for improving students' proficiency in quantitative skills.

In summary, the results indicate that the self-blend model had limited effectiveness in improving the performance of student-respondents in the areas of concepts and application, calculation and accuracy, and representation and communication. The majority of respondents remained at the beginning level, with only a small proportion demonstrating progress at the developing level. These findings highlight the need for further investigation and refinement of the self-blend model to effectively address the challenges associated with these specific skill areas.

### ***Test of Significant Difference between the Pretest and Posttest Performance***

The subscales to which the pretest and post test scores are significantly different are the following: knowledge, analysis, concepts and application and calculation and accuracy. This means that the self-blended learning material may truly help in increasing the performance of students in Statistics along the aforementioned subscales. On the other hand, the subscales to which the pretest and posttest scores are not significantly different are the following: calculation and representation and communication. The involvement or guidance of teachers in the process of learning statistics/mathematics may be necessary for students, as indicated by Alrajeh and Shindel's (2020) study on student engagement and math teachers support. The study highlighted that instructional support emerged as the predominant factor influencing students' learning outcomes in these subject areas. As we all know, teacher's role as a facilitator of learning refers to the one who guides, assists and manages the learning process effectively, they ensure participation and allow students to engage in their own learning ways. Teachers greatly influence students' mathematical problem-solving skill. Moreover, the study conducted by Daher (2020) as mentioned in Alrajeh and Shindel's (2020) work reiterated the importance of effective instructional support in positively influencing students' emotional well-being. This included fostering their motivation to engage in learning across various subject areas. Also, Aziz et al. (2018), classroom

discussions where teachers were present are an important aspect of participation of students. It makes them more motivated, supports their learning, improves their communication and promotes higher order thinking skills. Teachers play a vital role in boosting participation by acknowledging all contributions made in class where teachers do the facilitation to overcome their fear of speaking, and providing examples related to their' lives. A supportive, non-threatening and open learning environment provided by teachers would make students feel comfortable in expressing their thoughts.

## **Conclusion**

This study concluded that self-blended learning material developed and applied to the students, they practiced self-regulated learning to some extent only, the scores in the pretest and posttest of the respondents before and after exposure to self-blended learning show difference, and the pretest and post test scores of the respondents are significantly different along the following subscales: knowledge, analysis, concepts and application and calculation and accuracy. On the other hand, scores of the respondents on calculation and representation and communication are not statistically significant. There is no significant difference between the pretest and posttest scores performance of the student-respondents before and after exposure to self-blend model on quantitative skills assessment. The implementation of the self-blended learning material had a positive impact on the quantitative skills of the respondents, particularly in areas related to knowledge, analysis, concepts and application, and calculation and accuracy.

These results provide valuable insights into the effectiveness of self-blended learning as a pedagogical approach for enhancing quantitative skills. The findings suggest the importance of further exploration and refinement of self-regulated learning practices to optimize the learning outcomes in these areas. Overall, this study contributes to the existing body of knowledge in the field of self-blended learning and provides practical implications for educators, instructional designers, and policymakers involved in designing and implementing effective learning environments.

## References

- Abel. (2020). Learning from the problems and challenges in blended learning: Basis for faculty development and program enhancement. *Asian Journal of Distance Education*, 15(2), 21-41. <https://doi.org/10.5281/zenodo.4292631>
- Alrajeh, TS. & Shindel, BW (2020). Student engagement and math teachers support. *Journal on Mathematics Education*. 167-180
- Aziz, F., Quraishi, U., & Kazi, A. (2018). *Factors behind Classroom Participation of Secondary School Students (A Gender Based Analysis)*. *Universal Journal of Educational Research*, 6(2), 211- 217. <https://doi.org/10.13189/ujer.2018.060201>
- Barnard-Brak, L., Lan, W., & Paton, V. O. (2010). Profiles in self-regulated learning in the online learning environment. *International Review of Research in Open and Distance Learning*, 11(1), 61-80.
- Barnard, L., Lan, W. Y., To, Y. M., Paton, V. O., & Lai, S. (2009). Measuring self-regulation in online and blended learning environments. *Internet and Higher Education*, 12, 1-6. <http://dx.doi.org/10.1016/j.iheduc.2008.10.005>
- Biggs, J. B., & Collis, K. (1982). *Evaluating the quality of learning: the SOLO taxonomy*. New York: Academic Pres.
- Boekaerts, M. (1999). *Handbook of self-regulation*. San Diego: Academic Press. Burns, R. J. (2021) 'Developing Dialogue: process, trial, outcomes', paper for the 17th international conference of EARLI, Finland. <http://www.robinalexander.org.uk/wp-content/uploads/2017/08/EARLI-2017-paper-170825.pdf>
- Bouilheres, F., Le, L. T. V. H., Mcdonald, S., Nkhoma, C., & Jandug-Montera, L. (2020). Defining student learning experience through blended learning. *Education and Information Technologies*. <https://dx.doi.org/10.1007/s10639-020-10100-y>
- Burns, Mary. (2021). *Distance education for teacher training: Modes, models, and methods*, <https://www.edc.org/sites/default/files/uploads/Distance-Education-Teacher-Training.pdf>
- Calderon, J. (2006). *Methods of research and thesis writing (2nd Ed.)*. Mandaluyong City: National Bookstore.
- Chiou, W. & Wan, C. (2007). The dynamic change of self-efficacy in information searching on the Internet: influence of valence of experience and prior self-efficacy. *The Journal of Psychology*, 141(6), 589.

- Chmiliar, L. (2011). Self-regulation skills and the post-secondary distance learner. *Procedia-Social and Behavioral Sciences*, 29, 318-321.  
<http://dx.doi.org/10.1016/j.sbspro.2011.11.245>
- Creswell, J. W., & Creswell, J. D. (2017). *Research design: Qualitative, quantitative, and mixed methods approaches*. Sage publications.
- Cummiskey, K. (2019). *Use of Games and Guided Labs in an Introductory Probability and Statistics Course*.
- Daher, W. (2020). Students' positioning and emotions in learning geometric definition. *Journal on Mathematics Education*, 11(1), 111-134.  
<http://doi.org/10.22342/jme.11.1.9057.111-134>.
- Department of Education. (2021). *National curriculum: Mathematics for ages 5 to 16*. Pasig City, Philippines.
- Dodge, T. (2010). *Personal Learning Environments: A Conceptual Landscape revisited*. eLearning Papers, 35, 1-16.
- Ebun, H. & Magallanes, M. (2018). Programmatic intervention research: Illustrations from the evolution of self-regulated strategy development. *Learning Disability Quarterly*, 22, 251-262.
- Elmaneay, M. R. (2016). *Difficulties in learning the content of the statistics and the probability of the third-grade students at preparatory school, and a proposed proposal for treatment them from the point of view of specialists*, Master Thesis published, Faculty of Education, Qassim University, Saudi Arabia, 1-136.
- Garfield, M. & Ahlgren, A. (2019). How do students deal with difficulties in mathematics? *CETLMSOR Conference 2010*, 34-38
- Gomez-Rey, P., Barbera, E., & Fernandez-Navarro, F. (2017). Online and offline teaching and learning: A comparative study of the congruence of teachers' and students' perspectives. *Journal of New Approaches in Educational Research*, 6(2), 130-136.
- Groth, R. (2018). High school students' levels of thinking in regard to statistical study design. *Mathematics Education Research Journal*, 15(3).
- Johnson, G. M., König, J., Robson, R., & Spooner-Lane, R. (2021). Self-blended Learning Design and Implementation. *In Blended Learning Innovations in Higher Education* (pp. 37-57). Springer.

- Kandeel, R. A. (2019). *Students' Academic Difficulties in Learning a Statistics and Probability Course: The Instructors' View. Journal of Education and Practice*, 10(9). <https://doi.org/10.7176/JEP/10-9-05>
- Kramarski, B. and Mizrachi, N. (2016). Online discussion and self-regulated learning: Effects of instructional methods on mathematical literacy. *The Journal of educational research*, 99(4), 218-230.
- Lavasani, M.G., Mir Hosseini, FS., Hejazi SE., & Davoodi, M. (2011). The effect of self-regulation learning strategies training on the academic motivation and self-efficacy. *Procedia - Social and Behavioral Sciences*, 627-632. <https://doi.org/10.1016/j.sbspro.2011.11.285>.
- Labuhn, A.S., Zimmerman, B.J., &Hasselhorn, M. (2010). Enhancing students' self-regulation and mathematics performance: The influence of feedback and self-evaluative standards. *Metacognition and Learning*, 5 (2), 173-194.
- Li, C. & Lalani, F. (2020). *The COVID-19 pandemic has changed education forever. This is how. World Economic Forum*. Retrieved from <https://www.weforum.org/agenda/2020/04/coronavirus-education-global-covid19-online-digital-learning/>
- Maccoun, Hussein Salem. (2016). The effect of using blended learning on the achievement of students and information retention of fifth graders in the biology course. *Faculty of Education Journal*, 22 (95) 209-240.
- Magpantay, T, S. (2019). *Challenges in Science and Mathematics Learning*. Paper presented in Curriculum Planning Class. Philippine Normal University.
- Memnum, D. S. (2019). A qualitative research on the difficulties and failures about probability concepts of high school students. *Journal of Educational Issues*, 15(1). <https://doi.org/10.5296/jei.v5i1.14146>
- Mutua, M. (2010). Self-regulated learning in technology enhanced learning environments: an investigation with university students. *Technology, pedagogy and education*, 17(3), 171-181.
- Naccache, Hiba Salim (2012). *Factors related to student performance in statistics courses in Lebanon*. Dissertations. 852. <https://aquila.usm.edu/dissertations/852>
- Nikolopoulou, Kassiani. (2022). *What is Purposive Sampling? I Definition and Examples*. <https://www.scribbr.com/methodology/purposivesampling/#:~:text=Purposive%20sa>

[mpling%20refers%20to%20a,on%20purpose%E2%80%9D%20in%20purposive%20sampling.](#)

- NISAU-UK (2020). *Principles and Standards for School Mathematics*. Reston, VA: NCTM.
- Oliveira Júnior, A. P. de; Zamora, P. R.; Azevedo de Oliveira, L.; & Costa de Souza, T. (2018). Student's attitudes towards probability and statistics and academic achievement on higher education. *Acta Didactica Napocensia*, 11(2), 43- 56, <https://doi.org/10.24193/adn.11.2.4>.
- Pandero, E., & Alonso-Tapia, J. (2014). How do students self-regulate? Review of Zimmerman's cyclical model of self-regulated learning. *Anales De Psicologia*, 30(2), 450-462. <http://dx.doi.org/10.6018/analesps.30.2.167221>
- Pappas, C. (2015). *The history of blended learning*. eLearning Industry. <https://elearningindustry.com/history-of-blended-learning>
- Pappas, S. (2020). SES differences in young children's metacognition in the context of mathematical problem solving. *Cognitive Development*, 18 (3), pp. 431–450.
- Paris, S.G. & Paris, A.H. (2001). *Classroom Applications of Research on Self-Regulated Learning*. [https://lchc.ucsd.edu/MCA/Mail/xmcamail.2013\\_09.dir/pdf4cg5OwMfev.pdf](https://lchc.ucsd.edu/MCA/Mail/xmcamail.2013_09.dir/pdf4cg5OwMfev.pdf)
- Patel, H. (2020, October 22). *Digital learning 2.0: How e-learning will change the course of education*. *BW Education*. <http://bweducation.businessworld.in/article/Digital-Learning-2-0-How-E-learning-WillChange-The-Course-Of-Education-/22-10-2020-334400/>.
- Price, J. L. (2017). *An analysis of self-regulated learning strategies, academic performance, and satisfaction among recent online high school graduates*. Doctor of Philosophy (PhD), Dissertation, STEM Education & Professional Studies, Old Dominion University, DOI: 10.25777/vxxn-4j83 [https://digitalcommons.odu.edu/stemps\\_etds/29](https://digitalcommons.odu.edu/stemps_etds/29)
- Sage, K., Jackson, S., Fox, E. et al. (2021). The virtual COVID-19 classroom: surveying outcomes, individual differences, and technology use in college students. *Smart Learn. Environ.* **8**, 27 (2021). <https://doi.org/10.1186/s40561-021-00174-7>
- Schraw, G. and Mossman, H. (2016). Promoting self-regulation in science education: metacognition as part of a broader perspective on learning. *Research in Science Education*, 36, 111-139.



- Schunk, D. (2010). *Self-regulation through goal setting*. <https://cyc-net.org/cyc-online/cyconline-june2010-schunk.html>
- Shantakumari N. & Sajith P. (2015). Blended learning: The student viewpoint. *Annals of Medical and Health Sciences Research*, 5(5). <https://doi.org/10.4103/2141-9248.165248>
- Smith, S. P. & Bogdanovic, I. (2019). The self-blended learning model: An alternative to flipped and hybrid instruction. *Journal of Online Learning Research*, 5(2), 183-203.
- Schunk, D. H. (2010). Self-efficacy and education and instruction. In J. E. Maddux (Ed.), *Self-efficacy, Adaptation, and adjustment: Theory, research, and application* (pp. 281- 303). New York: Plenum Press
- Tishkovskaya, S. & Lancaster, G. A. (2012). Statistical education in the 21st century: A review of challenges, teaching innovations and strategies for reform, *Journal of Statistics Education*, 20, 1-56.
- Tuguic, L. A. (2021). *Challenges of the new normal: students' attitude, readiness and adaptability to blended learning modality*. Kalinga State University.
- Walters, C. A., Pintrich, P. R. & Karabenick, S. A. (2008). *Assessing Academic Self-regulated Learning. Conference on Indicators of Positive Development: Definitions, Measures, and Prospective Validity*. ChildTrends, National Institutes of Health.
- Wang, C., Shannon, D. M., & Ross, M. E. (2013). Students' characteristics, self-regulated learning, technology self-efficacy, and course outcomes in online learning. *Distance Education*, 34(3), 302-323.
- Wang, M., Liu, W., & Kang, Y. (2018). The effectiveness of blended learning in health professions: Systematic review and meta-analysis. *Journal of Medical Internet Research*, 20(4), e160.
- Warren, H., & Wagner, E. (2020). *Save Our Education: Protect every child's right to learn in the COVID-19 response and recovery*. Save the Children. <https://www.savethechildren.org/content/dam/usa/reports/ed-cp/save-our-education-report.pdf>
- Winne, P. (2006). How software technologies can improve research on learning and bolster school reform. *Educational psychologist*, 41(1), 5-17.
- Winne, P. (2005). Key issues in modeling and applying research on self-regulated learning. *Applied Psychology*, 54(2), 232-238.

- Wolters (2020). The impact of mobile learning on students' learning behaviours and performance: Report from a large blended classroom. *British Journal of Educational Technology*, 40(4), 673-695. <http://dx.doi.org/10.1111/j.1467-8535.2008.00846.x>
- Won, J. R. (2010). Book review of Developing Adaptive and Personalized Learning Environments. *Open Praxis*, 8(4), 361-363. <http://dx.doi.org/10.5944/openpraxis.8.4.375>
- Xiayan, S. (2021). *An analysis of difficulties in learning Probability in high school*. East China Normal University.
- Yang, Y. (2006). Effects of embedded strategies on promoting the use of self-regulated learning strategies in an online learning environment. *Journal of Educational Technology Systems*, 34(3), 257-2006.
- Zimmerman, B. J. (2010). Becoming a self-regulated learner: An overview. *Theory into Practice*, 41 (2).
- Zumbrunn, D. E., Tadlock, E. & Roberts, N. (2011). Attaining self-regulation: A social cognitive perspective. In M. Boekaerts, P. R. Pintrich, & M. Zeidner (Eds.), *Handbook of self-regulation* (pp. 13- 39). San Diego: Academic Press.