

Science Teacher Competence and Implementation of Authentic Learning Approach in Online Learning Modality and Student Academic Performance in Science

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ABSTRACT

The science curriculum is designed to be learner-centered, constructivist, and inquiry-based, using evidence to build explanations. This study aimed to investigate the competence level of teachers in the implementation of an authentic learning approach. It employed a quantitative descriptive correlational design using an online survey among grade 10 junior high school science teachers and students from seven (7) private schools in Butuan City during the academic year 2021-2022. Results consistently indicated high teaching competence among science teachers in most schools; however, certain indicators such as gamification, Phet simulations, and conducting small-scale research still need to be implemented in some schools. Significant differences in competence and implementation of authentic learning approach were noted based on schools, attributed factors such as the use of learning management system, resource availability, and online training for teachers. Moreover, a significant relationship was found between the competence of teachers and the implementation of an authentic learning approach. The study also found a commendable level of proficiency in the academic performance of students. However, no significant relationship was observed between teacher competence and the implementation of an authentic learning approach to students' academic performance. These findings suggested that students cultivated a sense of independence in their learning process. It emphasized that empowering students to take ownership of their learning journey and leveraging teachers' expertise as facilitators lays the foundation for enhanced academic success in science education.

KEYWORDS

teacher competence; authentic learning approach; online learning modality; student academic performance

INTRODUCTION

The K-12 Science curriculum is learner-centered, constructivist, and inquiry-based, emphasizing facts and evidence in constructing explanations. Science curriculum must represent the real world to make scientific ideas more accessible and engaging. One approach that is said to be effective for students' success is the Authentic Learning Approach. According to Yeen-Ju et al. (2015) and Redmond et al. (2018), this approach connects students to real-life situations and encourages higher-order thinking skills development. Recently, the COVID-19 pandemic compelled teachers to exhibit greater ingenuity, creativity, and resourcefulness to sustain the learners' engagement. As highlighted by Darby

and Liang (2019), the challenge of teaching science subjects online is how to ensure that the students can comprehend the lessons, concepts, and terms to be used in everyday living. Ancho and Serbo (2019), stated that when teachers fail to connect the lesson to the outside world, some students may struggle to connect with reality.

The shift to online delivery presented challenges to educators in the Philippines (Mamidted and Maulana, 2023). This included having to redesign lessons and assessments, the limitations on technological resources, and the decreased social interactions among teachers and learners. DepEd Order No. 42, series of 2016, provided guidelines for lesson preparation, which emphasized the importance of aligning lessons with real-life experiences and promoting inquiry-based and learner-centered approaches. This aligned with the need for authentic learning experiences during online classes. Additionally, the implementation of online learning during the COVID-19 pandemic was guided by DepEd Order No. 12, s. 2020. This outlined the adoption of the Basic Education Learning Continuity Plan and acknowledged the challenges faced by teachers, students, and parents in adapting to the new learning modalities.

In addition, Geverola et al. (2022) reveal in their study about science teachers' experience during the new normal in the Philippines that despite the efforts of the administrators and teachers to continue student learning, science teachers still struggle to develop an engaging academic discussion in online learning. It is known that a significant number of students have limited to no access to gadgets and internet connections to facilitate online learning. Moreover, the students find difficulty in following the schedule of online classes. In turn, this affected the delivery of the lessons and student learning.

Additionally, in the study of Martinez-Alcala et al. (2021), it was found that the pandemic necessitated teachers in the Philippines to carry on multiple roles. They were not just teachers and advisers, but they were also counselors, IT practitioners, and content creators of video materials. It is only reasonable that teachers should receive further support in enhancing teaching competence to improve student learning.

Liu et al. (2022) stated that teachers' competence primarily refers to their self-efficacy and enthusiasm for teaching, which directly controls their professional engagement and teaching activities. A competent teacher could help the students become scientifically literate, which could produce well-informed, active citizens capable of applying their knowledge to make positive impacts in their social, physical, or environmental well-being. Teachers must be assessed for their competence and capabilities to teach science virtually.

The science teachers in private schools of Butuan City expressed the same view that schools experience difficulties in handling student engagement on top of the technological struggles in carrying out virtual classes. The teachers' needs were addressed to meet the basic needs of the students. These fundamental requirements include access to educational online resources, seminars, training, and other administrative support that may enhance their competence to teach online science classes.

Determining the level of teachers' competence and implementing an authentic learning approach of the junior high school science teacher's enhancement program will create an opportunity for schools to enhance online learning and can still be deemed useful even when schools are back in a face-to-face classroom setting.

LITERATURE REVIEW

The theoretical framework for this study integrates the constructivism theories of Piaget and Bruner to explore the relationship between teachers' competence and the implementation of the Authentic Learning Approach.

According to Piaget, constructivism is a learning theory emphasizing learners' active construction of knowledge through interactions with the social and physical world. Piaget's theory suggests that students are not passive recipients of knowledge but actively build their understanding by integrating new information with their existing knowledge and experiences. In the context of this study, teachers who embrace constructivist principles recognize the importance of engaging students in active learning experiences, encouraging them to explore, question, and construct their knowledge. By implementing the Authentic Learning Approach, teachers provide students with authentic, real-world tasks and contexts that promote active construction of knowledge and the development of higher-order thinking skills.

Similarly, Bruner's constructivism emphasizes that learning is an active process where students construct new ideas or concepts based on their existing knowledge and experiences. Bruner suggests that learners utilize cognitive frameworks, such as schemas and mental models, to organize and make meaning of information. In the context of this study, teachers who adopt the Authentic Learning Approach provide opportunities for students to engage in problem-solving, critical thinking, and collaboration actively. By integrating real-world scenarios and tasks into their teaching, teachers facilitate students' active construction of knowledge and support the development of their cognitive frameworks.

In this study, the constructivism theories of Piaget and Bruner serve as a theoretical foundation to examine the relationship between teachers' competence and the implementation of the Authentic Learning Approach. Teachers' competence refers to their knowledge, skills, and abilities to effectively design and facilitate authentic learning experiences. By embracing the constructivist principle, teachers create a learner-centered environment that fosters students' active engagement, critical thinking, and application of knowledge in real-world contexts. The implementation of the Authentic Learning Approach provides opportunities for students to develop their cognitive frameworks, construct meaningful knowledge, and enhance their academic performance in science.

By applying the constructivism theories of Piaget and Bruner, this study aims to explore how teachers' competence and the implementation of the Authentic Learning Approach impact student learning outcomes in science. It seeks to identify the factors that influence teachers' competence, the strategies employed in implementing the Authentic Learning Approach, and the effects on students' academic performance. Through this investigation, the study aims to provide valuable insights and recommendations to enhance teachers' competence and improve the implementation of the Authentic Learning Approach in science education.

The study aimed to determine the level of teachers' competence of Grade 10 private junior high school science teachers within Butuan City and the implementation of an Authentic Learning Approach to the student's academic performance in online learning classes.

RESEARCH METHODS

Research Design

This study utilized a quantitative descriptive correlational design using an online survey technique to determine the levels of science teachers' competence and the level of implementation of the Authentic Learning Approach in private junior high schools in Butuan City in an online learning modality. The student Grade Point Average (GPA) in science subjects collected by the researcher served as the student's academic performance.

Research Instrument

The researcher used an adapted survey questionnaire as the primary tool in data collection, which was modified to suit the intended respondents. The questionnaire contained three (3) important parts; the first part would determine the teachers' demographic profile. The second part was adapted and had 24 indicators with eight (8) items each for engagement, instructional strategies, and classroom management. Finally, the third part, adapted from Baskaran & Abdullah (2020), determined the teachers' readiness to implement the Authentic Learning Approach in terms of the teachers' knowledge (14 items), skill (6 items), attitude (10 items), and interest (7 items). The researcher asked permission from the author through email and allowed the researcher to use the instrument.

Since modifications of the questionnaire were done, the instrument used in this study was subjected to content validation by a school principal, a science subject coordinator, and a dean of research. For reliability, the instrument underwent a pilot testing process to ensure correctness and consistency. The result of the pre-testing process was analyzed adopting Cronbach's alpha with a very high result when piloted with teachers, teacher competence ($\alpha = 0.919$), and implementation of the Authentic Learning Approach ($\alpha = 0.961$). From among the students, the results yielded teacher competence ($\alpha = 0.975$) and implementation of the Authentic Learning Approach ($\alpha = 0.974$).

Sampling Technique

In this study, the teacher-respondents were chosen through a purposive sampling technique. A simple random sampling method was employed to select the student respondents. The respondents were chosen based on the following criteria: For teachers, respondents are those teachers who are handling science subjects in grade 10 only in the current school year and have no administrative functions. For students, respondents are those who are Officially enrolled in grade 10 in the school year 2021-2022.

Ethical Considerations

Several important ethical concerns had specific implications for this quantitative investigation. These concerns primarily stemmed from the study's methodology. The ethical challenges relevant to this research pertained to the right to conduct the study, confidentiality, and anonymity.

To adhere to ethical standards, the researcher followed specific study protocol assessments to manage data collection while adhering to standardized criteria, including but not limited to: Voluntary Participation. Teachers and Students from selected schools were given the freedom to participate without facing any consequences, penalties, or loss of benefits. The researcher carefully explained the purpose and benefits of the study to the participating schools, considering the rights of the respondents to contribute to the body of knowledge. As a result, respondents' participation in the research was entirely voluntary, and they had the right to withdraw from the study at any stage if they wished to do so.

Privacy and Confidentiality. Personal information collected from the respondents was kept confidential to ensure anonymity. The researcher made sure that the study's findings did not reveal any specific representation from any of the respondents.

Informed Consent Process. Respondents were not blindly informed of their voluntary participation. The researcher transparently explained that participants were free to skip any survey questions they were uncomfortable with or discontinue their participation if they chose to. During the interview orientation, it was emphasized that there would be no penalties or loss of benefits for discontinued participation. However, participants were made

aware that their contribution could significantly contribute to the growing body of knowledge about the variables under investigation.

No Inducement. The researcher did not use their cultural or professional status, excessive compensation, or implied increase in healthcare to influence the participants' decisions. The main goal was to ensure that participants fully understood all the provided information, and informed consent was obtained by presenting the necessary information clearly for the participants to make an informed decision.

Failure to follow these procedures could have resulted in the compromise of the study, leading to wasted opportunity, time, and resources. The primary objective was to obtain ethical consent from participants while ensuring their understanding of the study's purpose and procedures.

Research Environment, Population, and Sample

The study was conducted in private high schools in Butuan City. Butuan City is a highly urbanized city in the Philippines and the regional center of the Caraga Region. The city is in the northeastern part of Agusan Valley, Mindanao, and sprawling across the Agusan River.

School A is a non-profit educational institution. The school offers nursery, kindergarten, and junior high school (grades 7-10). The school had a population of eighteen (18) students in grade 10 and one (1) newly hired science teacher with a bachelor's degree in teaching science. The science teacher also handles multi-level subjects like science in Grades 6, 7, 8, and 9. The school used social media, which that served as a way for students to submit their outputs and quizzes. The school had a subscription for their platform for their online lectures and discussions. Only one hour per week is allotted for synchronous classes, while four days are allotted for asynchronous lessons.

School B offers kindergarten, preschool, and elementary (grades 1-6), junior high school (grades 7-10), and senior high school (grades 11-12) strands: ABM, GAS, HUMSS, and STEM. The school had thirty-one (31) grade 10 students in the Academic Year 2021-2022 and one (1) science teacher with a bachelor's degree in teaching science and four years of teaching experience in science. The school's internet provider is PLDT. The school utilized a learning management system, which provides ready-to-use lessons and activities, and the teacher's task is to do the lecture and facilitate the submission of student outputs only. Schools also use an online platform for online discussions and meetings. The teacher had to meet the students twice weekly for one hour in their science class.

School C is a non-stock institution that offers nursery, kindergarten, junior high school (grades 7-10), and senior high school (grades 11-12) or General Academic Strand (GAS). The school has eighteen (18) students in grade 10 in Academic Year 2021-2022 and one (1) newly hired science teacher with a bachelor's degree in teaching science. Teachers were given a load allowance for their internet when working from home. The school did not utilize learning Management system but used a social media app for submission of outputs and assessments. The schedule of classes is daily, with a one-hour allotment for each subject through an online app meeting. Every Friday is allotted for weekly assessment.

School D is a school with a total population of 588 students. It offers preschool, elementary (grades 1-6), junior high school (grades 7-10), and senior high school (grades 11-12). The school has thirty (30) students in grade 10 in the Academic Year 2021-2022 and one (1) science teacher with a bachelor's degree in teaching science and waiting to take the Licensure Examination for Teachers. The school had a stable internet connection during the time of the pandemic. The school utilized and provided a Learning management system that was used by teachers for the presentation of the lesson, giving assessments, and where the

students submit their outputs and answer their quizzes and assessments. The school also had an online application subscription for online meetings, online lectures, and discussions. Also, teachers are supplied with a 250 pesos per month internet load allowance when working from home. The online class schedule during the pandemic was four days per week, one hour for each meeting per subject.

School E offers preschool, elementary, junior, and senior high school. The school has one-hundred sixty (160) students in grade 10 in Academic Year 2021-2022 and (2) science teachers with bachelor's degrees in teaching science. One of the Science teachers in grade 10 has earned a master's unit in teaching science. The school utilized and provided the teacher and student an account for a known Learning Management System that was also used by big universities in the Philippines. The school also had a subscription to an online application platform and provided each teacher with an account and used it for every online meeting. Teachers do not have a load allowance but are given an internet allowance through an economic subsidy. Online synchronous classes in this school were held twice a week for one hour. Science teachers in this school utilized instructional strategies, like Phet Simulation and other science activities, to make the science subject more engaging and interesting.

School F is a non-sectarian academic institution that provides a holistic learning environment from preschool to senior high school. The school has one hundred thirteen (113) students in grade 10 and one (1) science teacher during the Academic Year 2021-2022. The school had an internet connection that was always very good. The school used a Learning Management System where students submit their outputs. A teacher used an online application platform for online meetings and discussions. Teachers were also provided a 500 pesos allowance and were required to work from home. The schedule of online classes is two (2) times a week for one (1) hour per subject.

School G is a non-stock and non-profit educational institution offering nursery, kindergarten, elementary (grades 1-6), junior high school (grades 7-10), and senior high school (grades 11-12). The school has eighteen (18) students in grade 10 and one (1) science teacher, newly hired and a fresh graduate with a bachelor's degree in science. The science teacher also handles multi-level science subjects in grades 8, 9, and 10. The school used a known Learning Management System, the same as school B, that provides teachers and students with all the lessons and activities. Teachers were given an online application account for the platform used in online classes. The teacher will only meet the students twice weekly for one (1) hour and thirty (30) minutes. The school only caters to a small population; most enrollees are non-Catholics.

Data Gathering Procedure

Letters were given to the private school principal, and the researcher discussed the scope and objectives of the study with them. Upon approval, the researchers contacted the science teachers via e-mail, messenger, and face-to-face. The survey questionnaire was sent online through google forms to the science teachers, and the teacher was the one who sent it to the students through their group chats.

The survey questionnaires were answered by the teachers and students independently. Further, they were given enough time to analyze each indicator. They were ensured with confidentiality of their answers to gather reliable responses. The quantitative treatments of the data gathering were then tabulated and analyzed.

Statistical Treatment of Data

The data gathered in this study were statistically treated using descriptive and inferential statistics. The following statistical measures were used to facilitate the data collected:

Weighted mean was used to assess the level of science teachers' competence and implementation of the Authentic Learning Approach. It is calculated to know the level of teachers' competence in each school and by respondents.

Descriptive Statistics (average) are tools used to summarize and describe the dataset of students' grade point averages for the student's academic performance and its percentage. An independent sample t-test was used to compare the means of two independent groups, such as the teachers' and students' responses in this study. The independent sample t-test was used to determine whether the means of the two groups (teacher and students) if responses were significantly different between schools and between student and teacher respondents.

Kruskal-Wallis test was used to compare several independent random samples and can be used as a nonparametric alternative to the one-way ANOVA. This Test was used to compare the responses when classified by schools for each indicator in every variable. Dwass-Steel-Crithlow-Fligner Test This test was used after significance was found from the Kruskal-Wallis Test. This test reveals what schools differ in a certain indicator in every variable.

Pearson product-moment correlation (Pearson-r) was used in this study to determine the relationship between teachers' self-efficacy and the Authentic Learning Approach. This test was also used to assess the relationship between teachers' self-efficacy in student academic performance and the implementation of an Authentic Learning Approach to student academic performance. All statistical tests were set at a 0.05 level of significance.

RESULTS AND DISCUSSION

The results reveal varied levels of teachers' competence in instructional strategies, virtual classroom management, and student engagement in teaching science. Teachers' instructional strategies ranged from high to very high, with a notable gap between schools with and without learning management systems (LMS). The use of LMS allowed for more engaging and accurate assessments, enhancing the overall learning experience. Conversely, schools lacking LMS faced challenges in implementing authentic activities effectively. Virtual classroom management also varied significantly, with constructive feedback highlighted as an area needing improvement, especially in larger classes. Some teachers successfully managed large and small classes by planning meticulously and adopting innovative methods. Student engagement was generally high, although limited face-to-face interaction during online classes posed challenges. Despite technological issues and logistical constraints, teachers remained committed to encouraging participation and supporting student learning. The implementation of the Authentic Learning Approach showed high knowledge and skill levels, though some indicators like time management and the development of assessment rubrics needed enhancement. Teachers demonstrated a positive attitude towards this approach, recognizing the importance of relating science lessons to real-life situations and continuously improving their teaching methods. However, interest levels varied due to factors like school support, class schedules, and the use of LMS. The analysis indicated.

Instructional Strategies

Teachers' instructional strategies ranged from high to very high, with a notable gap between schools with and without Learning Management Systems (LMS). One school (A) scored the lowest mean (3.06) in instructional strategies, categorized as "high," while another school (G) achieved the highest mean (3.67), categorized as "very high." Overall, teachers demonstrated proficiency in various online instructional strategies, but gamification was limited. The mean scores for the use of gamification were the lowest at 3.06 and 3.32, indicating limited application. However, teachers ensured coverage of essential science competencies, which was highly rated with means of 3.33 and 3.60.

Virtual Classroom Management

Virtual classroom management varied significantly, with constructive feedback highlighted as an area needing improvement, especially in larger classes. The lowest mean observed was for the indicator "give students constructive and formal feedback about their timely outputs." Some schools have adopted LMS that includes sections for student feedback, but not all students read the feedback. Despite these challenges, some teachers successfully managed large and small classes by planning meticulously and adopting innovative methods. High mean scores were observed for indicators such as organizing and planning science lessons and setting up virtual classroom routines.

Student Engagement

Student engagement was generally high, although limited face-to-face interaction during online classes posed challenges. One school (A) obtained the lowest mean (3.17) in student engagement, though it still falls within the "high" level of teachers' competence. Teachers faced difficulties balancing their personal lives and work during the pandemic, impacting their responsiveness to students' queries. Despite technological issues and logistical constraints, teachers remained committed to encouraging participation and supporting student learning. Teachers' efforts were evident in the high overall mean scores for engagement indicators, despite occasional frustrations due to internet connectivity issues.

Implementation of the Authentic Learning Approach

The implementation of the Authentic Learning Approach showed high knowledge and skill levels, with overall means of 3.62 and 3.56 in knowledge, and 3.70 and 3.62 in skills. However, some indicators like time management and the development of assessment rubrics needed enhancement. Teachers demonstrated a positive attitude towards this approach, recognizing the importance of relating science lessons to real-life situations and continuously improving their teaching methods. The overall attitude towards the implementation was positive, with the majority of indicators rated "always." However, interest levels varied due to factors like school support, class schedules, and the use of LMS. The indicators "understanding the structure of the science curriculum" and "encouraging students to relate real-life experiences to science topics" received the highest means.

Significant Differences in Implementation and Perception

The analysis indicated significant differences in the implementation of the Authentic Learning Approach among the schools in terms of knowledge (P-value <0.001), skills (P-value 0.018), and attitude (P-value 0.006), but not in interest (P-value 0.133). Additionally, significant differences were found in instructional strategies (P-value 0.007), virtual

classroom management (P-value 0.002), and student engagement (P-value <0.0001) among the seven schools. These differences were attributed to varying utilization of LMS and online instructional resources.

Academic Performance of Students

The academic performance of students in science subjects varied among the schools. School B had the highest average (93.06, "Outstanding"), while School E had the lowest average (86.71, "Very Satisfactory"). Overall, the performance was very satisfactory, with an overall average of 89.03, indicating effective online learning implementation. This suggests that online learning has been effective in supporting student academic performance in science among the private junior high schools in Butuan City.

Relationship Between Teachers' Competence and Student Performance

The study found no significant correlation between teachers' self-efficacy and student academic performance in instructional strategies (P-value 0.537), virtual classroom management (P-value 0.525), or student engagement (P-value 0.845). Similarly, there was no significant relationship between the level of implementation of the Authentic Learning Approach and students' academic performance in knowledge (P-value 0.614), skills (P-value 0.490), attitude (P-value 0.745), or interest (P-value 0.839).

Proposed Enhancement Program

The study suggests a two-day training workshop aimed at enhancing teachers' competence and implementation of authentic learning approaches in online science education. The program aims to improve instructional strategies, virtual classroom management, and student engagement through the use of gamification, virtual science manipulation, and other interactive online lessons. This training will be targeted at private junior high school science teachers in Butuan City and will require a budget of 13,500.00 PHP, proposed for funding and implementation by the Butuan City Private Schools Association.

Overall, the results emphasize the importance of enhancing teachers' competence, providing adequate resources, and addressing time management challenges to ensure the effective implementation of authentic learning approaches in online science education.

CONCLUSION

Schools faced challenges in fully adopting and applying authentic learning methods in their science classes. The level of implementation varied among different schools. Nevertheless, teachers who exhibited higher levels of confidence and competence in teaching science are more likely to successfully incorporate diverse, authentic learning activities into their science lessons.

Enhancing teachers' competence in teaching science is crucial as it directly correlates with their ability to implement and facilitate authentic learning approaches in online classrooms. Moreover, this approach nurtures students to become more independent and responsible in solving real-life problems, which will benefit the students. It is essential to focus on developing teachers' skills and expertise to create a conducive and effective learning environment that promotes authentic learning experiences for students.

RECOMMENDATIONS

Given the findings and conclusions derived from the study, the following recommendations are offered for consideration:

The school administrators should send science teachers to training workshops or design a school-based training program to enhance teachers' competence and design the integration of authentic activities in science lessons in an online class.

Science teachers should further develop their time management skills and confidence in integrating small-scale research in science class so that students can explore and integrate their learnings into real-life world problems.

Science teachers should improve their technological skills and online instructional strategies carefully so they can select technical resources.

Future researchers should conduct parallel studies of wider scope and bigger populations to know the status and competence of science teachers in online learning modality.

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