

ACCEPTABILITY OF SELF-LEARNING MODULE USING SKETCHUP TO IMPROVE SPATIAL INTELLIGENCE OF TECHNICAL DRAWING STUDENTS

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ABSTRACT: *This study assesses the acceptability and efficacy of a self-learning module using SketchUp to enhance spatial intelligence among technical drawing students at USTP-Oroquieta. The descriptive research design focused on module evaluation by 75 students and three faculty members, revealing high acceptability across all components such as the title, instruction quality, and learning activities. Both student and faculty ratings affirmed the module's effectiveness, suggesting its potential for broader educational integration. Given the module's success, recommendations include continued use and integration of modular learning in technical curricula, curriculum enhancement based on feedback, and further research to explore generalizability and long-term effects. This approach aims to enhance technical skills crucial in today's digital landscape, preparing students for advanced studies in technical fields.*

Keywords: Curriculum Development, SketchUp, Self-Learning Modules, Spatial Intelligence, Technical Drawing

1. INTRODUCTION

Technical drawing is a critical subject in the Bachelor of Technology and Livelihood Education, aiming to equip students with the necessary skills to excel in their future jobs as TLE teachers [1] and in other allied disciplines [2, 3]. It demands a high level of spatial intelligence, which involves the ability to understand, manipulate, and visualize spatial relationships in both two and three dimensions [4]. Unfortunately, many students enrolled in this course struggle to meet these cognitive demands, as highlighted in recent educational research [5, 6].

Research indicates that a significant portion of students lack adequate spatial intelligence, which is essential for mastering technical drawing [5, 6]. This deficiency can hinder their ability to interpret and create complex designs, a fundamental skill in technical professions. The consequence of poor spatial abilities extends beyond academic challenges, affecting career readiness in highly technical fields like engineering and architecture, where such skills are indispensable.

Students' academic performance, such as in spatial intelligence, has been attributed to ineffective teaching strategies [7, 8] and inadequate learning resources [9, 10]. These factors contribute to students' struggles with academic tasks such as spatial intelligence, which is crucial for visualizing and manipulating objects in space. Furthermore, traditional teaching methods and outdated resources do not align well with the learning preferences and needs of today's technologically adept students [11].

Previous studies have confirmed the relationship between spatial intelligence and academic performance in STEM disciplines [12], highlighting the importance of spatial thinking in educational success. Insufficient spatial intelligence negatively impacts students' performance and can diminish their interest in pursuing advanced studies [13]. This is particularly concerning as Technical Drawing serves as a foundational course that supports more complex subjects in the engineering and architecture curricula.

To address these educational challenges, this study explores the integration of SketchUp, a three-dimensional modeling software, into the technical drawing curriculum. SketchUp has been recognized for its ability to enhance spatial

reasoning and visualization skills through interactive and immersive modeling experiences [14]. SketchUp allows users to create, edit, and view three-dimensional models from multiple angles, providing a dynamic platform to enhance spatial intelligence. Studies have found that tools like SketchUp can significantly improve students' ability to visualize and manipulate spatial constructs [15, 16] Self-Learning Modules.

Recognizing the potential of SketchUp to improve educational outcomes in technical drawing, this study includes the development and implementation of a self-learning module tailored to this software. Self-learning modules are instrumental in promoting self-paced, personalized learning, enabling students to engage with material at their speed and according to their specific learning needs.

The self-learning module designed for this study aims to maximize the educational benefits of SketchUp by providing detailed instructions, interactive exercises, and comprehensive visualizations that enhance understanding and engagement. The content is crafted to support both novice and advanced users, ensuring accessibility for all students. However, the introduction of this new learning module into the curriculum raises questions about its acceptability and effectiveness in a real-world educational setting. Therefore, assessing the module's reception among students and its impact on their learning outcomes is crucial. This study will rigorously evaluate both the effectiveness of SketchUp in improving spatial intelligence and the acceptability of the self-learning modules designed around it. The research conducted at the University of Science and Technology of the Southern Philippines—Oroquieta Campus (USTP-Oroquieta) will provide valuable insights into the potential of digital tools to transform technical education.

Hence, the need for innovative educational tools and strategies in technical drawing is clear. By integrating advanced software like SketchUp into the curriculum through well-designed instructional modules, this study aims to significantly enhance the spatial intelligence of students, preparing them for success in technical disciplines. The findings could lead to broader changes in educational practices and curriculum development across technical fields.

2. RESEARCH QUESTIONS

To address this gap in the literature, this study seeks to answer the research question: What is the extent of acceptability of the learning modules in terms of title, instruction quality, learning objectives, scope, content, and teaching-learning activities?

3. METHODOLOGY

The methodology of this study is based on a descriptive research design, which is ideal for systematically describing the acceptability of a self-learning module using SketchUp among technical drafting students. Descriptive research is the most appropriate approach for this study because it allows for detailed observation and description of participants' behaviors and attitudes without influencing them, aligning with the study's goals of assessing learning outcomes as they naturally occur in an educational setting [17].

The participants of this study were 75 students enrolled in the Technical Drafting class during the second semester of the 2019–2020 academic year, and three faculty members worked in the areas of content, research methodology, and technical. All of the respondents were purposefully selected. We selected the students based on their presence in the sections offering this particular subject. Table 1 presents the demographic profile of the respondents.

The primary instrument used to evaluate the acceptability of the learning module was based on Napoles [18], which focuses on an in-depth analysis of several key aspects: module title, quality of instruction, clarity and relevance of learning objectives, scope and content, and effectiveness of teaching-learning activities. This instrument, validated by three experts in curriculum, research methods, and technical fields, utilized a five-point Likert scale to assess acceptability, ensuring comprehensive feedback from participants. Each of these evaluation criteria is assessed using a five-point Likert scale, ranging from "strongly disagree" to "strongly agree." This scale facilitates a quantitative measurement of participants' perceptions and satisfaction with various dimensions of the module, enabling researchers to identify areas of strength and potential improvement.

Data were analyzed using mean scores and standard deviations to determine the module's level of acceptability. Ethical considerations were meticulously observed; approvals were obtained from university authorities, the subject teacher, and the students, ensuring that respondents' identities remained confidential and their information was securely handled.

In this study involving students, ethical considerations were prioritized to protect the participants. Approval was first obtained from the university authorities, followed by consent from the subject teacher and the students themselves, ensuring that all parties were informed and agreed to the research procedures. To safeguard participants' privacy, their

identities were anonymized, and all personal information collected during the study was kept confidential. These measures ensured the study adhered to ethical standards in educational research, providing a secure framework for the collection and analysis of data.

Table 1. Demographic Profile of the Respondents

Characteristics	Students (n=75)		Instructors (n=3)	
	n	%	n	%
Gender				
Female	42	56	1	33
Male	33	44	2	67
Age				
20 and below	5	6.7		
21-30 years old	67	89.3		
31-40 years old	3	4.0	1	33
41-50 years old			2	67
Area of Specialization				
BTLED HE	39	52		
BTLED ICT	36	48		
Academic Qualification				
Bachelor's Degree			1	33.3
Master's Degree			1	33.3
Doctoral Degree			1	33.3

RESULTS AND DISCUSSION

The overall results of the data analysis from both students and faculty experts are presented in Table 1, while Table 2 details the module's acceptability.

The overwhelmingly positive evaluations of the self-learning module by both students and faculty indicate its broad acceptability and effectiveness in enhancing learning outcomes. This widespread approval across various demographic segments highlights the module's versatility and alignment with educational standards, supporting findings from recent studies that emphasize the importance of inclusive and adaptable educational tools in diverse academic settings [8, 19].

The demographic diversity of the respondents, including a predominance of female students from varied academic disciplines, underscores the module's universal design and applicability. This aspect of the findings aligns with research suggesting that gender and field of study can significantly influence educational engagement and outcomes, advocating for educational resources that are universally appealing and accessible across different demographic groups [20].

The slightly lower ratings by faculty in certain categories such as "Other Characteristics" suggest areas for improvement, pointing to the necessity of ongoing updates and refinements based on user feedback. This iterative approach to educational design is supported by literature that highlights the importance of continuous improvement in educational resources to meet evolving academic needs [21, 22]

Table 2. Acceptability Level of the Learning Module

Module Components	Student Evaluation (n=75)			Faculty Evaluation (n=3)		
	Mean	SD	Description	Mean	SD	Description
The Title	4.68	1.01	Acceptable	5.00	0.63	Acceptable
Instruction	4.63	0.85	Acceptable	4.89	0.97	Acceptable
Learning Objectives	4.60	0.56	Acceptable	4.53	0.88	Acceptable
Scope Content	4.61	1.11	Acceptable	4.58	0.65	Acceptable
Teaching-Learning Activities	4.60	0.81	Acceptable	4.67	0.78	Acceptable
Other Characteristics	4.62	1.20	Acceptable	4.17	0.91	Acceptable
Overall Rating	4.62	0.923	Acceptable	4.64	0.80	Acceptable

Table 3 Mean and Standard Deviation of the Acceptability of the Learning Module

Areas for Evaluation/Question Items		Mean	SD	Descriptio
Title				
1.	The title is comprehensible enough to be understood	4.68	0.471	Acceptable
2.	The contents specific to the module are relevant	4.68	0.471	
Overall Mean		4.68	0.393	
The Foreword/Instruction to the Teachers and Students				
1.	It tells the need for the module in classroom instructions	4.58	0.552	
2.	It is important to the user	4.71	0.515	
3.	It provides clear instructions to teachers and students on how to use the module	4.61	0.547	
Overall Mean		4.63	0.444	
Objective				
1.	The objectives of the lesson provide a clear statement matter of the lesson	4.63	0.541	Acceptable
2.	The learning objectives are related to the scope or subject matter of the lesson	4.66	0.481	
3.	It shows how the students will be evaluated	4.61	0.495	
4.	It precisely states the performance expected, condition, and standard.	4.55	0.555	
5.	The statement is directed to both teachers and students.	4.55	0.555	
Overall Mean		4.60	0.470	
Scope Contents				
1.	The contents of the modular lesson adequately cover the topics specified in the objectives	4.63	0.541	Acceptable
2.	The concepts of each lesson are logically arranged to ensure that there is no duplication of	4.58	0.642	
3.	The given examples complement the given topics.	4.63	0.589	
4.	There is adequate practice for the application of concepts learned	4.61	0.547	
Overall Mean		4.61	0.525	
The Teaching-Learning Activities				
1.	The instructions for each exercise provide a clear direction for the students to follow	4.66	0.481	Acceptable
2.	The activities are related to the skills being developed	4.68	0.471	
3.	The activities are practical and feasible for the students to perform	4.59	0.498	
4.	The exercise encourages the students to become actively involved in each learning task	4.62	0.492	
5.	The student's activities are appropriate for different learning styles.	4.61	0.495	
6.	The activities suit the general intellectual level of the students in the class	4.47	0.557	
7.	The learning materials provide learner's readiness for self-directed learning	4.53	0.603	
8.	The activities allow immediate feedback and corrective process	4.50	0.604	
9.	The activities seek to relate new learning to previous learning	4.66	0.481	
10.	The activities are designed to be challenging to the learners	4.63	0.489	
Overall Mean		4.60	0.401	
Other Characteristics				
1.	The pictures, drawings, or illustrations attractive	4.66	0.481	Acceptable
2.	There's an adequate guide or instruction for both teachers and students in the use of the	4.66	0.534	
3.	It is cost-effective to allow dissemination in case the module will be used by other Lumion 6	4.55	0.504	
4.	The equipment tools are easily acquired in case the students need them	4.47	0.647	
Overall Mean		4.59	0.391	
Evaluation				
1.	The evaluation makes use of a variety of techniques such as problem-solving	4.39	0.718	Acceptable
2.	The evaluation makes use of a variety of techniques such as Paper tests, Lab Exercises, and	4.42	0.599	
Overall Mean		4.41	0.568	

Overall, the high ratings from both students and faculty not only validate the module's educational design but also its effectiveness in meeting the learning needs of a diverse student body. This is consistent with studies that have demonstrated the positive impacts of well-designed educational tools on student learning and satisfaction [6].

The success of the module in this study suggests the potential for wider application and integration into curricula, which could significantly enhance the development of technical skills necessary in today's digital landscape. Future research might explore the long-term impacts of such modules on academic and professional success, providing further evidence to support the integration of similar tools in educational settings [6, 23].

RECOMMENDATIONS

Based on the results of this study, the following recommendations are proposed:

Continued Use of Modular Learning. Educational institutions may continue to implement modular learning approaches, especially in technical subjects such as Technical Drawing. The high level of acceptability and effectiveness demonstrated by the self-learning module underscores its potential to enhance student understanding and engagement. Schools may invest in further developing and customizing these modules to meet the diverse learning needs of students.

Improvement in Curriculum Design and Implementation. It is recommended that curriculum designers integrate modular learning elements more extensively across different disciplines. This integration may be supported by ongoing research and feedback from both students and educators to refine the content and delivery methods. Such an approach will not only cater to varied learning styles but also ensure that the curriculum remains relevant and effective in promoting significant learning outcomes.

Guidance for Future Researchers. Future studies may consider replicating this study in different educational contexts and with varied demographic profiles to test the generalizability of the findings. Researchers may also explore longitudinal studies to assess the long-term impacts of modular learning on student success and retention in technical fields. Additionally, comparing the effectiveness of various types of self-learning modules could provide deeper insights into the specific design features that most significantly influence learning outcomes.

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