PERCEPTION ON THE INTEGRATION OF GEOGRAPHIC INFORMATION SYSTEM (GIS)-BASED LEARNING AMONG THE COLLEGE STUDENTS
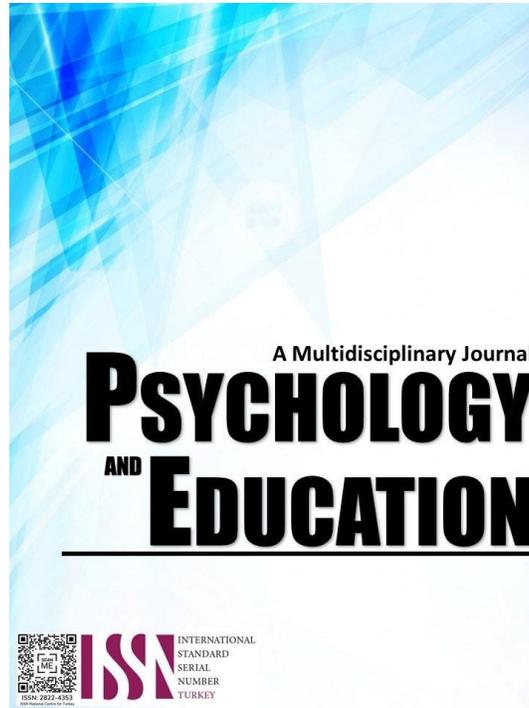
Perception on the Integration of Geographic Information System (GIS) Based Learning among the College Students

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Abstract

The study aimed to determine the perception on the integration of Geographic Information System (GIS)- based learning among the college students and tried to analyze the student's academic competency, mastery goals and in determining their academic performance towards GIS integration. The study employed descriptive correlational design to collect quantifiable information of the respondents towards the integration of GIS-based learning in which one hundred eighteen (118) randomly selected Civil Engineering students of MSU-IIT who undergone GIS in the 1st semester A.Y. 2022-2023. The results revealed that in the perception on the integration of Geographic Information System (GIS)-based learning in the classroom as to the academic competency the respondents strongly agree with the total average weighted mean of $\bar{x}$=3.25 and the SD + 0.42, thus, as to their mastery goal results showed that respondents agree with the total average weighted mean of $\bar{x}$=2.59 and the SD + 0.55, hence, there was a significant relationship between the academic performance and the demographic profile in terms of age. However, the data demonstrated that age and mastery objective play a key role in the integration of GIS-based learning, indicating that age was solely influenced by this element, which was associated with the content's mastering. As a result, we may conclude that using GIS-based teaching improves respondents' academic achievement.

Keywords: *geographic information system, perception, academic performance, mastery goal*

Introduction

Technology integration became a useful tool in the teaching and learning process, and it became a necessity for teachers and learners in providing and acquiring knowledge. Technology was said to have been successfully incorporated into education when it improved students' learning processes and created a more effective, efficient, and/or appealing educational environment (Farjon et al., 2019). Most teachers agreed that Information and Communication Technology (ICT) has the potential to improve learning outcomes and effectiveness, especially with the advent of the internet. It was acknowledged that the integration of technology learning has significant benefits in terms of knowledge, development of skills, and attitudes. Education and technology, when coupled, have the potential to generate teaching and learning experiences that were dynamic and targeted to the development and transformation of educators and learners that were required to power the digital economy (Garcia, 2017).

In line with this digital era, with the pertinent provisions of Republic Act 7722, otherwise known as "The Higher Education Act of 1994", the Commission on Higher Education (CHED) issued a Memorandum Order No. 52, Series of 2016 known as "Pathways to Equity, Relevance and Advancement in Research, Innovation, and Extension in Philippine Higher Education". It could work towards achieving greater equity, relevance, and advancement in research, innovation, and extension, contributing significantly to the country's overall development. Thus, it created innovation centers and technology hubs within universities to promote research and development and increased funding for research projects, with a focus on addressing societal challenges which could establish knowledge-sharing platforms to facilitate the exchange of expertise between academia and local communities.

Consequently, the Philippines agency funded a project to address such challenges by using the technology. They created a team with experts to gather information and process data by using technologies, and one of these were by using Geographic Information System (GIS) because the Philippines ranks as the third most disaster-prone country in the world according to the 2017 World Risk Report of the United Nations University Institute for Environment and Humanity Security (UNUEHS). Over the past decade, a number of major disasters took the stage in the country, prompting high economic damage and losses, casualties, and social disruptions. Worse, they were expected to further rise as a result of increased anthropogenic activities if no appropriate measures were put in place.

These were valuable tools in improving the country's resilience to disasters. Phil-LiDAR 1 attested that science-based approached to disasters were essential for effective and efficient DRRM efforts. But programs such as the Phil-LiDAR 1 were just part and parcel of the whole DRRM efforts of the country (PCIEERD Policy Brief, 2018). The MSU- Iligan Institute of Technology (MSU-IIT) - where the data being gathered in the study, implemented the project in catering the need of the LGU in Mindanao in effective visualization of maps by using GIS. In the culmination of the project, it was realized that this tool was very substantial so in the year 2019 many departments in the university integrated their subject and projects in the used of GIS for the undergraduate and graduate students beginning in the year 2019 because it became an innovative tool now in the country. Integrating GIS became an educational tool rather than an information technology (Yagbasan & Yilmaz, 2021). GIS was a tool that linked databases and maps, managed information, and helped answer questions such as; where was it, what else was nearby, where was the highest concentration of x, and where was the closest to my location. In addition, GIS could be regarded as the center of all modern spatial decision-making tools. GIS was a computer system that captured, stored, analyzed, managed, and presented data and related qualities that were spatially referenced to the Earth.

Hence, the Civil Engineering Department in the university, who firstly integrated GIS in their subject especially surveying and hydrology subjects. It became special to note why the Civil Engineering utilized it first because GIS played a crucial role in designing multi-source information based civil infrastructure plans. GIS made used of data that was associated with a specific location. Civil engineers required a large amount of geographically related spatial data. In which data was used in their designs and decision-making processes. GIS formed the interface between spatial data and engineering projects in the majority of civil engineering projects (Perera et al., 2021).

In education, the salient features of GIS instruction in the hands of students helped them to understand the content in a variety of disciplines. GIS is used as an inquiry-driven, problem-solving, standards-based set of tasks that incorporated fieldwork and provided career pathways that were increasingly in demand. It helped students think critically, used real data, and connect to their own community. In the Philippine setting, GIS was increasingly used by managing the school administration to ensure the timely and relevant provision of data and information. Learning using GIS entails GIS as an instructional tool that provided an additional opportunity to developed crucial spatial skills. Learning about GIS correlated with the requirement for education programs that prepared learners to became GIS practitioners.

Further, in successfully implementing this plan, integrating this into the classroom and in the curriculum helped the system trained learners to became experts and critical thinkers, which might lessen difficulties in integrating into the classroom. This tool was widely used in teaching in some areas of discipline without knowing if the knowledge and skills they embed were effective and useful in the classroom and in the community as well.

The intention of the study brought a beneficial contribution to the quality and innovative educational tool that the school provided. One of these was to understood the perception of the students on the integration of GIS-based into the learning environment could enhanced spatial thinking, problem-solving and critical thinking abilities among students through their academic achievement and mastery goal and created possible action plans. Hence, it was also important to note that only MSU-IIT- the only university in Iligan City introduced GIS to the students because of the availability of experts and facilities for this application made the subject innovative and interactive for free. Although, many studies have been conducted in integrating GIS in secondary education globally (Sejati et al., 2022; Alazmi, Gunes et al., 2020; Wijayanto et al, 2021; Bakri et al., Ridha et al., Hammond et al., 2019; Sharma, Schlemper et al., 2018) but few studies have been conducted in higher education in the Philippines that made this study significant.

The study was conducted in the Civil Engineering student's academic year 2022-2023. The researcher is seven (7) years in the service for the period of 2014-2021 as a project administrative staff in the Department of Science and technology (DOST)- Philippine Council for Industry, Energy, and Emerging Technology Research and Development (PCIEERD). In addition, the researcher is also a trained for GIS software application for conducting training to some Local Government Units in some parts of Mindanao.

Research Questions

This study aimed to determine the perception on the integration of Geographic Information System (GIS)-based learning. It also tried to analyzed the student's academic competency, mastery goals and also in determining their academic performance towards GIS integration. The study sought to answer the following questions:

1. What is the demographic profile of the respondents in terms of:
    1.1. age;
    1.2. sex;
    1.3. availability of learning resources;
    1.4. technology literacy; and
    1.5. availability of internet connectivity?
2. What is the perception of the respondents in the integration of Geographic Information System (GIS)-based learning as to:
    2.1. academic competency, and
    2.2. mastery goal?
3. What is the academic performance of the respondents based on the Grade Point Average (GPA) during 2nd semester A.Y. 2022-2023?
4. Is there a significant relationship between the respondents' demographic profile and their academic performance?
5. Is there a significant relationship between the respondents' perception on the integration of GIS-based learning and their academic performance?
6. Which of the demographic profiles and perception on the integration of GIS-based learning best predict academic performance of the respondents?
7. What action plan can be designed based on the findings of the study?

Methodology

Research Design

The researcher utilized the descriptive- correlational research design which aimed to systematically obtain information to describe a

phenomenon or a population in which this study was described and interpreted the statistical data. Moreover, correlational research design investigated the relationship between two variables (or more) through survey research which was analyzed through frequencies and patterns. Descriptive-correlation design described the variables and the relationships that occurred naturally between and among them.

Similarly, descriptive correlation was utilized in this study to describe the student's demographic profile, including age, sex, availability of learning materials, technology literacy, and students' internet connectivity. Quantitative data were gathered using survey questions to determine respondents' perceptions of GIS-based learning, and the data and responses were then examined. In addition, comments on GIS-based learning were gathered throughout data collecting.

Furthermore, statistical instruments were used in this study to determine the relationship between variables such as the students' demographic profile, their perception of the integration of GIS-based learning in terms of academic performance, and mastery goal as to academic achievement in order to develop the best action plan possible.

Respondents

The respondents were enrolled students of the first semester of the Academic Year 2022-2023 of the Civil Engineering Department. The entire population was 260 students, of which 120 were introduced to GIS, which is why the researcher concentrated on this demographic when collecting data. The researcher used a basic random sampling approach to ensure that every member of the population had an equal chance of being selected. However, only 118 people out of the population responded to the questionnaire at random, and two of them were unresponsive; the researcher also looked at the grade point average record from the first semester of enrollment to follow their academic success.

Instruments

The researcher used an adapted questionnaire from Demirci, 2008 and administered a pilot testing to assess the validity and reliability of the items in the questionnaire. The findings revealed that GIS-based applications may be used in schools, and that new strategies should be developed to reduce the barriers to GIS usage, which resulted in the recommended action plan of the researcher in the conduct of this study.

The questionnaire has three parts. Part I of the instrument would determine the demographic profile of the learner which included the age, sex, availability of learning resources, technology literacy, and availability of internet connectivity. In the demographic profile questionnaire, respondents self-assessed their degree of literacy in terms of utilizing the GIS tool and technology. Self-assessment involves evaluating their knowledge, skills, and talents by selecting items on a scale of excellent, very good, and good.

The Part II of the survey questionnaire was about the perception of the integration of the Geographic Information System (GIS)-based learning by collecting data through test questionnaire by assessing their academic competency and mastery goal of the learner through their attitude to the manuals provided in the lesson using a Likert scale (4 -strongly agree, 3 -agree, 2 -disagree, 1 -strongly disagree). The instrument was validated in the light of experts' opinions in the subject matter and pilot-tested and resulted that the questionnaire was acceptable for research purposes which showed a value of 0.7. The pilot testing was conducted through the twenty-five (25) Environmental Engineering course students in the College of Engineering who were also introduced to the tool before proceeding to the focused group of respondents in the Civil Engineering course. The result showed that age has a significant factor in using new technology and there were factors that need to change in the questionnaire in the conduct of the pilot test with these results the researcher made to alter.

Part III was looking through the grade point average obtained in the 1st semester of the Academic Year 2022-2023. And Part IV was knowing the opinions of the respondents towards the integration of GIS-based learning approach.

Procedure

Prior to doing this investigation, the researcher followed the research protocol. A letter of consent from the department head to do research in the research environment was received, which was then forwarded to the class adviser. When the head authorized the request, the researcher administered the instruments to the respondents via a Google Form. Furthermore, the researcher explained to the adviser what form was sent. The researcher went on to discuss the necessity and mechanics of answering the instrument. The respondents were notified that the data obtained would be kept strictly secret and used for research purposes only. After data collection, it was translated, summarized, and analyzed using descriptive and inferential statistics, which were addressed in the following chapter of the study. The learners' class adviser was asked to help administer the instrument.

Data Analysis

The following statistical tools were utilized to analyze and explain the variation in the sample data. Frequency and percentage distribution would be employed to interpret the distribution of sample data:

Problems 1 and 3, Frequency and Percentage. These were employed to interpret the distribution of age, sex, availability of learning resources, technology literacy, and availability of internet connectivity and also in interpreting the respondents' grade point average.

Problem 2, Weighted Mean and Standard Deviation. These were used to analyze the responses on the item of the questionnaire in the perception of the respondents in the integration of Geographic Information System (GIS)- based learning as to their academic competency and mastery goal. This was computed by the number who answered strongly agree, agree, disagree and strongly disagree.

Problem 4, Chi-square Test. This was used to analyze the relationship between the respondents' demographic profile and their academic performance.

Problem 5, Pearson's r Correlation. This was utilized to determine the significance of the relationship between respondents' academic performance and the perception on the integration of GIS-based learning.

Problem 6, Regression. This was used to analyzed the variables that best predict respondents' academic performance.

Results and Discussion

This section presented the data gathered to answer the problems of the study. It analyzed and interpreted the data collected by the researchers to solve the issues in the study. The presentation, interpretation, and analysis were supported by tables and arranged in the same manner as the questions presented in the statement of the problem in Chapter 1.

Problem 1: What is the demographic profile of the respondents in terms of age, sex, availability of learning resources, technology literacy, and availability of internet connectivity?

Table 1. *Age*

Age	Frequency Count	Percentage (%)
18 – 22 years old	100	84.7
23 – 27 years old	16	13.7
28 – 32 years old	1	0.8
33 – 37 years old	1	0.8
38 – 42 years old	0	0
Total	118	100.0

Table 1 presented the age of the respondents. The result showed that 84.7% was in the age between 18- 22 years old, 13.7% in the age between 23-27 years old, 0.8% in the age between 28-32 years old and 33-37 years old with no respondents between the ages from 38-42 years old. It implied that most of the respondents who answered the survey questionnaires were the ages between 18-22 years old in which in this semester GIS-based learning were introduced to the respondents in the 2nd year of the Civil Engineering course. Results showed that   most of the respondents range from the age of 18-22 years old.

In a study conducted by Costache et al. (2017) which proved that the respondents were "digital natives" because between these years of age (18-24 years) they been using the computer for over 9 years, and as far as using GIS was concerned, it was introduced in 2nd year as what was told by the head of the department during the interview.

Table 2. *Sex*

Sex	Frequency Count	Percentage (%)
Male	67	56.8
Female	51	43.2
Total	118	100.0

Table 2 displayed the sex of the respondents. The result presented the distribution of the respondents as 56.8% male and 43.2% female. It showed that mostly male respondents were enrolled in the courses. Sex ratio was a significant and important demographic characteristic of a population study. It was assumed that the proportion of males in the total population was larger than that of females in the supply of labor force (Salunke et al., 2020), especially in the civil engineering field because of the build, build, build program, which aimed for a golden age for infrastructure in the Philippines.

Table 3. *Availability of Learning Resources*

Learning Resources	Frequency Count	Percentage (%)
Computer Desktop	13	11.1
Laptop	20	16.9
Mobile Phone	85	72.0
None	0	0
Total	118	100.0

Table 3 showed the availability of learning materials of the respondents. The results presented that respondent used 72% mobile phones as their available learning sources and 16.9% used laptops while 11.1% used computer desktops that can be used as an available learning resource. It implied that respondents preferred mobile phones because of its readily available by everyone in learning. Given the ubiquitous nature of mobile phones and continued advances in technology, we have witnessed a gradual shift in thinking about the creation of new approaches to teaching and learning. The increasing used of mobile phone technology within the higher education

context represents a paradigm shift in thinking about teaching and learning strategies (Ahmad, 2020). The combination of mobile phones and GIS has democratized access to spatial information, allowing people and organizations to use location data for a variety of applications. This intersection was constantly changing as mobile technologies and GIS applications progress.

Table 4. *Technology Literacy*

Technology Literacy	Frequency Count	Percentage (%)
Excellent	14	11.9
Very Good	60	50.8
Good	44	37.3
Poor	0	0
Total	118	100.0

Table 4 presented the technology literacy of the respondents. The result presented that 50.8% of the respondents has a very good technology literacy, and 37.3% has a good technology literacy while 11.9% of the respondents has an excellent technology literacy. In this digital era, one would think that all were equipped and excellent in utilizing technology, however, the result showed that there were still needed to explore in discovering new technology. The table presented which implied that based on the students' self-assessment on the GIS tool they were still not so excellent in this technology as evident in the interview:

"It was a medium of learning that was somehow new, in which technology, no matter how mainstream, was still challenging in some ways." One of the respondents also added that: "GIS interface was intimidating due to its complexities. There was also a need for spatial thinking which was a challenging to do".

Knowledgeable and awareness on utilizing technology in the classroom should be taken into account as what Abella et al. (2023) stated that careful consideration and evaluation of technology integration were essential to maximize its impact on student learning.

Table 5. *Availability of Internet Connectivity*

Availability of Internet Connectivity	Frequency Count	Percentage (%)
Internet Connection/ WIFI	100	84.7
Mobile Data	18	15.3
None	0	0
Total	118	100.0

Table 5 showed the respondents' availability of internet connectivity. The result revealed that 84.7% of the respondents have access to internet connection/ Wi-Fi and 15.3% used mobile data, which implied that most people nowadays used the internet for searching and acquiring information.

According to Shahibi and Rusli (2017), the internet made it easier for students to obtain the desired information easily and quickly. This facility made students more motivated to search for information more often.

Problem 2: What is the perception of the respondents in the integration of Geographic Information System (GIS)-based learning as to academic competency, and mastery goal?

The perception of the respondents varies to each individual based on their experiences, backgrounds, and the specific context in which the GIS integrated.

Researcher takes into account the respondents' may perceived GIS as a valuable tool for enhancing their understanding of spatial relationships and ability to apply these skills.

Table 6. *Academic Competency*

Indicators	Mean	+	SD	Description
1. GIS-based application increases my interest in the subject.	3.21	+	0.50	Agree
2. It helps me understand the lesson better	3.21	+	0.52	Agree
3. It increases my curiosity to learn more in the classroom.	3.28	+	0.54	Strongly Agree
4. It helps me understand how GIS is used in daily life.	3.20	+	0.55	Agree
5. It improves my computer skills.	3.26	+	0.56	Strongly Agree
6. It helps me improve my inquiry skills.	3.18	+	0.56	Agree
7. It helps me improve my problem-solving skills.	3.19	+	0.54	Agree
8. It motivates me to learn about and use new technologies.	3.36	+	0.56	Strongly Agree
9. It helps me understand map reading.	3.31	+	0.50	Strongly Agree
10. It helps me analyze map visualization.	3.31	+	0.58	Strongly Agree
Weighted Mean	3.25	+	0.42	Strongly Agree

Note: 3.25-4.00, Strongly Agree; 2.50-3.24, Agree; 1.75-2.49, Disagree; 1.00-1.74, Strongly Disagree

Table 6 presented the perception of the respondents in the integration of Geographic Information System (GIS)-based learning as to academic competency. The result showed that the item # 8 the respondents strongly agree with the highest mean (3.36) and the SD (+ 0.56) that the integration of the GIS-based learning motivates them to learn about and use the new technology, hence, students were

technology-driven and innovative when introduced to new technologies.

In the discussion of Bikar et al. (2022) which resulted that the impact of GIS-integrated teaching on students, it was an innovative teaching method that teachers can utilized to stimulate and enhance students' motivation (intrinsic) in learning. Thus, to develop students' intrinsic motivation in a GIS-integrated learning environment, teachers need to plan and provide an instructional context incorporating the introduction of GIS-based task that were of an optimal or moderate difficulty and allow for choice and student autonomy. On the other hand, the data showed that the item # 6 the respondents agree with the lowest mean (3.18) with SD (+ 0.56) but provided a positive response that the integration of the GIS-based learning helps them improve inquiry skills.

In addition, the data revealed that the total average weighted mean in perception of the respondents was $\bar{x}=3.25$ and the SD + 0.42, with a descriptive equivalent of "strongly agree" in the integration of GIS-based learning as to their academic competency. In a similar study conducted by Kinoti and Muchai (2017), for the impact of GIS training on students' skills and competencies there were statistically significant levels of improvement in skills and knowledge in using the GIS. The most important was that many learners began experimenting new ways to use the technology in their training.

Table 7. *Mastery Goal*

Indicators	Mean	+	SD	Description
1. I understand the concept of GIS.	3.00	+	0.54	Agree
2. I understand the learning materials of the GIS.	2.92	+	0.62	Agree
3. I understand fully the materials	2.63	+	0.65	Agree
4. I practice by repeating the contents of the material.	2.75	+	0.69	Agree
5. I know how the step-by-step of applying GIS software.	2.55	+	0.66	Agree
6. I can now apply GIS without looking at the material.	2.36	+	0.70	Disagree
7. I can interpret maps using GIS overlay.	2.57	+	0.66	Agree
8. I can now analyze map overlay using GIS.	2.51	+	0.68	Agree
9. I am confident to share my skills with my classmates.	2.33	+	0.73	Disagree
10. I am confident to train GIS for those who want to know GIS.	2.27	+	0.81	Disagree
Weighted Mean	2.59	+	0.55	Agree

Note: 3.25-4.00, Strongly Agree; 2.50-3.24, Agree; 1.75-2.49, Disagree; 1.00-1.74, Strongly Disagree

Table 7 presented the perception of the respondents in the integration of Geographic Information System (GIS)-based learning as to mastery goals. The result showed that the item # 1, the respondents agree with the highest mean (3.00) and SD (+ 0.54) that the perception on the integration of GIS-based learning, which indicates they understood the concept of GIS. It implied that learning GIS helps students enhance their ability to generate and recognize some spatial concept.

In addition, Kolvoord et al. (2019), integration of geospatial technology helped students see patterns of human movement, population distribution, and interactions between humans and the environment in the form of interactive digital maps, which helped internalize concepts better. On the other hand, the lowest mean result showed that the item # 10, the respondents disagree with the mean (2.27) and SD (+ 0.81) which indicate that they were not confident to train GIS for those who wanted to know GIS. This was evident because the respondents found the GIS as challenging. To summarize:

"They found it challenging since GIS-based learning presented a number of typical difficulties for learners. It can be difficult to deal with GIS software's complexity, the difficulties of managing geospatial data, the need to use spatial reasoning, and its interdisciplinary nature. Access to appropriate gear and software can sometimes be a barrier, and keeping up with the rapidly developing GIS technology adds another layer of difficulty".

Moreover, Fleischmann and Westhuizen (2020) argued that the cause for the difficult challenges was the delayed acceptance of GIS and the uncertainty about where and how to begin with GIS practice integration. GIS education has stalled due to multifaceted implementation obstacles; as a result, countries at all stages of development struggle to incorporate GIS practice.

Problem 3: What is the academic performance of the respondents based on the Grade Point Average (GPA) during the 2nd semester A.Y. 2022-2023?

The impact of GIS-based learning on the academic performance may not be uniform on all students. Individual learning styles, preferences, and prior experiences of GIS technology may positively contribute to academic outcomes.

Table 8 presented the academic performance of the respondents based on the Grade Point Average (GPA) during the 2nd semester of A.Y 2022-2023. The result revealed the respondents had a 39% performance rating between 1.6-2.0 which had the highest percent of the grading system. It has a descriptive value of satisfactory based on the MSU-IIT grading system.

In the study conducted by Turkuresin (2021) which showed that GIS affects academic achievement positively at a very large level, thus, it was important in terms of showing how important GIS especially in affecting students' success and so, it was thought that increasing the used of GIS in lessons would be a great contribution to increase the success of students.

Table 8. *Academic Performance*

Performance Rating	Frequency Count	Percentage (%)
1.0 – 1.5	41	34.7
1.6 – 2.0	46	39.0
2.1 – 2.5	24	20.3
2.6 – 3.0	7	5.9
3.1 – 5.0	0	0
Total	118	100.0

Problem 4: Is there a significant relationship between the respondents' demographic profile and their academic performance?

The researcher tested the significance of the respondent's demographic profile and their academic performance by using the Chi-squared test in which data revealed as shown in the table:

Table 9. *Relationship[1] Respondents' Academic Performance and Demographic Profile*

Variables	Academic Performance		Remarks	Decision
	X^2 (df)	p-value		
Age	31.538*** (9)	<0.000	Significant	Reject Ho
Sex	2.643ns (3)	0.450	Not Significant	Failed to reject Ho
Availability of learning resources	2.717ns (6)	0.843	Not Significant	Failed to reject Ho
Technology literacy	11.863ns (6)	0.065	Not Significant	Failed to reject Ho
Availability of internet connectivity	3.242ns (3)	0.356	Not Significant	Failed to reject Ho

*Note: 1 – based on Chi-squared Test   ** - P < 0.01   *** - P < 0.001   ns – P > 0.05   * - P < 0.05*

Table 9 displayed the relationship between the respondents' demographic profile and their academic performance. The result showed that the respondents' academic performance had a significant relationship with their demographic profile in terms of age. Thus, the null hypothesis, which stated no significant relationship between the respondents' academic performance and the demographic profile in terms of sex, availability of learning resources, technology literacy, and availability of internet connectivity were not rejected while age was rejected.

According to Viehrig (2014) It could be assumed that older students have a higher achievement in geographic system competency than younger students. Reasons for this are, for instance, the generally increasing maturity, background knowledge, and experience. However, this seems to be the case only to a limited extent. Contrastingly, in this study younger students were mostly surveyed which could also be assumed that the students' impact of GIS-based learning differs by age.

Problem 5: Is there a significant relationship between the respondents' perception on the integration of GIS-based learning and their academic performance?

Table 10. *Relationship[1] Respondents' Academic Performance and Perception on the Integration of GIS-based Learning*

Variables	Teaching Performance		Remarks	Decision
	r-value	p-value		
Academic competency	0.060ns	0.519	Not Significant	Failed to reject Ho
Mastery goal	0.194*	0.035	Significant	Reject Ho

*Note: 1 – based on Pearson's Correlation   ** - P < 0.01   *** - P < 0.001   ns – P > 0.05   * - P < 0.05*

Table 10 displayed the relationship between academic performance and the perception on the integration of GIS-based learning of the respondents. The result showed that the respondents' academic performance had no significant relationship with the perception of the integration of GIS-based learning. Thus, the null hypothesis, which stated that no significant relationship between academic performance and the perception on the integration of GIS-based learning of the respondents, was not rejected. It showed that mastery goal has a significant relationship with respondents' academic performance and the perception on the integration of GIS-based learning in which it referred to the learning material used. The respondents remarked that they still needed to practice more:

"When it comes to GIS, it needs time and practice in order to be adequate enough to use the main functionalities. However, learning this in college would probably be a great tool for courses that mainly focus on using GIS in their future occupation."

In the study of Ridha et al. (2019), the learning material that was employed helped to improve learning objectives. The percentage findings of 77 percent indicated that students understood the topic in the utilizing the GIS learning materials that have been used so far. Students, on the other hand, required innovative and up-to-date GIS learning materials. It was evident because the students were still not confident to train GIS to those who wanted to learn GIS which was deemed important in learning GIS.

Problem 6: Which of the demographic profiles and perception on the integration of GIS-based learning best predict academic performance of the respondents?

The study looked at the association between demographic profiles, perceptions of GIS-based learning, and academic performance, which could provide useful insights into the elements impacting students' success in the subject.

Table 11. *Variables that best predict Respondents' Academic Performance*

Indicator	Unstandardized Coefficients		Standardized Coefficients		
	B	Std. Error	Beta	t	Sig.
(Constant)	0.951	0.747		1.273	0.206
Age	0.580	0.189	0.302	3.067	0.003
Sex	0.038	0.163	0.021	0.233	0.816
Availability of learning resources	0.136	0.119	0.104	1.151	0.252
Technology literacy	-0.031	0.127	-0.023	-0.244	0.807
Availability of internet connectivity	0.315	0.233	0.128	1.348	0.180
Academic competency	-0.323	0.236	-0.154	-1.368	0.174
Mastery goal	0.271	0.183	0.168	1.485	0.140
R = 0.387	R2 =0.150		F = 2.774	Sig. = 0.011	

Table 11 presented the variables that best predict respondents' academic performance. The respondents' academic performance was affected only by the demographic profile in terms of age. This implied that age affected the respondents' academic performance.

The R^2 value of 0.150 implied that 15% of the variance in academic performance could be explained by the demographic profile in terms of age. Hence, 85% of the respondents' academic performance difference could be attributed to other variables not included in the regression model.

The regression analysis was significant, with an F-value of 2.774 with a corresponding p-value of 0.011. Therefore, the null hypothesis stating that "there is no variable singly or in combination that best predicts respondents' academic performance was rejected in terms of age. The p-value of 0.003 of age was a measure of the evidence against the null hypothesis which was relatively low, indicating that the observed results were unlikely to have occurred by random chance alone. This suggested that age, either singly or in combination with other variables, was statistically a significant factor in predicting respondents' academic performance.

When it comes to learning GIS, the age of the students can vary. Zabukovsek et al. (2022) which stated that different results may be revealed with different age groups of users and by users with more advanced knowledge on GIS functionality.

Conclusions

Based on the statistical analysis and findings of this study, the following conclusions were formulated.

It can be drawn that the students have a positive response towards the integration of the GIS-based learning. The majority of them strongly agreed that they were motivated to learn new technologies because they were well literate in terms of technology advancement. It allowed the learner to became more independent of their learning as they find ways to understood the lesson. It was anchored by the connectivism learning theory that produces an examination of technology trends, the evolution of learning, changes in organizations, and the nature and source of knowledge.

From the findings, the academic performance of the learners was good as well. Therefore, it was the innate capacity of the learner to adjust and cope with innovative tools introduced to them. Moreover, it was important to note that there was no significant relationship between sex, availability of learning resources, technology literacy, and availability of internet connectivity to the student's perception on the integration of GIS-based learning, however, age has significant relationship because changes in age were linked to changes in academic performance, and this relationship was not likely to be due to chance alone. The findings might have practical implications for educators, policymakers, or other stakeholders. For example, if the study indicated that older students tend to perform better academically, it could inform decisions about academic interventions, teaching methods, or support services. In another indicator, that mastery goal has a significant relationship with respondents' academic performance and the perception on the integration of GIS-based learning implied that individuals with a mastery goal may view the integration of GIS into their learning environment more positively or differently than those with other goals.

Moreover, GIS-based learning was anchored by a constructivist learning theory which states that active engagement, experiential learning, inquiry-based, problem–based learning, and collaboration with others and also anchored in the connectivism learning theory in which in the learning and teaching process technology became a trend and source of knowledge.

Given the findings derived from the study, the following recommendations are offered:

Tailor instructional approached in which based on the findings on students' perceptions of GIS-based learning, consider modifying

instructional approaches to better line with their preferences and favorable perceptions. Understanding how students perceive the incorporation of GIS-based learning might help guide instructional design. If some features are very well received, they can be highlighted, and if there are any issues, changes can be made.

Addressing barriers and challenges where we identify and address any limitations or challenges revealed in the study related to the integration of GIS-based learning.

Developing strategies to communicate and promote the benefits of GIS-based learning to students because, according to the findings, there is a positive relationship between GIS-based learning and academic performance; therefore, it is critical to ensure that students are aware of the benefits in order to increase motivation and engagement.

Create a mastery-oriented learning environment in which students are motivated by a desire to comprehend and master GIS ideas. The data revealed a substantial association between mastery aim and perception of GIS-based learning; therefore, promoting a syllabus that supports mastery-oriented learning can lead to beneficial outcomes.

Creating a method for continuously evaluating the integration of GIS-based learning and use input to make continuing changes. Education is dynamic, and technology advances; therefore, continually analyzing the success of GIS integration and incorporating feedback ensures that the learning experience remains current and powerful.

Collaboration and interdisciplinary approaches in which we encourage collaboration among GIS educators, as GIS is commonly used across other professions. Collaborative techniques can give students a more thorough understanding of how GIS is used in many contexts by experts from other disciplines, enriching the learning experience.

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