EXPLORING THE ROLE OF SCIENCE ENGAGEMENT AND LEARNING INTERACTION IN ACQUIRING 21ST-CENTURY SKILLS OF GRADE 7 ONLINE DISTANCE LEARNERS

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ABSTRACT

This study examined the influence of Science engagement and learning interaction of Grade 7 online learners’ acquisition of 21st-century skills and Science achievement. Seventy-six (76) Grade 7 online learners of San Pablo City Integrated High School served as respondents of the study to find a correlation between 21st-century skills (communication) and Science achievement in student-teacher interactions using descriptive and inferential statistics. Accordingly, findings revealed that student-teacher interaction is a significant mediator in the relationship between Science engagement and Science achievement. The correlation results showed that the perceived online Science engagement (cognitive, affective/emotional, and behavioral) and learning interaction (student-student, student-content) have no significant relationship to the acquired 21st-century skills (critical thinking, creativity, and communication) and Science achievement of the respondents. Moreover, student-teacher interaction significantly influences Science engagement. The presence of the teacher does influence learner's outcome in acquiring 21st-century skills. The mediated variable, learning interaction (student-teacher), partially mediated the influence Science engagement has on Science achievement. Thus, considering the study’s findings and conclusions, it is recommended that schools must invest in online learning environments that improve learning and teaching outcomes. Enable online engagements, and stimulate connections with peers, teachers, and the institution. Foster Science and 21st-century skills, add student online engagement and learning interaction data that can guide school-wide activities, and lastly have multiple sources to facilitate a more profound understanding among online students.

Keywords: 21st-Century Skills, Learning Interaction, Science Achievement, Science Engagement

INTRODUCTION

Many students struggle to meet their academic objectives given the abrupt transition of the Philippine educational system to online learning as one of the favored subtypes of distance learning. In addition to the use of distance learning and the accessibility of technology, other variables like student interaction and learning engagement may have an impact on how well they complete their courses.

The unanticipated shift to remote teaching during early 2020 shined a direct spotlight on the demand for educators to have a reasonable appreciation of the value of distance education (Harris, 2020). Distance education is currently in
demand by numerous institutions. The Department of Education (DepEd) sought an effective method of delivering education to learners without face-to-face interactions. DepEd suggested online distance learning (ODL), where lessons would be held remotely via internet platforms (Bajaro et al., 2021).

According to Martin and Bolliger (2018), there are three learning interactions in an online setting: interaction between students, teachers, and content. Data suggests that these interactions may help students become more involved and engaged in learning. As depicted by Anderson (2003) interaction develops student engagement, and increasing engagement is critical in online learning. The essential dimensions of engagement — behavioral, affective, and cognitive — have been used to identify the fundamental components of student involvement.

Nowadays, there has been a more considerable change in emphasis on teaching "21st-century skills," specifically through science education. The "Four C's" of creativity, critical thinking, communication, and collaboration are among them, while Science, at its core, is about curiosity, innovation, and collaboration. On that account, when Science is presented in a participatory, inquiry-based manner, students learn to examine difficulties, assess concepts, and show the results obtained to one another, as mentioned by Fazzino (2017).

Vilia et al. (2017) expounded that Science education is crucial because of its relevance in motivating students to pursue technology occupations deemed necessary in modern cultures to meet scientific development issues. Likewise, students' academic achievement is a critical indicator when designing and planning educational interventions at the national (e.g., curriculum definition) and classroom levels (teaching strategy).

Distance education is beneficial, and this trend is here to stay and will only grow in the near future (Sadeghi, 2019). However, there are a few notable unfavorable perceptions of the distance education system, such as limited engagement, infrastructural issues, and a lack of equipment (Hebecic et al., 2020). Another major issue with online learning is a lack of engagement with teachers, which adds to a high dropout rate when combined with students’ low levels of interactions (Lee & Choi, 2011). Moreover, it is noteworthy to mention that improving learner interactions with instructional activities is a critical challenge in online learning. Lastly, the Philippines fared in the low 70s in the 2018 Program for International Student Assessment (PISA). As opposed to the 489 OECD average, Filipino students performed poorly in both Mathematics and Science, scoring 353 and 357 points, respectively, as documented by (Magsambol, 2020).

Although taking classes online is becoming increasingly prevalent, it is crucial to keep in mind that not all students are successful in this environment. Some students may lack the engagement and discipline required to control their progress in online classes, which may influence their academic success, as claimed by (Kelani et al., 2021).

With the preceding discussions in mind, the researchers were prompted to determine if Grade 7 online students effectively acquire 21st-century skills by exploring the role of science engagement and learning interactions.

Referring to the model, the independent variable is as follows: Science Engagement components (cognitive, affective/emotional, and behavioral). On the other hand, the mediator variable comprises Learning Interaction dimensions (student-student interaction, student-teacher interaction, student-content interaction, and student-context interaction).
teacher interaction, and student-content interaction). Lastly, the dependent variable refers to the Learner’s outcomes, including the acquisition of 21st-century skills (critical thinking, creativity, and communication) and Science achievement measured by the student's performance on a competency-based achievement test.

OBJECTIVE OF THE STUDY

This study sought to determine if there is a significant relationship between the Science Engagement and Learning Interaction Dimensions and how these are correlated with the acquisition of 21st-century skills (Critical Thinking, Creativity, and Communication) and improvement in the Science achievement of Grade 7 online students at San Pablo City Integrated High School during the third quarter of the School Year 2021-2022.

METHODOLOGY

This research study is quantitative in nature. This study aimed to look into the link between online Science engagement and learning interaction in obtaining 21st-century skills and improving the Science achievement of Grade 7 online learners in San Pablo City Integrated High School. It was carried out throughout the 2021-2022 school year with the participation of seventy-six (76) online students. As highlighted in the invitation notification that was posted to each respondent's Google Classroom, participation in the research study was completely voluntary. Respondents in this study had complete discretion to opt in or out of the study at any point in time. Prior to participating in the study, each respondent was provided with a comprehensive explanation of the objectives, benefits, and potential risks of the research. As a strict agreement to participate in the study, respondents needed their parents’ consent beforehand. All responses, including any personal information, were kept confidential, and the data that were gathered digitally was stored in a secured computer file.

The researchers adapted two survey questionnaires on Science engagements and learning interactions. In addition, it was crafted with a forty-five (45) items covering five (5) learning competencies in Science 7 during the third quarter period.

The research study has two significant phases: developing and administering the survey questionnaires and the competency-based achievement test. Prior to the completion of the final research instruments, the questionnaires and achievement tests were validated by the selected expert in the education field.

Descriptive and inferential statistics were utilized in this research to provide meaning to the set of data gathered (Panoy, 2017). To determine the extent of learning interaction's mediating effect on the relationship between Science engagement and Science achievement, the researchers utilized Process Macro v4.1.

RESULTS AND DISCUSSION

1. Respondents’ Perceptions of Science Engagement in Cognitive, Affective/Emotional, and Behavioral Engagement

Table 1 presents the Respondents’ Perceptions of Science Engagement as to Cognitive, Affective/Emotional, and Behavioral Engagement. It is found that students are more “engaged” in Science in their behavior than in the other Science engagement dimensions. This might suggest that behaviorally engaged online students are more attentive, participatory, committed, and respectful in synchronous sessions. However, data demonstrate that affective/emotional engagement garnered the lowest mean score of 4.02. This might be attributed to the fact that, even when students
communicate or interact with others during online sessions, there is a lack of emotional quotient, popularly known as "E.Q."

2. Respondents' Perception of the online learning interaction as to student-student, student-teacher, and student-content dimension

Table 2
Respondents' Perception of the online learning interaction

| Learning Interaction dimensions | Mean  | Standard Deviation | Verbal Interpretation |
|---------------------------------|-------|--------------------|-----------------------|
| 1. Student-Student              | 4.13  | .575               | Agree                 |
| 2. Student-Teacher              | 4.46  | .499               | Agree                 |
| 3. Student-Content              | 4.27  | .566               | Agree                 |
| Overall                         | 4.29  | .547               | Agree                 |

Table 2 reveals that the students have "engaged" in online Science classes in terms of learning interaction. The students' perceptions of the various learning interaction dimensions during distance learning in Science were consistent, as indicated by the mean scores obtained. According to the collected data, the student-teacher dimension got the highest mean score based on the students' perceptions. This indicates that an established relationship between students and teachers is highly needed due to the restricted opportunities for face-to-face interactions presented by online learning.

3. Summary of the Respondents' 21st-Century Skills acquisition

Table 3
Respondents' 21st-Century Skills acquisition

| Critical Thinking | Creativity | Communication |
|-------------------|------------|---------------|
| f     | %          | f    | %          | f    | %          |
| 74% and below     | 3          | 4.0  | 4          | 5.3  | 2          | 2.7  |
| 75-79%            | 5          | 6.7  | 1          | 1.3  | 4          | 5.3  |
| 80-84%            | 12         | 16.0 | 4          | 5.3  | 16         | 21.3 |
| 85-89%            | 20         | 25.7 | 6          | 8.0  | 17         | 22.7 |
| 90% and above     | 35         | 46.7 | 60         | 80.0 | 36         | 48.0 |

Total: 75 100 75 100 75 100

Table 3 illustrates the achievement test performance of Grade 7 online learners and their level of 21st-century skills acquisition in terms of critical thinking, creativity, and communication. Regarding critical thinking skills, the respondents displayed 46.7% of the achievement test score under the Advanced level (90% and above), and only 4.0% achieved the Beginning level (74% and below). This explains that 35 out of 75 respondents have advanced development in terms of critical thinking skills acquisition, whereas only 3 respondents are only beginning to demonstrate this skill.

In terms of Creativity skills, 80% or 60 out of 75 respondents exhibited achievement test results at the Advanced level, as opposed to just 5.3% and 1.3% for the Beginning and Developing levels, respectively. This indicates that 4 out of 75 respondents are at the Beginning level, and only 1 respondent is under the Developing level. The findings suggest that the students were capable of analyzing, problem-solving, organizing, and illustrating fresh perspectives. Most Grade 7 online learners developed Communication skills, as demonstrated by the data from their accomplishment tests. In fact, sixteen or 21.3% attained the level of Approaching Proficiency, seventeen or 22.7% displayed Proficient level, and forty-eight percent, or 36 out of 75 respondents, achieved the level of Advanced in terms of communication skills. This implies that most Grade 7 online learners interact well by utilizing digital media to facilitate individual and group learning through the efficient and effective sharing of information.

4. Respondents' Level of Science Achievement

Table 4
Level of Science Achievement

| Science Achievement | f   | %  |
|---------------------|-----|----|
| 74% and below       | 1   | 1.3|
| 75-79%              | 2   | 2.7|
| 80-84%              | 5   | 6.7|
| 85-89%              | 22  | 29.3|
| 90% and above       | 45  | 60.0|

Total: 75 100
The overall level of science performance as measured by a competency-based achievement test is presented in Table 4. The data indicate that 89.3% of respondents had verbal interpretations of "Proficient" and "Advanced" within the range of 85-100. This transpired despite the absence of a traditional school day’s structure owing to the pandemic and quarantine procedures. Moreover, enhancing student participation and developing relationships amongst students during online classrooms has been demonstrated to assist struggling students.

According to the findings, it is conceivable to assume that the seventh-grade students who took their science class online achieved a level of competence that ranged from proficient to advanced based on how well students performed on the competency-based achievement test.

5. Correlation between the Perceived Online Science Engagement and Learning Interaction Dimensions and the 21st Century Skills Acquisition and Science Achievement

Table 5
Correlation between the Perceived Online Science Engagement and Learning Interaction Dimensions

| Science Engagement                | 21st-Century Skills | Science Achievement |
|-----------------------------------|---------------------|---------------------|
|                                   | Critical Thinking   | Creativity          | Communication |
| Cognitive Engagement              | .006                | -.039               | .123          | .036         |
| Affective/Emotional Engagement    | .160                | -.016               | .085          | .055         |
| Behavioral Engagement             | .015                | .002                | .052          | .030         |
| Learning Interaction Dimensions   |                     |                     |               |
| Student-Student                   | .021                | -.016               | .191          | .082         |
| Student-Teacher                   | .184                | -.137               | .279*         | .257*        |
| Student-Content                   | .010                | .012                | -.185         | .088         |

*Correlation is significant at the 0.05 level (2-tailed).

The test of relationship between the perceived Science Engagement and 21st-century skills and Science Achievement are presented in Table 5, along with those between the Learning Interactions and acquisition of 21st-century skills and Science achievement. It shows that the perceived online science engagement in terms of Cognitive, Affective/Emotional, and Behavioral have no significant relationships or correlations to the acquired 21st-century skills (Critical thinking .006, Creativity -.039, and Communication .123) and Science Achievement (.036) of the respondents. This indicates that the level of 21st-century skills acquired, such as Critical thinking, Creativity, and Communication, and the level of performance based on Achievement test scores are not related to the level of student engagement experienced during online classes.

On the other hand, statistics indicate that the student-student dimension of learning interaction has no significant correlations with the respondents’ achievement test performance (.082) and the development of 21st-century skills, namely Critical thinking (.021), Creativity (.016), and Communication (.191). Furthermore, data revealed that the student-content dimension of learning interaction has no significant relationship with Science Achievement (.088) and acquisition of 21st-century skills (Critical thinking -.010, Creativity -.012, Communication -.185). In synchronous classes, however, interaction is limited to the specified period of time since the time is predetermined. Moreover, despite the fact that instructional design establishes an environment for interaction that increases learning, research suggests that online learners still need additional assistance to engage in productive interaction (Strauß & Rummel, 2020).

However, there is a significant relationship between 21st-century skills (communication) and the achievement of students in Science when it comes to the interaction between students and teachers. However, the correlation is weak (r=.279, p<0.05). This data indicates that an engaging and collaborative online learning environment and student-teacher interaction are crucial for student engagement and learning performance.

Additionally, there is also a weak correlation between the learning interaction dimension (student-teacher) and the Science Achievement (r=.257, p<0.05). This data strongly agrees with the findings of (Gopal et al., 2021) that “teacher quality, student expectations, rapid feedback, and effective course design” all greatly impact students’ online learning experiences and achievement. perceived Science Engagement and 21st-century skills and Science Achievement are presented in Table 5, along with those between the Learning Interactions and acquisition of 21st-century skills and Science achievement.
In summary, these results indicate how the level of student-teacher interaction influences the acquisition of 21st-century skills (communication) and Science achievement performance.

6. Mediating Effect of Learning Interaction Dimensions between Science Engagement and Science Achievement

Table 6
Mediating Effect of Learning Interaction Dimensions between Science Engagement and Science Achievement

| Indirect Effects | Effect | SE  | LCL  | UCL  |
|------------------|--------|-----|------|------|
| CE→ST→SA        | .0631  | .1905| .1130| .2136|
| CE→ST→SA        | .3828  | .1534| .0787| .6883|
| CE→ST→SA        | .2076  | .2126| .6368| .2193|
| AEE→ST→SA       | .0711  | .1500| .1500| .0700|
| AEE→ST→SA       | .0711  | .1500| .1500| .0700|
| AEE→ST→SA       | .2335  | .1753| .6175| .0638|
| BE→ST→SA        | .2335  | .1753| .6175| .0638|
| BE→ST→SA        | .2335  | .1753| .6175| .0638|
| BE→ST→SA        | .2335  | .1753| .6175| .0638|

Legend: CE (Cognitive Engagement); AEE (Affective/Emotional Engagement); BE (Behavioral Engagement); SS (Student-Student); ST (Student-Teacher); SC (Student-Content); SA (Science Achievement)

Table 6 presents the mediating effect of learning interaction components between Science engagement and Science achievement. The data gathered from Grade 7 online student-respondents were tested using PROCESS Macro v4.1, following the procedure of Hayes (2022). Results reveal that only the student-teacher interaction component has a significant mediating effect on the relationship between Science engagement and Science achievement.

Based on the findings, student-teacher interaction mediates the relationship between Science engagement and Science achievement. As such, student-teacher interaction was added; it influences Science engagement to improve Science achievement. In addition, the data indicate that student-teacher learning interaction can transmit the effect of being influenced by Science engagement, which increases Science achievement. According to the findings, it can also be noticed that the student-teacher interaction demonstrated mediating effect on the relationship between Science engagement (CE=.3628; AEE=.3941; BE=.4071) and Science achievement.

This result validates the claim by Geller et al. (2018) asserted the competence of teachers is a reliable predictor of the level of student engagement, and they are held accountable for the level of academic involvement that their students demonstrate. Therefore, mediation was present in student-teacher interaction mediating the effect of cognitive, affective/emotional, and behavioral engagement on students’ Science learning.

Furthermore, the indirect effect shown in the table means that respondents who differ by one unit in their reported science engagement are estimated to vary by .3628, .3941, .4071 units on their science achievement. Therefore, findings revealed that the student-teacher learning interaction dimension could explain the variation in students' Science achievement.

CONCLUSIONS

In the light of the aforementioned findings, the following conclusions are drawn:

1. There is no significant relationship between the respondents’ perception of online Science engagement (Cognitive, Affective/Emotional, and Behavioral) and learning interaction (Critical Thinking and Creativity) to their acquired 21st-century skills. However, there is a significant relationship between learning interaction (Student-Teacher) to their acquired 21st-century skills (Communication).

2. There is no significant relationship between the respondents’ perception of online Science engagement (Cognitive, Affective/Emotional, and Behavioral) and learning interaction (Critical Thinking and Creativity) to their science achievement. Nevertheless, there is a significant relationship between the learning interaction (Student-Teacher) to their science achievement.

RECOMMENDATIONS

Based on the findings of the study and conclusion drawn, the following are recommended:
1. Schools must invest in developing online learning environments that improve learning and teaching outcomes, facilitate opportunities for students to engage online, and encourage interactions with one another, teachers, and the educational institution while promoting the development of strong knowledge and expertise in Science and 21st-century skills.

2. Efforts and studies relating to the design and evaluation of online student engagement and learning interaction must also seek information on the implementation that will have a direct relationship with positive student outcomes.

3. The large-scale gathering of online student engagement and learning interaction data can provide administrators with additional and current learning environment data sources that may guide actions at the school-wide level. In addition, multiple sources of information may facilitate a deeper comprehension among online students.

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