#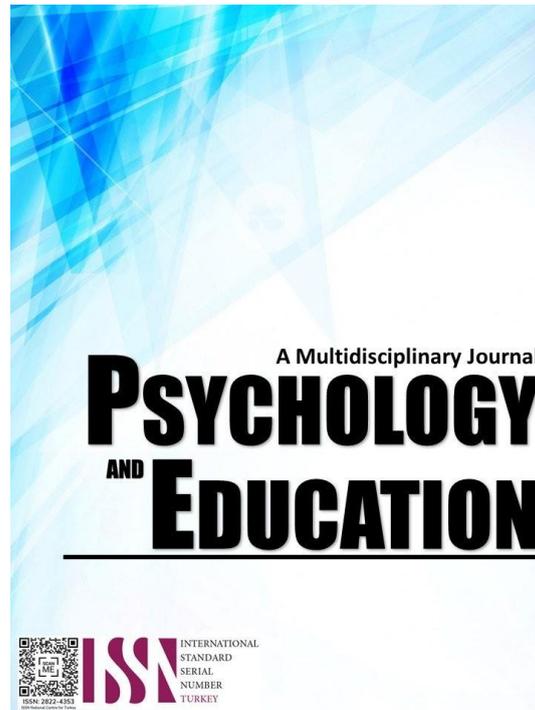 SELF-EFFICACY, MENTORING EXPERIENCE AND PERFORMANCE LEVELS OF STEM STUDENTS IN RESEARCH THROUGH DISTANCE LEARNING MODALITIES



**PSYCHOLOGY AND EDUCATION: A MULTIDISCIPLINARY JOURNAL**

# Self-Efficacy, Mentoring Experience and Performance Levels of STEM Students in Research Through Distance Learning Modalities

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## Abstract

Conducting research during the COVID-19 pandemic brought tremendous challenges in supporting the research capabilities of Filipino learners due to the remote learning set-up prescribed by the Department of Education. This study examined the self- efficacy, mentoring experience, and performance of Grade 12 STEM students employing distance learning modalities. A mixed method design was utilized with correlational emphasis to explore the self-efficacy, and research performance among systematically selected 231 student-respondents from eight (8) public senior high schools in the Division of Isabela. Based on the results, the respondents have moderate self-efficacy and mastery in research performance. Data revealed that the respondents are more familiar with qualitative research but need help synthesizing literature, formulating hypotheses, crafting conclusions and recommendations, sampling, proper citation styles, and identifying statistical methods. However, their mentoring experience level is very satisfactory. Moreover, there is a positive significant correlation between research performance and self-efficacy, and between self-efficacy and mentoring level. Nevertheless, no significant correlation exists between research performance and mentoring experience level. Thematic analyses of the challenges experienced by students in carrying out research in a blended learning environment predominantly include communication and technological barriers, protocol restrictions in carrying-out data collection/experiments, delayed feedback on research outputs, and irregular one-on- one online supervision of teachers in tracking students' research progress. Hence, it is recommended that training and seminars be conducted on recalibrating pedagogies, assessments, and strategies in teaching research using the blended set-up, which is pivotal for more productive research conveyance in senior high schools during crises.

**Keywords:** *STEM, self-efficacy, mentoring experience level, research performance, mixed method*

## Introduction

In the Philippine education landscape, the Department of Education has many mechanized initiatives to propel research sustainability among senior high school students, especially in the STEM field (Department of Education, 2017). This accounted for the introduction of Research subjects in the Enhanced Basic Education Curriculum, where STEM students are exposed to Practical Research 1 (Qualitative Research), Practical Research 2 (Quantitative Research), and Research Capstone/Project, which serves as the culminating output (Roxas, 2020). As a result, STEM students are expected to be competent and well-skilled in polishing quality scientific research that impacts their immediate environment. However, the COVID-19 pandemic created disorientation in the research curriculum regarding modality, assessment, and pedagogies as it transitioned from face-to-face to a remote paradigm.

Various studies have pointed out the moderate performance level of students in research during the face-to-face modality (Estacio, Barcelona and Mejia, 2018; Formeloza and Patena, 1970; Ciocon, 2018). However, it cannot be denied that acquiring knowledge and skills entails extensive personal effort and mentoring expertise to meet the required standards, especially in this emerging pandemic. It requires proper planning and management to yield optimum results based on students' learning. Students are also affected by contact, connectivity, communication, and additional workload (Beena and Sony, 2022). The new modality became an arduous task for working parents. Students have limited socialization with other children, and so with their teachers. They are more exposed to many distractions at home than substantial school undertakings (Dargo and Dimas, 2021). As to their research tasks, they were experiencing a negative impact of the lockdown on their ability to collect data, discuss ideas and findings with peers, and disseminate research findings (Byrom, 2020).

The Department of Education has developed remote learning plans combining synchronous and asynchronous instructions aided by technologies (print materials, radio, TV, Internet, and mobile). However, teachers needed help to incorporate these technologies into their teaching. Transitioning lesson content designed for delivery in an actual setting to an online scheme is burdensome for them (Wilichowski and Cobo, 2020). Adapting to the new normal of teaching and acquiring the vital skills to engage with the students effectively is the new challenge in the profession (Dargo and Dimas, 2021). Accumulated research findings unveiled that teachers' major hurdles

involved pandemic health threats, distribution and retrieval of modules, internet connectivity, miscommunication in giving instructions, and power outages (Agayon, Agayon and Pentang, 2022). According to Barron et al. (2021), the pandemic has shifted two status quo. First, the conventional physical instruction method is not fit for remote learning instruction, thus requiring pedagogical adaptation. Second, the pandemic has created new time routines for teachers' engagement with students and their administrative functions. The pandemic has accentuated the need for flexibility and more time for student-teacher interactions. Moreover, since research is an inherently collaborative endeavor, it further impelled the need for more open communication between the learner and the research teacher. Speer et al. (2021), as asserted by Callo et al. (2020), readiness for remote online teaching depends on the amount of preparation, availability of ICT tools, and competence, confidence, and expertise in utilizing these technologies.

As cited by Speer et al. (2021), many studies deduced that there is no difference between virtual mentoring and in-person mentoring in terms of academic, social, and career support since it also promotes the development of relevant and technical skills (Breck et al., 2018; Oppenheim and Knott; 2018; De and Cavanaugh, 2020). However, transitioning from in-person to virtual mentoring can be complex and present challenges, such as access of rural students to technology, confidentiality, and miscommunication (Ensher, Heun and Blanchard, 2003). Since there are limitations in conducting data collection, most research has revolved around doing literature reviews which students find undesirable and less meaningful than the actual experimentation method. Similarly, other responses indicated that they could not collect data in the laboratory but took time to build their understanding of scientific theory. Furthermore, at the onset of the COVID-19 pandemic, most ongoing STEM research by students has been put to an end or could have been more polished in terms of quality due to several restrictions (Speer, Lyon and Johnson, 2021). Several local and foreign studies have investigated self-efficacies and mentoring levels according to engagement in research. However, a limited number explored the pandemic-related research engagement and productivity of high school students under the mentoring guidance of their teachers.

### Research Questions

This study sought to determine the relationship between self-efficacy and mentoring assistance on Grade 12 STEM students' performance in conducting scientific research. Subsequently, it will serve as a basis for developing capability-building programs to enhance and recalibrate teachers' efficiency and strategies towards teaching research through the proposed distance learning modalities. Specifically, it aims to answer the following questions:

1. What is the self-efficacy level of Grade 12 STEM students in conducting scientific research through distance learning modalities?
2. What is the mentoring experience level of Grade 12 STEM students in conducting scientific research relative to
   2.1 Mentor-mentee relationship;
   2.2 Mentor's guidance;
   2.3 Mentor's feedback; and
   2.4 Mentor's experience?
3. What is the performance level of Grade 12 STEM students in conducting scientific research along with
   3.1 Nature of the Research Problem;
   3.2 Review of Related Literature;
   3.3 Research Method; and
   3.4 Interpreting the Results of the Study?
4. Is there a significant relationship between and among the self-efficacy, mentoring experience and research performance of the students?
5. What are the Grade 12 STEM students' perspectives in the conduct of scientific research through distance learning modalities?

## Literature Review

Bandura's (1977) self-efficacy theory (SET) put forward a new standpoint on human behavior regarding outcomes by suggesting that an individual's success is embedded in one's belief that one possesses the ability to achieve a specific outcome by drawing on their cognitive and behavioral skills to produce desired results (Bandura, 1986). While a person's recognized self-efficacy can impact one's accomplishment, witnessing others perform successfully can increase or decrease an individual's personal belief in achieving a similar result (Bandura, 1986; Varghese & Finkelstein, 2020). Thus, belief leads to success, but it is important to note that an individual's "self-efficacy belief system is a differentiated set of self-beliefs linked to distinct realms of functioning, not a one-size-fits-all trait" (Bandura, 2019).

Social cognitive theory (SCT) relates cognition to self-efficacy. Thus, one must consider the environmental

impact on an individual's social cognitive conditions, which can positively or negatively influence a person's self-efficacy levels. Through requisite contexts, individuals interact with physical and socio-structural environments beyond their control, but individuals may also elect to interact with specific settings that provide personal or career opportunities based on the potential for achievement. If a person is satisfied and productive in his present experiences, it influences his self-efficacy which leads to the creation of a facilitating climate that encourages success (Bandura, 1997; Varghese & Finkelstein, 2020). From this expanded perspective, one could argue that variations among students' belief systems require a flexible approach to instruction and mentoring that promotes high self-regulatory skills to increase motivation and achievement (Burney, 2008).

A person's self-efficacy is positively influenced by their mentors (Bandura, 1997; Martin & Dowson, 2009; Meyer & Bouchey, 2010). The potential for academic motivation, engagement, and accomplishment is increased when mentors and mentees are matched based on shared interests and aspirations (both academic and career-related) (Martin & Dowson, 2009). According to Larose (2013), Martin & Dowson (2009), Varghese & Finkelstein 2020, a mentor's perceived self-efficacy level has an impact on how the mentor and mentee assess the success of their relationship. Mentors who believe they are confident and effective in modeling and communicating the necessary elements of the mentoring position frequently have protégés who feel the same way about themselves.

Vygotsky's (1978) sociocultural theory also relates to mentoring. While Vygotsky's idea of the zone of proximal development (ZPD) is traditionally applied to children, the scaffolding approach can also be directed at student participation in school activities. The ZPD is defined as "the difference between the level of potential development as determined through problem-solving in collaboration with more capable peers and the level of actual development as determined by independent problem-solving" (Vygotsky, 1986). There is an argument that learners in any educational program would benefit from mentors who have experienced similar paths to those they are mentoring.

SCT offers a framework for cooperative and interactive learning that promotes constructivism. The two basic principles of constructivism are that learners actively assimilate knowledge and construct new ideas or interpret concepts based on their current and past knowledge (McMahon, 1997). Learning is viewed as a

personal endeavor, which implies that knowledge is subjective and learners use their existing knowledge to bridge the gap between known and unknown information. Constructivism, therefore, embodies the idea of building on scaffolding. As an offshoot of constructivism, cooperative learning incorporates the idea that the best learning occurs when students are actively engaged in learning while collaborating with peers to accomplish shared goals (McMahon, 1997).

To conclude, the theory stipulates that the social context influences learning and is reciprocal to the environment (Bandura, 1999). The theory emphasizes the importance of observing and modeling the behavior, attitudes and emotional reactions, and it suggests that all behaviors are learned through conditioning. Relating this to the mentor / mentee relationship, the theory postulates that both mentors and mentees significantly influence each other. The mentee's negative experience resulting from the mentor's behavior may negatively affect the mentee's progress (Henfield, Owens & Witherspoon, 2011 in Burt 2012). The supervision environment, such as a delayed response to the mentee's submitted work, the unavailability of the mentors, the lack of a cordial relationship between the mentor and mentee, and poor communication, may create a state of helplessness on the part of the mentee. The mentor is expected to correspond to the supervisee's needs in a realistic amount of time. Mentors need a clear, concrete and logical supervisory model of mentorship. How the mentor relates to the mentee has much influence on the mentee's progress during the research process. With social learning theory as its solid ground, this study has investigated the influence of research mentoring and self-efficacy on students' research performance in Isabela.

The mentoring relationship concerned with teaching and learning is also supported by learning models and theories. According to Kram's mentor role theory (1985), mentors can provide two broad categories of mentor functions: career/cognitive development functions – enhance cognitive and skills of mentee; and psychosocial functions – enhancing the mentee's sense of competence and self-efficacy, engagement and personal development. In collaborative learning, it includes approaches involving joint intellectual and active effort, where social and intellectual engagement and mutual responsibility are emphasized between student and teacher(Turkish, et. al., 2014).

Self-efficacy has been one of the significant psychological influences affecting individual behavior under the social learning theory (Bandura, 2005;

Pajares & Shunk, 2001). The self-efficacy concept is the belief in oneself of his capacity to fulfill a specific task successfully through organizing the actions necessary for an individual to demonstrate a particular performance (Bandura, 2005). Zimmerman (1995) defines it as an individual's beliefs in realizing a task and his ability to achieve it. A person's sense of self-efficacy influences actions they choose to take, the amount of effort expended on a task or goal, and their ability to persevere (Bandura, 1997).

Self-efficacy is developed through four primary sources. In order of importance, these are the following (Evans, 1989 and Powell, 2007):

• Experience: Personal assessment of accomplishments is the most crucial factor influencing self-efficacy. Successes raise expectations and failures lower them.

• Modelling/Vicarious experience: Observing successful people can generate the expectation that observers will also become successful by modeling observed behavior. This is particularly true when people recognize similarities between themselves and the models.

• Social persuasion (encouragement): Coaching and receiving positive evaluative feedback on performance lead people to believe that they can execute tasks. It is generally easier to decrease than to increase a person's self-efficacy.

• Physiological and emotional states: These states can influence self-efficacy judgments; anxiety, for instance, can be a negative influence.

Self-efficacy judgments influence goals, goal-directed effort, persistence and affective experiences (Evans, 1989; Schunk, 1995; Zimmerman et al., 1992). People are more inclined to take on tasks if they believe they can succeed; learners stop trying when they believe that their effort is futile: this is the phenomenon of learned helplessness (Nicholls, 1989). Self-efficacy also induces thought patterns: low self-efficacy can lead people to believe that tasks are more challenging than they are, and to attribute failure to poor ability, whereas people with high self-efficacy feel that they are generally in control of their own lives (Chetse, 2008). Thus, self-efficacy is related to locus of control. Bandura (quoted in Zimmerman, 1989) hypothesizes that self-efficacy and expected outcomes motivate independent learning. However, research has delivered mixed results, and the true nature of the relationship between self-efficacy and performance is still unknown in this pandemic era (Barnes, 2004).

# Methodology

This study utilized the mixed method design to describe the relationship among the respondents' levels of mentoring experience, self-efficacy, and performance in conducting scientific research. In the qualitative aspects, structured interviews will answer several questions about students' experiences while conducting scientific research employing distance learning modalities.

## Participants

The study was conducted among public senior high schools in the Division of Isabela, particularly in Alicia, Aurora, Sto. Tomas, Luna, Tumauini, Roxas, and San Mateo. These schools are chosen due to their STEM course offerings, where investigatory research projects are requirements for graduation. Likewise, they also employ distance learning modalities, particularly online and modular, in their research instruction. The respondents were the selected Grade 12 students enrolled in the Academic Track under the Science, Technology, Engineering, and Math (STEM) Strand with research subjects for the School Year 2021-2022.

The study employed systematic sampling to select respondents per school. The total population of Grade 12 STEM students is 566. Hence, using Slovin's formula, the respondents were 231 student-respondents. Random sampling was employed in determining the STEM schools to be included in the study.

## Instruments of the Study

The research questionnaire consists of four (4) parts:

1. Research Self-Efficacy Level Questionnaire (expert-validated by the Philippine Association of Research Practitioners, Educators and Statistical Software Users Inc.) adopted after the study of Camara et al., (2021)
2. Mentoring Experience Level Questionnaire modified from the study of Malunda et. al. (2021) and Rawls (2008).
3. Standardized Research Achievement Test (RAT) for assessing research performance for the Research K to 12 Curriculum developed by Ivy P. Mejia (2018) of UP NISMED.
4. Semi-structured survey interview to corroborate the results of the three (3) preceding questionnaires and to elicit other information not revealed by the said instrument.

## Results and Discussion

The drafts of the modified instruments were submitted to three (3) experts, a statistics teacher, a science master teacher, and a research expert, for content validation purposes. Professional recommendations were incorporated into the instruments. Face validity was undertaken with the assistance of the three (3) aforesaid experts and with the language and research teachers. The face validity result showed 92 overall agreement indicating Retain action utilizing the Face Validation Technique by Desai and Patel (2020). The Content Validity Index was computed 0.9 employing Content Validity Index Calculation by Yusoff (2019). Testing the reliability of the questionnaire was done on selected Grade 12 STEM students who were not part of the samples of the study through Cronbach's Alpha with a computed value of 0.91 indicating an Excellent level of reliability.

### Procedure

A letter was given to the Schools Division Superintendent, school principals of the select high schools, and student -respondents asking for their permission to conduct the study. Upon approval, the researcher administered the questionnaires and conducted interviews among the selected respondents. Because of the pandemic, the researcher used flexible data collection methods such as Google Forms and phone calls. Google links were also given to the student respondents under the guidance of their advisers to guarantee their adherence. For some students who do not have gadgets for online data collection, actual questionnaires will be given remotely and retrieved later.

### Statistical Methods

Descriptive statistics (mean, standard deviation, and frequency) were used to describe the students' level of self-efficacy, mentoring experience, and performance in research. In addition, Pearson product-moment correlation was used to determine the relationship between the study variables. In analyzing qualitative data, a thematic analysis was used to describe students' perspectives on conducting scientific research through distance learning modalities. In tabulating and analyzing the overall data, the Statistical Package for Social Science (SPSS) software licensed version was employed with the assistance of a qualified statistician.

### Research Self-Efficacy Level of the Respondents

Table 1. *Research Self-Efficacy Level of the Respondents*

| Statements | Mean | Qualitative Description* |
|---|---|---|
| 1. I can explain the importance of Qualitative Research in Daily Life. | 3.58 | High Self-Efficacy |
| 2. I can explain the importance of Quantitative Research in Daily Life. | 3.62 | High Self-Efficacy |
| 3. I can differentiate qualitative from quantitative research. | 3.89 | High Self-Efficacy |
| 4. I can identify the different kinds of qualitative research. | 3.47 | Moderate Self-Efficacy |
| 5. I can identify the different kinds of quantitative research. | 3.5 | Moderate Self-Efficacy |
| 6. I can identify the characteristics of research. | 3.58 | High Self-Efficacy |
| 7. I can identify the different processes of research. | 3.55 | High Self-Efficacy |
| 8. I can identify the different ethical principles in doing research. | 3.47 | Moderate Self-Efficacy |
| 9. I can write a good Chapter 1. | 3.61 | High Self-Efficacy |
| 10. I can write a good research title. | 3.55 | High Self-Efficacy |
| 11. I can write correct general problems | 3.39 | Moderate Self-Efficacy |
| 12. I can write correct specific problems. | 3.45 | Moderate Self-Efficacy |
| 13. I can write a good Chapter 2. | 3.31 | Moderate Self-Efficacy |
| 14. I can select relevant studies for my research. | 3.51 | High Self-Efficacy |
| 15. I can write correct synthesis of reviewed studies. | 3.29 | Moderate Self-Efficacy |
| 16. I can write a good Chapter 3. | 3.38 | Moderate Self-Efficacy |
| 17. I can choose appropriate methodology for my study | 3.38 | Moderate Self-Efficacy |
| 18. I can compute samples using the correct sampling method. | 3.4 | Moderate Self-Efficacy |
| 19. I can identify appropriate statistical methods to test my research hypotheses. | 3.31 | Moderate Self-Efficacy |
| 20. I can write a good Chapter 4 | 3.46 | Moderate Self-Efficacy |
| 21. I can compute using the correct statistical tool. | 3.33 | Moderate Self-Efficacy |
| 22. I can write a good Chapter 5. | 3.55 | High Self-Efficacy |
| 23. I can write correct findings. | 3.61 | High Self-Efficacy |
| 24. I can write correct conclusions. | 3.63 | High Self-Efficacy |
| 25. I can write correct recommendations. | 3.53 | High Self-Efficacy |
| 26. I can write correct bibliographical references | 3.55 | High Self-Efficacy |
| 27. I can write the correct Abstract. | 3.48 | Moderate Self-Efficacy |
| 28. I can confidently present/defend my research paper orally. | 3.29 | Moderate Self-Efficacy |
| Grand Mean | 3.49 | Moderate Self-Efficacy |

The table 1 below shows the research self-efficacy of respondents who used distance learning via blended learning (modular/online). It indicates the respondents have moderate research self-efficacy, as denoted by the overall mean of 3.49. This suggests that they have

an average capacity to execute the behaviors necessary to produce research-related tasks. Furthermore, the table also shows that among the indicators, respondents find it easy to distinguish qualitative from quantitative research, with the highest mean of 3.89. In the study of Camara et al. (2021), adult learners' research self–efficacy is remarkably high during the pre-pandemic/face-to-face modality (M=3.58; sd=0.77). This agrees with Hill et al. (2022) whose study divulged that undergraduate students report fairly high levels of research self-efficacy and moderate levels of interest in research overall. Ouano's study (2011) hypothesized that the experience of academic difficulty (as experienced by students during the pandemic) is one of the reasons for this sudden decrease in students' self-efficacy in research.

Though still in moderate capacity (M=3.29), correctly synthesizing reviewed studies and confidently defending research papers orally have the least overall mean among the statements. As revealed by Shook (2018), one of the challenges in synthesizing literature is that students must identify their viewpoints and how the literature intersects with their ideas. As noted by one of the respondents, this is also due to the limited communication and transfer of knowledge emanating from the technological and distance barriers between the teacher and the students during the blended delivery of lessons. Another respondent also disclosed low self-confidence for an oral research defense because he cannot express himself clearly due to extreme nervousness in front of the panelists.

**Mentoring Experience Level of the Respondents**

Table 2 reveals the level of mentoring experience of the student-respondents during the blended learning modality. It is shown that students rated their mentoring experiences with their research teachers as "Very Satisfactory," as indicated by the overall mean of 3.95. This signifies that research teachers exerted much effort in delivering their lessons by channeling mentoring relationships, guidance, an immediate feedback system, and expertise fit for a distance learning setting.

In addition, the table unveils that among the indicators, the teacher's mastery of research skills and knowledge imparted to students has the most impact, as justified by the highest mean of 4.09. This depicts that a mentor's experience profoundly influences shaping students' competence in crafting quality research.

Though still commendable, a mentor's guidance has the least mean of 3.8268. Under this category, "I have

a mentoring schedule with my research teacher" obtained the lowest mean of 3.18 (Satisfactory). This manifests the need for a definite timetable for the students to acquire feedback or expert advice from their mentors regarding their research. A respondent opined that most feedback is generally given during online discussions, social media chat groups, and private messenger. Teacher feedback significantly improves students' overall writing ability and reduces writing differences (Bitchener, Cameron, and Young, 2005; Chandler, 2003). Nonetheless, there are different perspectives on the feedback given by teachers and students in online learning due to the absence of human touch, thus initiating misunderstandings (Hodges et al., 2020). Second to the lowest is the statement, "I regularly interact with my research teacher online," which further insinuated the tentative schedule for individual or group virtual mentoring.

The mentor-mentee relationship, guidance, and feedback are significant factors in students' performance (Rawls, 2008). In a MENTOR study, about a third of mentors report that the pandemic has positively impacted their mentoring relationships. Many research teachers have shifted to virtual mentoring environments and technology solutions. According to Seidu (2015), some research teachers do not provide timely and sufficient feedback on students' research work, thus delaying the continuity and drive of the research process. The meager support from the research teacher is further aggravated by several families, peers, and community-related difficulties (Wamala and Oonyu, 2012). Switching from in-person to virtual mentoring is a period of adjustment due to many challenges in technology access and limited mobilizations (Ellen, Heun and Blanchard, 2003; Owen, 2014).

Table 2. *Mentoring Experience Level of the Respondents*

| Indicators | N | Mean | Qualitative Description* |
|---|---|---|---|
| Mentor-Mentee Relationship | 11 | 3.9642 | Very Satisfactory |
| Mentor's Guidance | 10 | 3.8268 | Very Satisfactory |
| Mentor's Feedback | 11 | 3.9229 | Very Satisfactory |
| Mentor's Experience | 3 | 4.0851 | Very Satisfactory |
| OVERALL | 35 | 3.94975 | Very Satisfactory |

**Research Performance of the Respondents**

According to the table below, the research performance of the respondents using the distance learning modality is average mastery, which is consistent with the findings of Estacio et al. (2018).

This implies a need to reexamine pedagogies and strategies for how research can be effectively taught to students in a blended setting to attain complete mastery of its competencies. Chapter 1, encompassing the nature of the research problem, is shown to have the highest mean (M=45.2951), while the least is in Chapter 3, covering the research methodologies (M=43.2136). Though the majority of the respondents perform well in interpreting tables and graphs, determining qualitative themes, and identifying the nature of the research problem (of which most statements have the highest means), the respondents have the least means in synthesizing literature, formulating hypotheses, crafting conclusions and recommendations, sampling, proper citation styles, and identification of statistical methods. These results are congruent to Sismundo (2020) where he deduced that students should be trained to analyze data, properly present the study findings, and come up with sound and correct conclusions and recommendations. Based on the Research Achievement Test scores, students are more knowledgeable about qualitative than quantitative research. One respondent argued through an interview that "quantitative research is a little more complex, requiring students to be adept in statistical methods and techniques which are not tackled broadly during the online discussion but only on modules of which I have difficulty understanding." The interviews conducted corroborated the results of the RAT.

Table 3. *Research Performance of the Respondents*

| Indicators | N | Mean | Qualitative Description |
|---|---|---|---|
| Nature of the Research Problem | 19 | 45.2951 | Average Mastery |
| Review of Related Literature | 9 | 44.9735 | Average Mastery |
| Research Method | 17 | 43.2136 | Average Mastery |
| Interpretation of Results | 15 | 44.8773 | Average Mastery |
| OVERALL | 60 | 44.589875 | Average Mastery |

**Relationships among the Respondents' Research Performance, Self-Efficacy and Mentoring Experience Level**

Table 4 below shows that there is a positive correlation between the respondents' research performance and their research self-efficacy, which is analogous to the findings of Haider et al. (2022), Hayes (1998), and Day & Allen (2004). Regardless of domain, empirical evidence supports the idea that self-efficacy predicts student motivation and performance (Schunk, 1995). The outcome of a research paper revealed a positive relationship between self-efficacy and research productivity (Philips and Russell, 1994). However, no correlation exists between research performance and

mentoring experience level, though in the research paper of Jain and Jain (2016), the two variables were significantly related. Abdellatif's study (2021) also demonstrated a non-significant correlation between the degree of mentoring and students' overall academic achievements. Moreover, Yurtseven and Altun (2011) indicate that the mentoring service has no significant effect on student's academic achievement and self-efficacy perceptions.

Additionally, a significant relationship exists between mentoring experience level and research self-efficacy. It highlights the importance of mentoring mechanisms in strengthening the research self-efficacy of STEM students. By building mentoring relationships, researchers will have more opportunities to receive verbal persuasion and vicarious experience to enhance their research self-efficacy. The current study was inconsistent with Rawl's (2008) and Petko's (2020) studies which found an inverse relationship between research self-efficacy and research mentoring. Nevertheless, Hollingsworth and Fassinger (2002) and Lee (2009) found a positive correlation. Mentors must encourage mentees to believe in their ability to complete research projects. This implies encouraging positive emotional states. The divergence between the findings in this study and others regarding the relationship of research self-efficacy to research mentoring indicates a need for further research.

Table 4. *Relationships among the Respondents' Research Performance, Self-Efficacy Level and Mentoring Level*

| Variables | N | Mean | Std. Deviation | Pearson Correlation | Sig. 2-tailed | Interpretation |
|---|---|---|---|---|---|---|
| RP and RSE | 231 | 45.4762 3.4881 | 13.63656 .68385 | .340** | <.001 | Significant |
| RP and MEL | 231 | 45.48 3.9223 | 13.637 .73770 | .017 | .800 | Not Significant |
| MEL and RSE | 231 | 3.9223 3.4881 | .73770 .68385 | .470** | <.001 | Significant |

**Perspectives on the Challenges Encountered by the Respondents in Research through Distance Learning Modality**

**Preparation**. As the table below indicates, 34 respondents noted that the lack of gadgets, internet connection, and load hinders students' grasp of work immersion prerequisites and processes during the concluded online orientation and information dissemination. One student-respondent opined, "*Online learning is hard if you do not have a load, internet connection, and money.*" which highlights

non-attendance to online discussions due to financial constraints. Gaps in students' performance related to home internet access exist regardless of differences in socio-economic status [44]. One respondent noted the need for laboratory equipment in a home-based research setting. This is similar to the claim of Jacob & Orleans (2016) that physical facilities are imperative for effectively delivering the curriculum's competencies.

It is further recommended to spearhead information dissemination through online platforms and other means where students can be adequately updated about their research activities. Likewise, DepEd should consider how to cater online learning even to the impoverished sector of society since it is being advocated on a larger scale. Moreover, alternative distance learning modalities and contextualized interventions should be designed to sustain course delivery even without online discussion modes.

**Learning Environment**. Thirty-nine (39) respondents argued they could not focus due to the clamorous, inconvenient, and distracting home-based setting. "It is *very noisy and messy at home; that is why sometimes I lose focus*," one student respondent stated. Another respondent mentioned the need for more learning resources in the house to execute performance tasks. Moreover, one respondent noted that household chores interfere with their research activities, as evidenced by her statement, "*My time for research study competes with household responsibilities, such as caring for children and a part-time job to help the family economically survive*." This implies that the research environment significantly impacts the learning process. It should conform with the rules and regulations on safety, appropriateness for learning, and availability of facilities and equipment that are issued by the DepEd (DO 40 s. 2015), Department of Labor and Employment (DOLE), and Commission on Higher Education (CHED).

**Relevance**. Another challenge given by thirty-two (32) respondents is the need for exposure to actual laboratory experimentation due to COVID restrictions. As one student remarked, " *Our research skills cannot really be effectively assessed in online instruction*." Moreover, they commented that most of the instructions were done online and that there was no actual assessment of the research outputs, mainly demonstrated through online platforms. There is also limited collaboration with other students due to offline and online communication barriers and contradictory priorities.

It is observed that ensuring student safety during the pandemic sacrificed some of the competencies in research. However, DepEd reiterated that all schools should maintain the quality of instructional delivery during remote learning without sacrificing the safety and security of students and teachers (DM 287 s. 2020).

**Delivery**. The majority of the challenges in research are evident during the delivery process. Just like in the preparation stage, insufficient materials, a slow internet connection, and an absence of load were the dominant challenges, with 38 respondents straining from those. One student said, "*Sometimes I cannot simultaneously do the required activities during the synchronous instruction because of low internet connection and lack of internet load*." On the other hand, inadequate supervision time for research teachers in tracking students' progress was another critical factor. A student stated, "*There is an inadequacy of updates from teachers on the task to be done in research*." Pertinent to this, the monitoring plan should be revisited periodically in terms of supervision because the students in a non-face-to-face continuum desperately need teachers' technical expertise and guidance. Furthermore, the modules given were least understood by some students and needed further insights and elaboration from the teachers.

Most students belong to the indigent segment whose families were affected by the onset of the pandemic. As such, students find opportunities to help parents earn an income by juggling between a part-time job and home-based research activities. As a result, working while studying became a trend during this pandemic. Reflecting on this, it becomes imperative for the school to boost flexible and self-paced learning strategies to cater to this type of student. As affirmed by DepEd guidelines, learners' tasks and activities will be modified to jive into the learners' and locality's situation.

**Alignment to the New Normal**. Twenty-two (22) respondents asserted the difficulty of students adapting to the home-based research setting due to the constraints brought by the COVID protocols. The protocols limited their strategies for accomplishing their outputs effectively. According to them, there is pressure to keep up due to many activities. Some students also adapt to web-based applications in demonstrating performance tasks and submitting outputs. Technology-based teaching pedagogy of teachers is another crucial factor in the construction of

students' learning experiences in research. Adjusting to the online environment scenario is a significant hurdle for teachers and students to surpass [47,48,49].

Table 5. *Challenges Encountered by the Respondents in Research through Distance Learning Modality*

| Themes | Significant Statements* | Frequency |
|---|---|---|
| **Preparation** | | |
| Lack of gadgets, internet connection, and load | "I have no gadget for the online class, not even a cellphone and load." [S26] "I experienced difficulty during our online class due to poor internet connection" [S56] | 34 |
| Insufficient materials/resources to be used | "..have no enough materials for research activities."[S44] | 25 |
| Insubstantial orientation and updates from teachers | "Announcements and orientations are insufficient that's why most students are caught off-guard." [S88] | 20 |
| Information dissemination is insufficient | "I was confused and I don't know what to do because I was not informed." [S32] | 12 |
| **Learning Environment** | | |
| The home-based setting is too noisy, inconvenient, and full of distractions | "I found it hard to study research due to the unwelcoming and noisy environment at home." [S145] | 39 |
| Household chores intervene with their research activities | "I have limited time doing research activities due to household chores and other responsibilities at home." [S96] | 15 |
| Challenging to work independently with no teachers around to clarify concepts | "There is no teacher around to inquire on if what we are doing is right or wrong." [S123] | 10 |
| **Relevance** | | |
| Most of the instruction is done online and no actual assessment of performance tasks | "It is difficult because the activities were not taught in an actual manner." [S60] | 24 |
| Limited collaborations with other students; activities mostly done independently | "It is hard to collaborate on the research activity because my groupmates are from other barangay." [S147] "Hard to do those activities because I'm alone." [S62] | 15 |
| **Delivery** | | |
| Insufficient materials, slow internet connection, and no load | "I cannot open my messenger due to lack of internet load. That's also the reason why I am not updated with my teacher's instructions." [S54] | 38 |
| Inadequate | "It's very difficult to do and understand research | 28 |
| supervision time for research teachers in tracking students' progress | when there is no actual teacher explaining it." [S127] | |
| Limited knowledge compared to the actual face-to-face research discussion | "We can't learn new skills and knowledge because we can't practice it." [S167] | 15 |
| Modules are hard to understand and need further elaboration | "Some of the explanations in the modules are not that easy to understand." [S112] | 13 |
| Difficulty in communicating with groupmates offline and online | "Face-to-face collaboration and interaction are limited due to health protocols and COVID restrictions." [S117] "Our group cannot simultaneously meet online due to conflicting schedules." [S148] | 12 |
| Part-time jobs intervene with the immersion process | "…busy working while studying." [S42] | 9 |
| Late delivery of modules to lockdown barangays and COVID- positive students | " I did not receive my research modules on time due to lockdowns being declared in our barangay." [S67] | 8 |
| **Alignment to the New Normal** | | |
| Difficulty in adapting to home-based research setting due to restrictions brought about by the COVID IATF protocols | Research experiments are very difficult to conduct because there are so many protocols to follow." [S93] | 22 |
| Limitations in the protocol hinder the execution of some competencies in research | "I cannot do other research tasks due to many hindering pandemic protocols. " [S87] | 12 |

## Conclusion

During the later stages of the COVID pandemic, when the Department of Education mandated the implementation of distance learning in all public and private schools, students' self-efficacy and research performance was revealed to be average, whereas their mentoring experience was very satisfactory. It implies that this sudden shift in learning arrangement from face-to-face to remote learning has caught students right in the middle and that they are gradually becoming adaptive to it. Teachers recalibrated and

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tailored their mentoring strategies to suit the blended learning setup. In the absence of the human touch, their mentoring relationship with the students, guidance, feedback, and expertise have an extensive impact on carrying out research tasks within the borders of the learners' homes. Results also indicate a significant positive correlation between research performance and research self-efficacy, as well as between research self-efficacy and mentoring level. However, no significant relationship exists between research performance and mentoring experience level. Significant challenges experienced by students in carrying out research in a blended learning environment include communication and technological barriers, protocol restrictions in actualizing data collection/experiments, delayed feedback on research outputs, and irregular one-on-one online interactions with teachers in tracking students' research progress, among others.

With the preceding conclusions, the following were drawn: 1) To assist students in remote research learning, teachers should develop appropriate and customized feedback and updating mechanisms, as well as increase supervision and monitoring; 2) Organize enrichment programs to boost the self-efficacy of students leading to enhanced research performance 3) Research departments in schools should organize regularly scheduled mentoring sessions with the students to review their progress in research; 4) Create a research management plan that provides mechanisms on how to address the concerns and challenges of respondents in conducting research, especially on the resources/facilities aspect; and 4) Congruent studies should be conducted at the regional and national level as primary mechanisms for remote learning during crises.

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