



Difficulty of Science Pre-Service Teachers in their Major Courses (Physics, Biology, Chemistry, Earth Science)

John Marc S. Bugarso*, Geraldine L. Arcenas, Janine M. Galigao, Michael Kennedy G. Camarao

Sultan Kudarat State University, EJC Montilla, Tacurong City, Sultan Kudarat, Mindanao, the Philippines

*Correspondence: E-mail: johnmarcbugarso@sksu.edu.ph

ABSTRACT

This study investigated the difficulty of science pre-service teachers in their major courses. The respondents are the ten purposively selected Bachelor of Secondary Education major in science students of Sultan Kudarat State University - ACCESS Campus. This qualitative research design aimed to determine students' difficulties encountered, study habits, and coping mechanisms. It was revealed that Physics is considered a difficult branch of science, while Biology is less difficult. In Biology, they find difficulty due to the complexity of the topics. In Chemistry, memorization of processes and the availability of learning materials and equipment. In Physics, problem-solving, and computations are most mentioned. In Earth science, memorizing concepts and processes, and performing tasks. Lastly, science instruction is the terms and teaching field of research. Study habits revealed that they are more on visual representation in all major courses. However, in Chemistry and Physics, they practice problem-solving, memorizing formulas, and peer mentoring. For Earth science and science instruction, organizing terms, and revisiting fundamentals are emphasized. Students responded that revisiting lessons, browsing, and watching online videos, peer-teacher mentoring, time management, self-motivation, and rewarding are the coping mechanisms. Science education through integrating appropriate teaching strategies to ease the difficulties encountered by the students.

ARTICLE INFO

Article History:

Submitted/Received 05 Nov 2023

First Revised 29 Dec 2023

Accepted 27 Feb 2024

First Available online 28 Feb 2024

Publication Date 01 Mar 2024

Keywords:

Coping mechanism,
Difficulty in major courses,
Science education courses,
Science pre-service teachers,
Study habits.

1. INTRODUCTION

Learning difficulties or learning disorders are a group of disorders that make it difficult for children to master certain skills or complete certain tasks if they learn conventionally. Learning difficulties are indicated by the existence of certain obstacles to achieving learning outcomes and can be psychological, sociological, or psychological (Simbolon, 2022). Science concepts are critical elements in explaining and understanding natural phenomena across all science disciplines. Several studies reported students' difficulties in learning scientific concepts.

Undergraduate students also suffered similar difficulties in distinguishing the concepts of astronomy and geometrical optics (Kaltakci-Gurel et al., 2017). Dinget et al. (2013) found that students misunderstood the concept of light in an energy context because they had experienced misconceptions in traditional physics learning in the classroom. In chemistry, undergraduate students had identified difficulties in understanding the relationship between molecular bonds and energy (Cooper & Klymkowsky, 2014). Additionally, pre-service science teachers mostly conceptualize heat as a material without evaluating its size or grade (Lewis & Linn, 1994). In biology, students fail to explain feeding relationships as a means of energy transfer in food chains (Hu, 2003). Galvin et al. (2015) also found that student misconception was caused by mistakes in biology classes at the secondary school and college student levels. Chabalengula et al. (2012) also investigated first-year college students concerning their understanding of the concept of science in biology and found that students failed to understand and apply energy concepts to the human body system and feeding relationships to explain life processes using aspects of energy transformation.

Based on Aina (2013), asserted that the teaching of biology, chemistry, and physics in Nigeria has continually suffered from low levels of application of information technology to the learning process with the resultant effect that teachers are largely inefficient and ineffective missing out on critical knowledge that is necessary for the careers and for coping in the knowledge society.

In the Philippines, the educational system has recently shifted from the Basic Education Curriculum to the new Kindergarten to 12 Curriculum. Science is one of the K to 12 Curriculum subjects that have undergone major revisions (Montebon, 2014). In the Programme for International Student Assessment (PISA) some 23% of students in the Philippines attained Level 2 or higher in science, meaning these students can recognize the correct explanation for familiar scientific phenomena and can use such knowledge to identify. However, almost no students were top performers in science, meaning that they were proficient at Level 5 or 6.

Although most research is related to student misconceptions of science concepts across disciplines, only a few studies focus on understanding the inherent difficulty level of items in science concepts in various science disciplines (Liu et al., 2015). Recently, Chen et al. (2014) found the importance of understanding the difficulty level of items in science concepts across science disciplines.

With these aforementioned issues and gaps, we came up with this topic to further study the difficulties of science pre-service teachers in their major courses. This study aims to determine which branch of science the pre-service teachers find difficult, the difficulties they encounter in every branch of science, their study habits, and how they address these difficulties.

2. METHODS

A qualitative research design and purposive sampling strategy were used in this study. The respondents of this study are the ten Bachelor of Secondary Education Major in Science Pre-service Teachers of Sultan Kudarat State University – ACCESS Campus for the academic year 2023-2024. We developed a semi-structured interview to explore respondent's difficulties, perceptions, experiences, and challenges related to their specialization. We gathered the respondents for a one-on-one interview for the data collection procedure and it will be audio-recorded with participants' consent, transcribed verbatim, and anonymized.

We collected data will be transcribed, coded, and thematically analyzed using qualitative data analysis software. Emerging themes will be identified based on participant responses, observations, and document analysis. The analysis will involve an iterative process of coding, comparing, and categorizing data to identify recurring patterns and develop a comprehensive understanding of students' experiences and perceptions.

3. RESULTS AND DISCUSSION

3.1. Branch/Field of Science Do Science Pre-Service Teachers Consider Difficult to Study

In Physics, out of ten respondents, six respondents responded that they consider Physics as a branch of science difficult to study (Respondents 1, 3, 4, 5, 7, and 10). For Chemistry, two respondents responded that they consider Chemistry as a branch of science difficult to study (Respondents 2 and 6). For Biology, two respondents responded that they consider Biology as a branch of science difficult to study (Respondents 8 and 9).

The data analysis supported by the study of [Erinosho \(2013\)](#) that students were found to have difficulty in understanding physics because of the lack of concrete examples and requiring a lot of mathematical manipulations or visualization. With that, Physics is the least preferred science discipline among students. On the other hand, students stated that biology is the easiest subject among science specialization subjects. However, some students have difficulties studying biology for a variety of reasons.

3.2. Particular Topics Do You Find Difficult in That Particular Branch of Science

In Physics, out of six respondents, they have different answers but commonly four respondents respond that they find Quantum Mechanics as a difficult topic of Physics (Respondents 3, 5, 7, and 10). On the other hand, respondents 1 and 4 have different responses to the question. The topics in physics are Special Theory of Relativity (Respondent 1) and Statistical Physics (Respondent 4). For chemistry, respondents have different responses to the question. Respondents said that they found chemical reactions and chemical bonding difficult to understand (Respondent 2) and organic chemistry specifically carbon compounds and reactions (Respondent 6). For Biology, respondents have different responses to the question. Respondent says that they find Microbiology and Parasitology, structure, and names of bacteria (Respondent 8), and Genetics and Mendel's law as difficult to understand (Respondent 9).

It can be said that the participants had the most difficulty in the transition from classical physics to quantum physics. This is especially evident in quantum physics topics that require a different understanding such as black body radiation, wave-particle structure of light, and the uncertainty principle. It was also found that the participants had no difficulties in terms of mathematical calculations and that approaches based on visualizing the topic were

received positively (Kızılçık & Ünlü Yavaş., 2017). College students had difficulty comprehending the problems and hard to plan a solution in Modern physics.

3.3. Factors Involved in Why It Is Difficult to Understand

In Physics out of six respondents, three respondents commonly responded that Student motivation, Interest, learning setting, and learning resources are the factors they consider involved in the difficulties they encountered in understanding (Respondents 3, 4, and 10). On the other hand, three respondents have different responses on the factors they consider involved in the difficulties they encountered in understanding, student's background on the subjects and Teacher availability (Respondent 1), Complexity of the topic, and Student's background on the subjects (Respondent 5), and Lack of time, teaching method and learning setting (Respondent 7). For Chemistry, respondents have different responses to the question on the factors involved why do BSED major in Science Pre-Service Teachers find it difficult to understand? Respondent says that they had trouble due to memorization, learning and student laziness (Respondent 2), Time management, Teacher's teaching behavior, and strategies (Respondent 6). For Biology, respondents have different responses to the question on the factors involved why do BSED major in Science Pre-Service Teachers find it difficult to understand? Respondent says that they had trouble due to Student's Motivation and Interest (Respondent 8) and Teaching Style (Respondent 6).

According to Feral Ogan-Bekiroglu (2009), there are two factors were considered, assessment and teachers' self-efficacy regarding their ability to assess. The difficulties are either external or internal. Internal difficulties depended on pre-service teachers' assessment skills and their subject matter knowledge and represented the difficulties that they encountered during the preparation and evaluation of assessment methods. External difficulties, on the other hand, depended on external factors such as school policy and facilities that might affect pre-service teachers' classroom assessment implementation.

3.4. Branch/Field of Science in Your Program Considered Easy to Understand

In Biology, out of ten respondents, seven respondents responded that they consider Biology as a branch of science easy to understand (Respondents 1, 2, 3, 4, 5, 6, and 7). For Earth Science, two respondents responded that they consider Earth Science as a branch of science easy to study (Respondents 8 and 10). For Chemistry, one respondent responded that he considers Chemistry a branch of science easy to study (Respondent 9).

Unlike other science subjects, biology is expected to perform much better because the subject matter touches on life and life processes that are expected to be interesting and motivating to the learners (Samikwo, 2013). Moreover, Ahmed and Abimbola (2011) argue that because of its numerous importance, Biology is the most popular choice, among science subjects.

3.5. Particular Topic in That Branch of Science Is Easy to Understand

In Biology, out of seven respondents, three respondents commonly respond Animal and Plant Cells as a topic of Biology easy to understand (Respondents 1, 2, and 5). On the other hand, four respondents have different responses to the question. Biochemistry (Respondent 3), Reproductive system (Respondent 4), Ecology and cell molecular biology (Respondent 6), and Human Body (Respondent 7). In Earth Science, respondents responded about Plate Tectonics and Rocks and Minerals as the topics of Earth Science are easy to understand (Respondents 8 and 10).

3.6. Factors Involved Why It Is Easy to Understand

In Biology, out of seven respondents, three respondents commonly respond to Familiarity with the lesson, Interactive, and hands-on learning (Respondents 1, 5, and 7). On the other hand, five respondents have different responses to the question. The factors involved are "Familiarity with the topic (Respondent 2), Teacher teaching strategies and student study habits (Respondent 3), Student's interest (Respondent 4), and Student's interest and teacher teaching strategies (Respondent 6). For Earth Science, respondents have different responses to the question. Respondents say that the factors involved are Students's Motivation and interest (Respondent 8) and the Impact of Resources and Internet Accessibility on Learning (Respondent 10). For Chemistry, respondents respond to the question. The Factor involved is the impact of Teaching Style on Learning (Respondent 9).

According to Çimer (2012), the factors that may help students to easily grasp the lesson are the use of visual materials, teaching through practical work, reducing the content of the curriculum, using various study techniques, teaching through connecting the topics with daily life, and making learning interesting.

3.7. Difficulties They Encountered in Every Branch of Science

In Biology, out of ten respondents, eight respondents responded that they have trouble due to the complexity of the topics (Respondents 1, 2, 3, 4, 5, 6, 8, and 10). For chemistry, respondents have different responses to the question on the difficulties/struggles they encountered. Respondent says that they experienced difficulty due to memorization of different processes (Respondents 1 and 2), also, the connection of topics to other topics (Respondent 3), another inability to understand due to the learning setting (Respondent 5), the complexity of the topics (Respondent 6), the availability of learning materials and equipment (Respondent 7), and the integration of mathematical concepts (Respondent 8). For physics, most of the respondents agreed that they have difficulties in physics due to problem-solving and computations (Respondents 1, 2, 3, 4, and 6). On the other hand, respondent 5 responded that they experience difficulty due to the complexity of the subject. Another is a lack of enough time for class discussion (Respondent 7). For earth science, respondents have different responses to the question on the difficulties/struggles they encountered. Respondent says that they experienced difficulty in different processes (Respondent 1), difficulty grasping (Respondent 2), difficulty memorizing the concepts (Respondent 3), performance tasks (Respondent 5), complexity of the topics (Respondent 7), and familiarization of every concept (Respondent 8). For science instruction, respondents have different responses to the question on the difficulties/struggles they encountered. Respondent says that they experienced difficulty in the terms (Respondent 1), complexity of the topic (Respondent 2 and 6), difficulty grasping the topic (Respondent 3), teaching field or research (Respondent 4 and 5), and effort (Respondent 8).

Many students struggle with biology and believe that the subject is solely about memorizing. Also, certain concepts, are extremely difficult for students to grasp. Besides, according to the study of Oon and Subramaniam (2011), students have been found to have difficulty with the nature of the subject requiring special skills in navigating the variety of learning tasks like using equations/formulas, problem-solving, theoretical/conceptual understanding, spatial reasoning, and experimentation.

3.8. Study Habits and Techniques Across Science Subjects

In Biology, out of ten respondents, three respondents responded that their study habits and techniques are through visual representation (Respondents 6, 8, and 10). On the other hand, seven respondents have different responses to the question. Reading and Watching videos (Respondent 1), Taking notes and watching videos (Respondent 2), Memorization (Respondent 3), Watching videos (Respondent 4), Reading notes (Respondent 5), and Feynman Technique (Respondent 9). For chemistry, all of the respondents have different responses on their study habits and Techniques Across Science Subjects. Reading and Watching videos (Respondent 1), Taking notes, and watching videos, Auditory Learner (Respondent 3), Self-study (Respondent 5), Practice problem solving (Respondent 6), Availability of Learning materials and equipment (Respondent 7), Kinesthetic practice (Respondent 8), Repetition of practice (Respondent 9) and familiarizing the concept (Respondent 10). In Earth Science, out of ten respondents, two respondents responded that their study habits and techniques are through taking down notes (Respondents 2 and 10). On the other hand, eight respondents have different responses to the question. Reading and Watching videos (Respondent 1), Memorization, Remembering, and Understanding skills (Respondent 3), Watching videos (Respondent 4), Reading notes (Respondent 5), Visualization of Learning Materials (Respondent 6), Visual (Respondent 8), Self-conditioning, Organization of terms, Distraction-free setting, and Time management (Respondent 7), Active Recall (Respondent 9). In Science Instruction, out of ten respondents, three respondents responded that their study habits and techniques are through also taking down notes (Respondents 2, 6, 8, and 10). On the other hand, six respondents have different responses to the question. Reading and Watching videos (Respondent 1), Going back to basics (Respondent 3), Watching videos (Respondent 4), Reading notes (Respondent 5), Self-conditioning, Organization of terms, Distraction-free setting, and Time management (Respondent 7), and None (Respondent 9).

According to Erduran and Kaya (2018), one possible strategy to facilitate pre-service teachers' understanding of epistemic aspects of science is visualization. Visual representations of objects and processes can be tools for developing and monitoring understanding.

3.9. Factor/S That Could Affect Study Habits

Out of ten respondents, the majority of their answers are, Laziness (Respondents 1, 2, and 9), Noise/Noise (Respondents 1, 2, 5, and 7), Lack of Motivation (Respondents 8, 9, and 10) and Lack of Time Management (Respondents 3, 4, and 6).

Academic procrastination negatively affects the learning and current and future success of learners. Delays in the beginning and completing tasks will cause misfortune in learning and the person has to learn in inappropriate conditions and with time limits (Steel, 2007). Moreover, this leads to disorder in the learning process and causes accuracy decrease, stress increase, and frequent errors in tasks and the learning process (Steel, 2007). According to studies, procrastination has a relationship with poor academic performance, inability to pass courses, depression, anxiety, low self-esteem, lack of motivation, low effort to achieve success, and neurosis (Bahari & Kheyraadi, 2016). Dişlen (2013) also argued, that students are less motivated and have poor academic performance due to boring lessons and complex tasks without a detailed explanation from the lecturer. The non-cognitive personal behavior i.e., the perspective of students regarding time management is also an effective predictor of educational achievement as with poor time management skills it becomes difficult for students to plan their studies which cause them anxiety and agitation during the assessment

time which usually takes place at the end of the course. Previous studies have determined a positive effect of time management. Time management skills have indicated a positive effect on student learning and associated outcomes. Time management skills have been shown to have a positive impact on student learning and student outcomes (Kearns & Gardiner, 2007) indicating that the ability to successfully manage their time is the benchmark of students in developing better study habits as well as strategies for success.

3.10. Addressing Difficulties/Struggles in Studying the Lesson/Topics in Major Courses

The Respondents have different perspectives; however, some respondents have the same answer. Respondents answered that they can address their difficulties through “Revisiting past Lessons (Respondent 1), Searching online (Respondents 1 and 2), Peer and teacher teaching (Respondents 1 and 4), Watching videos (Respondents 2, 3, and 4), Time management and focus (Respondent 5), and Self-Motivation and Reward (Respondents 8, 9, and 10).

Using videos for learning was instrumental in professors’ teaching productivity and video brought the maximum level of enjoyment (Tang & Austin, 2009). Furthermore, YouTube is the 2nd most visited website in the world, just behind Google. YouTube, a valuable instructional resource, and a teaching supplement can motivate and engage students and assist their digital learning. As a free teaching and learning resource, YouTube is a significant consideration for educational budgets (Burker & Snyder, 2008). Self-reward makes an individual pursue more challenging goals than she otherwise would. And we analyzed how and when different kinds of rewards help the individual overcome a self-control problem. A crucial element of the model is that the promise of a self-reward shapes expectations. The promise of a self-reward conditional on meeting a goal means that buying the good after achieving the goal is something the individual expected to happen, whereas buying it after missing the goal goes against what she expected. Whether expectations are met or not matters. According to Köszegi and Rabin (2006), past expectations become reference points against which people evaluate outcomes, such as the benefit of a good and the price to be paid for it.

4. CONCLUSION

The difficult branch of science that most of the Science pre-service teachers encountered is Physics since it requires problem-solving skills and the complexity of the topic. On the other hand, Biology is an easy subject for students since it is a real-life application of the topic, familiarity with the topic, and accessibility to the topic. The difficulties encountered by the Science pre-service teachers in Biology are due to the complexity of the topics. In Chemistry they encounter struggles in memorization of different processes, connection of topics to other topics, and availability of learning materials and equipment. On the other hand, in Physics, difficulty in problem-solving and computations is most mentioned. In Earth science, difficulty in different processes, difficulty memorizing the concepts, and performance tasks. Lastly, in science instruction. Difficulty in the terms and teaching field of research is highly emphasized. The study habits of science pre-service teachers in studying their major courses revealed that in Biology they are more on through visual representation such as reading and watching videos. For Chemistry, respondents have diverse study habits like reading and watching videos, taking notes, and watching videos, auditory learning, self-study, practice problem-solving, repetition of practice, and familiarizing the concept. For Physics, watching videos, practicing problem-solving, memorizing a formula, and peer mentoring. For Earth

science, taking down notes, reading and watching videos, memorization, organization of terms, and Time management. Lastly, Science instruction, reading and watching videos, going back to basics, taking down notes, and online browsing. The result revealed that the coping mechanisms of students in order to address their difficulties are revisiting of past lesson, searching online, peer and teacher teaching, watching videos, time management and focus, and self-motivation and reward. These coping mechanism helps students to improve their grades and learnings and they can manage their time effectively.

5. ACKNOWLEDGMENT

We would like to express our warmest and deepest gratitude to the people who contributed to this paper. We would like also to commend our validators, and respondents as well as Prof. Brando C. Razon- for his support and effort.

6. AUTHORS' NOTE

The authors declare that there is no conflict of interest regarding the publication of this article. Authors confirmed that the paper was free of plagiarism.

7. REFERENCES

- Ahmed, M. A., and Abimbola, I. O. (2011). Influence of teaching experience and school location on biology teachers' rating of the difficulty levels of nutrition concepts in Ilorin, Nigeria. *Journal of Science, Technology, Mathematics and Education*, 7(2), 52–61.
- Aina, J.K. (2013) Effective Teaching and Learning in Science Education through Information and Communication Technology [ICT]. *IOSR Journal of Research and Method in Education*, 2, 43-47.
- Bahari, A.Z., Kheyraadi, M., and Azimpoor, A. (2016). The Relationship between Personality Characteristics and Academic Procrastination of Students. *Academic Journal of Psychological Studies*, 5(3), 241-247.
- Burker S. C., and Snyder, S. L. (2008). YouTube: An innovative learning resource for college health education courses. *International Electronic Journal of Health Education*, 11, 39-46.
- Chabalengula, V. M., Sanders, M., and Mumba, F. (2012). Diagnosing students' understanding of energy and its related concepts in biological context. *International Journal of Science and Mathematics Education*, 10, 241-266.
- Çimer, A. (2012). What makes Biology learning difficult and effective: Students' views. *Educational Research and Reviews*, 7(3), 61–71.
- Cooper, M.M., and Klymkowsky, M.W., (2013). The trouble with chemical energy: why understanding bond energies requires an interdisciplinary systems approach. *CBE-Life Sci. Educ.* 12 (2), 306–312.
- Dinget, L., Chabay, R., and Sherwood, B., (2013). How do students in an innovative principle-based mechanics course understand energy concepts? *J. Res. Sci. Teach.* 50 (6), 722– 747.
- Dişlen, G. (2013). The reasons of lack of motivation from the students' and teachers' voices. *The Journal of Academic Social Science*, 1(1), 36-45.

- Erduran, S., and Kaya, E. (2018). Drawing nature of science in pre-service science teacher education: Epistemic insight through visual representations. *Research in Science Education*, 48(6), 1133-1149.
- Erinosho, S. Y. (2013). How do students perceive the difficulty of Physics in secondary school? An exploratory study in Nigeria. *International Journal for Cross-Disciplinary Subjects in Education*, 3, 1510-1515.
- Galvin, E., Simmie, G. M., and O'Grady, A. (2015). Identification of misconceptions in the teaching of biology: A pedagogical cycle of recognition, reduction, and removal. *Higher Education of Social Science*, 8(2), 1-8.
- Hu, R., (2003). Students' understanding of energy flow and matter cycling in the context of the food chain, photosynthesis, and respiration. *International Journal of Science Education*, 25(12), 1529-1544.
- Kaltakci-Gurel, D., Eryilmaz, A., and McDermott, L. C. (2017). Development and application of a four-tier test to assess pre-service physics teachers' misconceptions about geometrical optics. *Research in Science and Technological Education*, 35(2), 238–260.
- Kearns, H., and Gardiner, M. (2007). Is it time well spent? The relationship between time management behaviours, perceived effectiveness and work-related morale and distress in a university context. *High Education Research and Development*, 26, 235- 247.
- Kızılcık, H. A. S. A. N., and Ünlü Yavaş, P. E. R. V. İ. N. (2017). Pre-service physics teachers' opinions about the difficulties in understanding introductory quantum physics topics. *Journal of Education and Training Studies*, 5(1), 101-109.
- Kőszegi, B., and Rabin, M., (2006). A model of reference-dependent preferences. *The Quarterly Journal of Economics* 121(4), 1133–1165.
- Lewis, E.L., and Linn, M.C. (1994). Heat energy and temperature concepts of adolescents, adults, and experts: implications for curricular improvements. *Journal of Research in Science Teaching* 31 (6), 657–677.
- Liu, O. L., Ryoo, K., Linn, M. C., Sato, E., and Svihla, V. (2015). Measuring knowledge integration learning of energy topics: A two-year longitudinal study. *International Journal of Science Education*, 37(7), 1044-1066.
- Montebon, D. R. (2014). K12 Science Program in the Philippines: Student Perception on its Implementation. *International Journal of Education and Research*, 2(12), 153-164.
- Ogan-Bekiroglu, F. (2009). Assessing assessment: Examination of pre-service physics teachers' attitudes towards assessment and factors affecting their attitudes. *International journal of science education*, 31(1), 1-39.
- Oon, P-T. and Subramaniam, R. (2011). On the declining interest in physics among students— from the perspective of teachers. *International Journal of Science Education*, 33 727–746.
- Samikwo, D. C. (2013) Factors which influence academic performance in biology in Kenya: A perspective for global competitiveness. *International Journal of Current Research*, 5(12), 4296-4300.

- Simbolon, D. (2022). Studi kesulitan belajar siswa sd advent 6 medan dalam belajar IPA. *Pendidikan, Saintek, Sosial dan Hukum (PSSH)*, 1, 1–14.
- Steel, P. (2007). The nature of procrastination: A meta-analytic and theoretical review of Quintessential Self-Regulatory Failure. *Psychological Bulletin*, 133(1), 65-94.
- Tang, T. L. P., and Austin, M. J. (2009). Students' perceptions of teaching technologies, application of technologies, and academic performance. *Computers and Education*, 53(4), 1241-1255.