

Transformative Pedagogical Innovations: Harnessing Ai Driven Technology for Effective Science Intervention Materials in General Chemistry

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Abstract

This study entitled, “TRANSFORMATIVE PEDAGOGICAL INNOVATIONS: HARNESSING AI DRIVEN TECHNOLOGY FOR EFFECTIVE SCIENCE INTERVENTION MATERIALS IN GENERAL CHEMISTRY”, explored how AI-driven technology can be integrated into transformative pedagogical innovations to improve science intervention materials in General Chemistry 1. A total of sixty science teachers participated, most of whom were female, aged 31–35, and holding master’s units, with the majority serving as Teacher III. Results showed that teachers strongly recognized the value of AI in enhancing student preparedness, addressing learning limitations, explaining lessons more effectively, and supporting the elaboration and evaluation of concepts. Despite

these benefits, teachers also reported notable challenges, particularly in replacing traditional methods, coping with added complexities in the teaching learning process, and achieving planned learning goals. Statistical tests revealed no significant differences in AI integration and challenges across demographic groups, except for sex in relation to elaboration and evaluation. Overall, the study concluded that while AI offers meaningful opportunities for student engagement and instructional improvement, it also brings barriers that may hinder teaching efficiency. It is therefore recommended that continuous teacher training, institutional support, and further research on practical AI applications be prioritized to maximize its potential in science education.

Keywords: *Artificial Intelligence, Transformative pedagogy, Science education, Teachers training, General Chemistry*

INTRODUCTION

Transformative pedagogical innovations refer to a unique and fast-emerging approach in education that enables learners to thoroughly analyze various aspects of their learning, including beliefs, contexts, knowledge, values, and attitudes. This approach encourages self-reflection, appreciation for diverse learning, and the enhancement of critical thinking skills, which are valuable not only in education but also

in other areas of life. As such, transformational pedagogical innovations were found to be significant in the learning of students, as well as in the perspectives of the school, students' families, and surrounding communities. Transformative pedagogical innovations have played a significant role in encouraging learners to actively participate in co-constructing and sharing their ideas. These innovations involve the use of inquiry-based approaches to integrate students' inputs into their educational materials and experiences and that this approach promotes personal experiences and aligns with the learning needs of the students.

The proponent of the study wanted to take a more in-depth analysis or investigation of the transformative pedagogical innovations that are currently present in the teaching and learning process or the whole of the educational sector and most specifically in the use of AI-driven technology in order to foster and facilitate effective science intervention materials or resources to be developed particularly for General Chemistry subject and to see if the use or integration of AI-driven technology as part of transformative pedagogical innovations can be helpful in harnessing the benefits of AI for teaching and learning and for the development of teaching and learning materials as well. An enhanced and harnessed teaching and learning process with the use and integration of AI-driven technology is necessary in order to also continuously enhance and transform the pedagogical innovations being used or applied by teachers and also the way that it can also be expected to contribute significantly for effective science teaching and learning process.

MATERIALS AND METHODS

Research Design

This study utilizes the descriptive research method, which involves doing a thorough investigation to gather factual information and interpreting the findings accurately and precisely.

According to McCombes (2019) in her article on descriptive-survey research, descriptive research aims to describe a population, situation, or phenomenon accurately and systematically.

In this study, the descriptive method will be applied in the discussion and analysis on the use of AI-driven technology for transformative pedagogical innovations in General Chemistry.

Population and Sampling

The researcher utilizes total enumeration. This means that all chemistry teachers are the respondents of the study. Total enumeration sampling is a systematic method used in research to exhaustively search and investigate a finite set or population. It involves the complete enumeration of all possible elements or configurations within the set of interest.

Respondents

The respondents of the study are the public and private school chemistry teachers of Batangas City Division during the school year 2023- 2024.

Research Instrument

The survey questionnaire serves as the primary instrument for data gathering. In this study, the developed survey questionnaire will be composed of three parts. The first part will be intended for the demographic profile of the target or selected respondents. The second part will be for the assessment of the use of AI-driven technology for transformative pedagogical innovations in General Chemistry 1. The third part of the questionnaire will be allotted for the challenges on the use of AI-driven technology for transformative pedagogical innovations in General Chemistry.

On the second and third part of the questionnaire, the respondents will rate each indicator using a scale of one (1) to four (4) with the following meanings. 4 for “Strongly Agree,” 3 for “Agree,” 2 for “Disagree,” and 1 for “Strongly Disagree”.

Validation of the Survey Questionnaires

The questionnaire will be validated by the three experts- graduate school professor, principal, and master teachers to be able to know if it fits the intended respondents or if there are some questions that need to be improved before giving it to the actual respondents. Their response also helped the researcher to verify if it is understandable and sustainable to the respondent’s needs.

For the reliability of the instrument, the questionnaire will be subjected through a dry run in selected teachers who are not part the study. There was a pilot testing to at least 15 chemistry teachers .. After the pilot testing, the reliability will be tested using the Statistical Package of Social Science (SPSS).

Data Gathering Procedure

In order to ensure the production of reliable and pertinent conclusions and suggestions for the research, the study will employ the following processes to obtain primary data from the selected respondents. The researcher will ask permission from the Schools Division Superintendent of Batangas City. Upon approval of the superintendents, the researcher will also request permission from the District Supervisor.

The researcher selected the participants and contact them over Messenger or Gmail, seeking their consent to take part in the study. As a component of the ethical considerations of the study, the intended participants will also be guaranteed the confidentiality of any data acquired during the process. Subsequently, the intended participants will consent to partake in the process of collecting data. Prior to this, the researcher and respondents will establish a mutually agreed upon time for the survey to be conducted. Participants will complete surveys, which will subsequently be collected, tallied, examined, and presented. The data analysis phase involved using specific statistical instruments or tools to tally and analyze the responses. This was followed by the creation of tables to present the collected data. The findings of the survey will be presented through both text and tables and will be followed by its conclusions and recommendations.

Statistical Treatment of the Data

The data gathered by the researchers will be tabulated, analyzed and interpreted by the following statistical tools:

1. Percentage. The percentage will be used for the demographic profile of the respondents.
2. Frequency Count. The frequency count will be used for the demographic profile of the respondents.
3. Weighted Mean. The weighted mean will be used to determine the level of integration and also the degree of difficulty of the use of AI-driven technology for transformative pedagogical innovations.
4. Analysis of Variance or ANOVA. The ANOVA will be used to determine if there is a significant difference in the level of integration of the use of AI-driven technology for transformative pedagogical innovations in science when grouped according to demographic profile and if there is also a significant difference in the degree of difficulty in the use of AI-driven technology for transformative pedagogical innovations in science when grouped according to demographic profile.

RESULTS

The following are the salient findings of the present study:

Demographic Profile of the Respondents

1. Most of the respondents are aged 31-35 years old with 28 respondents with 46.7%.
2. Majority of them are female with 45 respondents or equivalent to 75%.
3. As for the respondents' position, most of them are Teacher III with 38 respondents or equivalent to 63.3%.
4. Majority of the respondents have Master Units with 30 respondents or equivalent to 50%.
5. Further, most of them had been teaching for about 11-15 years now with 47 respondents or equivalent to 78.3%.
6. As for the number of seminars attended related to pedagogy, most of the respondents were able to attend about 6-10 seminars with 23 respondents or equivalent to 38.3%.

Level of Integration of the Use of AI-Driven Technology

1. In terms of engage, the indicator "The use of AI-driven technology allows the students to become more prepared in class" had obtained the highest mean of 3.65 and verbally interpreted as Strongly Agree.
2. In terms of explore, the indicator "The use of AI-driven technology helps understanding the students' limitations" had the highest obtained mean of 3.68 and interpreted as Strongly Agree.
3. Further, in terms of explain, the indicator "The use of AI-driven technology helps the student explain their understanding of lesson" had the highest mean of 3.93 and interpreted as Strongly Agree.

4. As for elaborate, the indicator “The use of AI-driven technology helps the teacher to relate the lesson to unfamiliar concepts” had gained the highest weighted mean of 3.88 and verbally interpreted as Strongly Agree.
5. Finally, in terms of evaluate, the indicator “The use of AI-driven technology helps the teacher to be creative in assessing or evaluating student performance” had the highest mean of 3.88 and verbally interpreted as Strongly Agree.

Degree of Difficulty in the Use of AI-Driven Technology

1. In terms of replacing traditional teaching methods, the indicator “AI-driven technology integration are not as effective as traditional methods” had the highest mean of 4.00 and verbally interpreted as Strongly Agree.
2. As for amplifying teaching and learning process, the indicator “AI-driven technology integration causes teaching and learning process more hassle” had the highest obtained mean of 3.88 and interpreted as Strongly Agree.
3. Finally, in terms of transformation of pedagogical innovations, the indicator “The planned or established learning goals are not met” had gained the highest mean of 3.85 and verbally interpreted as Strongly Agree.

Significant Difference between the Level of Integration of the Use of AI-Driven Technology and Demographic Profile

1. There is no significant difference in the level of integration of the use of AI-driven technology for transformative pedagogical innovations in science when grouped according to age.
2. Only in terms of elaborate (0.034) and sex had shown a significant difference and thus proceeded to reject the null hypothesis of no significant difference found.
3. There is no significant difference in the level of integration of the use of AI-driven technology for transformative pedagogical innovations in science when grouped according to highest educational attainment.
4. There is no significant difference in the level of integration of the use of AI-driven technology for transformative pedagogical innovations in science when grouped according to seminars attended related to pedagogy.

Significant Difference between the Degree of Difficulty in the Use of AI-Driven Technology and Demographic Profile

1. There is no significant difference in the degree of difficulty in the use of AI-driven technology for transformative pedagogical innovations in science when grouped according to age.
2. There is no significant difference in the degree of difficulty in the use of AI-driven technology for transformative pedagogical innovations in science when grouped according to sex.
3. There is no significant difference in the degree of difficulty in the use of AI-driven technology for transformative pedagogical innovations in science when grouped according to position.
4. There is no significant difference in the degree of difficulty in the use of AI-driven technology for transformative pedagogical innovations in science when grouped according to highest educational attainment.

5. There is no significant difference in the degree of difficulty in the use of AI-driven technology for transformative pedagogical innovations in science when grouped according to length of service.
6. There is no significant difference in the degree of difficulty in the use of AI-driven technology for transformative pedagogical innovations in science when grouped according to seminars attended related to pedagogy.

Significant Relationship between the Level and Degree of Difficulty of the Use of AI-Driven Technology

1. There is no significant relationship between the level and degree of difficulty of AI-driven technology for transformative pedagogical innovations in science in terms of replacing traditional teaching methods.
2. Only in terms of elaborate (0.001); and evaluate (0.034) had shown a significant relationship and proceeded to reject the null hypothesis of no significant relationship found between amplifying teaching and learning process and the degree of difficulty of AI-driven technology.
3. Finally, only in terms of elaborate (0.000) had shown a significant relationship and proceeded to reject the null hypothesis of no significant relationship found between transformation of pedagogical innovation and the degree of difficulty of AI-driven technology.

Discussion

This study requires the commitment and involvement of the concerned personnel to sustain its effectiveness and reliability; thus, the following recommendations were made.

1. It is first recommended to the General Chemistry Teachers for them to take in great consideration the need to become active participants in different trainings and seminar programs that will enable them to continuously enhance their teaching knowledge and skills and specifically on how they can effectively integrate the use of AI-driven technology in teaching science or science-related subjects in school.
2. As such, it is also recommended for students to also take an active part on assessing and monitoring how the use and integration of AI-driven technology is being helpful or not for their learning and also in understanding lessons and concepts in class.
3. The school heads are also recommended to develop and conduct different training and professional development programs that will help their teaching staff to become more knowledgeable as well as skillful in integrating and utilizing AI-driven technology in their teaching and learning process in class.
4. It is also recommended for the DepEd to also monitor and review current or existing guidelines and policies in order to continuously enhance and promote the use and integration of AI-driven technology in the modern-day teaching and learning setting.
5. Finally, it is also recommended for students and future researchers to further explore and conduct studies with regards to specific types of AI technology used in the teaching and learning process to better assess its effectiveness and address its limitations as well.

Conclusion

Based on the findings of the study, the following conclusions were drawn:

1. It can be concluded that the demographical profile of the science teachers can consider them as capable as well as competent and also showing a significant regard in relation to continuously enhancing their learning, skills and knowledge as a teacher and using the combination of their acquired intellect and experience to become a more effective science teacher.
2. As such, it can also be concluded that the level of integration of the use of AI-driven technology by the teachers is usually seen in the way that AI helps the students to become more prepared in class, recognize and address their academic limitations, and at the same time, to also utilize AI for improved understanding of lessons and concepts and also for continuously and closely monitoring the progress of the students.
3. Further, it can also be concluded that the degree of difficulty that is usually or mostly being encountered in the use of AI-driven technology is the way it tends to become a hindrance for meeting planned academic goals, creates more hassle and also does not compare in terms of quality and effectiveness as with the use or application of traditional methods used in the teaching and learning process.
4. It can also be further concluded that the differences between the gender or sex of the teachers tend to have an impact on the way they are using AI-driven technology as part of their transformative pedagogical approach and also the way that they can be able to effectively elaborate lessons and concepts or ideas to their students in class.
5. Moreover, it can also be concluded that the differences with regards to the demographical profile of the respondents tend to cause no influence or impact on the way that they are experiencing or encountering challenges or difficulties in the use of AI-driven technology in their teaching and learning process.
6. Finally, as based from the analysis of the gathered findings, it can be concluded that there lies an influence or impact on the integration of the use of AI-driven technology and its challenges particularly pertaining to elaborating ideas and lessons and evaluating the progress and performance of the students or learners.

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