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ENHANCING STUDENTS' TECHNICAL COMPETENCE IN DRAWING USING ISOTOP APPLICATION

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Abstract: While isometric drawing and orthographic projection are crucial for engineers and designers, traditional methods can be a hurdle. This study investigated whether the ISOTOP mobile app could improve students' technical drawing skills. The app aimed to bridge the gap between traditional and modern methods in making Isometric and Orthographic Projections, irrespective of their background or experience. The research suggests that engaging mobile applications can make technical drawing both more enjoyable and effective. The study employed a quasi-experimental design, specifically a single-group pretest-posttest approach to achieve this. Grade 10 students' initial technical competence in manual isometric and orthographic drawing was assessed. A sample object (photo) was presented to the group without using ISOTOP. Experts then evaluated the output using scoring rubrics. The intervention with the ISOTOP application was then introduced. The results, based on the scoring rubrics, indicated that students' technical competence improved significantly using ISOTOP compared to the traditional manual method. It showed a significant improvement, with average scores jumping from "Satisfactory" in the pre-test to "Excellent" in the post-test. This suggests that the ISOTOP application can effectively address skill gaps and enhance students' technical abilities in these areas. Additionally, the low standard deviation in the post-test scores indicates a consistent level of improvement across the participants. Therefore, these findings suggest that technology-aided learning with ISOTOP can be a highly effective method for enhancing students' skills in isometric and orthographic drawing. This approach can not only foster a deeper understanding of spatial relationships but also create a more engaging learning experience for students.

Keywords: ISOTOP, Technology, Isometric, Orthographic, Technical Competence, Drawing.

I. INTRODUCTION

Background of the Study

Developing strong technical skills in drawing is crucial for students in various fields, especially those pursuing engineering, architecture, or design. Traditional methods of learning these skills can be time-consuming and challenging for some students. Therefore, before a product can be manufactured, it must first be designed. Isometric drawing and orthographic projection are fundamental concepts that form the basis for understanding spatial relationships and creating technical drawings.

Isometric drawing, a technique used in technical and architectural fields, allows visualization of threedimensional objects on a two-dimensional surface (Craig, 2022). As a way to show how different parts and measurements of an object come together. The term "isometric" comes from the Greek word "isos" meaning "equal," reflecting the use of three axes that all meet at a single point and form 120-degree angles with each other. This method relies on a foundation in orthographic projection, which involves creating separate flat views, namely the top, front, and right side of an object to capture all the necessary details (Einde et al., 2022). By understanding orthographic views, students can then build upon this knowledge to construct isometric drawings, a valuable skill for visualizing and communicating spatial relationships. In essence, isometric drawing acts as a bridge, allowing students to translate 3D concepts into a clear and understandable 2D format (Giesecke, et al., 2018).

Orthographic projection is a fundamental drawing technique used to represent three-dimensional objects in two dimensions. It achieves this by creating multiple flat views of the object, typically a top view, a front view, and a side view. Imagine standing directly in front of, above, and to the side of the object, and tracing only the visible edges onto a flat surface (Sophiarichardson, 2020). These views are then arranged together in a specific layout to provide a comprehensive understanding of the object's shape and dimensions. Unlike perspective drawing, orthographic projection does not depict depth or vanishing points (Gallardo-Echenique, et al., 2015). Instead, it prioritizes accuracy and maintains

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true proportions of the object's features in each view. This makes it a valuable tool for engineers, architects, and designers who need to clearly communicate the details and dimensions of their creations (Paler, 2019).

Traditionally, drafting isometric drawings was done manually using pencil, paper, and other drawing and drafting tools. Even in the digital age, this technique persisted in schools and universities offering trade drawing and drafting subjects. For example, Capiz State University-Main Campus prepared high school students for tertiary courses in engineering and other related fields through this approach.

However, isometric and orthographic projections often presented challenges for students, especially those whose chosen fields did not necessarily align with drawing skills. Students from various trades historically reported difficulties with the required drawing outputs. In some cases, students even transferred to other schools due to a lack of skills and interest in the subject. These experiences highlighted the importance of both skills and interest in mastering isometric drawing. Technical competence, including accuracy and speed, was crucial to complete drawings within the allotted timeframe while still maintaining aesthetics and functionality (Ilomäki, et al., 2016). Beyond conceptual challenges, students often struggle with visualization skills but still, they must do it for all CAPSU students in laboratory high school should have the output to present. Three-dimensional concepts like isometric projection, a common method in drafting classrooms, were taught using passive learning approaches, potentially leading to a heavy cognitive load (Krasulia, 2018).

The rise of mobile devices has fundamentally changed how people work and learn (Almerich, et al., 2016). These ubiquitous gadgets, particularly popular among today's tech-savvy students, empower them to explore the various features and functions of their devices. His worth noting that compared to earlier models, today's mobile devices boast greater sophistication and advanced capabilities (Krasulia, 2018). This shift necessitates the identification of suitable teaching and learning approaches that maximize student engagement. The ideal approach would involve students taking an active role in their learning, with technology supplementing rather than replacing the role of the instructor (da Silva & Agostinho, 2018). So, the development of technology has opened doors for incorporating mobile applications and software into teaching, fostering a progressive learning environment. This approach is further bolstered by the availability of sophisticated, affordable, and reliable communication technologies.

Mobile devices offer the exciting potential for learning to happen anywhere, anytime (Astra, et al., 2015). Based on this premise, the researcher conducted a study to determine whether using the ISOTOP could enhance students' technical competence in drawing. ISOTOP mobile application is an Android application designed to help students and teachers in K-12 develop and improve their isometric drawing skills. It allows users to create a wide variety of isometric objects. These blocks come with their corresponding top, front, and side views (orthographic projections) for easy reference. The application even highlights hidden lines and coplanar faces for better understanding. The application's offline functionality on mobile phones made it a promising tool to address the difficulties associated with isometric projection in drawing subjects. The researcher utilized the ISOTOP application as an intervention strategy, aiming to improve the technical competence of students in drawing, regardless of their trade specialization, skill level, or prior experience. This study investigated the potential of the ISOTOP application to bridge this gap and enhance technical competence in drawing.

Theoretical Framework

This study was anchored on the theories related to mobile applications and technology's influence on learning. Four (4) theoretical frameworks are particularly relevant for this study on mobile applications and technology which have significantly influenced learning in various ways, namely: Constructivism, Connectivism, TPACK Theory, and the Elaboration Theory.

Constructivism, advocated by Jean Piaget and Lev Vygotsky, emphasizes the active role of learners in constructing their knowledge. Mobile apps can provide interactive and engaging environments that allow learners to explore, experiment, and build their understanding through hands-on activities (Hannafin & Landrum, 2018).

Next is Connectivism which was proposed by George Siemens. Connectivism highlights the importance of connections and networks in the learning process. Mobile apps can facilitate connections to information, resources, and other learners through online communities and collaborative tools, fostering a more networked and distributed learning experience (Siemens, 2015).

On the other hand, the concept of TPACK (Technological Pedagogical and Content Knowledge) developed by Mishra and Koehler (2006), Emphasizes three crucial knowledge areas for educators. Effective technology integration hinges on

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educators possessing a strong foundation in all three and seamlessly blending them. Furthermore, this theory draws upon existing learning theories like constructivism to explore how technology can best support specific learning goals and enhance existing teaching approaches. The focus is on fostering student-centered environments that promote active learning, collaboration, and personalized experiences through technology. Finally, the theory emphasizes the importance of assessment and evaluation, ensuring technology effectively advances learning outcomes and improves teaching practices.

And lastly, the Elaboration Theory proposed by Craik and Lockhart (1972), suggests that learning is enhanced when new information is connected to existing knowledge. Mobile apps can provide multimedia content, simulations, and real-world examples that help learners connect new concepts to their existing knowledge base, leading to deeper understanding.

Therefore, these learning theories provide a strong theoretical foundation for why the ISOTOP application might be effective in enhancing students' technical drawing skills. The various learning theories like Constructivism (active exploration through app features), Connectivism (potential online communities for collaboration), Technological Pedagogical and Content Knowledge (TPACK), and Elaboration Theory (multimedia content connecting new concepts to existing knowledge) all provide a theoretical framework for why the ISOTOP mobile application could be effective in enhancing students' technical drawing skills.

These theories highlight how the app's design elements can promote active learning, build confidence, increase motivation, and facilitate deeper understanding, potentially leading to significant improvement in students' technical abilities. The app's potential to promote active learning, connect learners, build confidence, increase motivation, and facilitate connections with prior knowledge aligns with the principles of these well-established learning theories.

Significance Of The Study

The findings of this study might benefit Grade 10 and Engineering students, Drafting and Engineering Teachers, Art enthusiasts, and future researchers.

Grade 10 and Engineering Students. The results of the study would give them the skills to interpret problemsolving and in performing orthographic projection in reading, which would lead to good academic performance. This, in turn, it could give them the self-confidence to continue learning and overcome the hardships they faced with the subject.

Drafting and Engineering Teachers. The results of the study would be beneficial to teachers. This could be adopted by other teachers as a strategy similar to the needs of their students and could be incorporated into the curriculum of universities that offered drawing and drafting courses.

Art Enthusiasts. The results of the study would have give techniques to help them design projects more effectively and efficiently as well as accurately, for example in wood-turning furniture making and other trade industries where isometric drawing is needed.

Future Researchers. The results of the study, would serve as a basis for conducting similar studies that would contribute to the enhancement of the technical competence of the academic performance of the students in drafting and drawing subjects.

Scope and Limitations of the Study

This study employed a quasi-experimental research design employing a pre-test-post-test one-group design to assess the technical competence in drawing of Grade 10 students at Capiz State University-Main Campus Laboratory High School, following their use of the ISOTOP application.

A quasi-experimental approach is a research design that attempts to establish cause-and-effect relationships, similar to true experiments, but with some key limitations. While the design allows for comparison of pre-test and post-test scores, it does not guarantee that any observed change is solely due to the application (Cook and Campbell, 2019). This study involved seventeen (17) Grade 10 students majoring in Foods who encountered difficulties in technical competence in isometric and orthographic projections in drawing subjects. A structured scoring rubric was used to evaluate the performance of the participants. In analyzing the data mean and paired t-tests were used as statistical procedures.

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II. METHODOLOGY

This chapter includes a detailed description of the research design and methodology utilized to obtain the research objectives. The study's methodology includes a description of the place and respondents of the study, the research instrument used to gather the needed data, and the data gathering and analysis procedures.

Research Design

This study attempted to ascertain the effects of ISOTOP application on the technical competence of the Grade 10 Foods major students in drawing. The goal afterward was to develop instructional material for making Isometric and Orthographic projections using the ISOTOP application.

The researcher employed a quasi-experimental design to establish a cause-and-effect (Thomas, 2022) to attain these objectives. The researcher used quasi-experimental specifically pretest and posttest design. Given the research one group only, the research design used was a "single-group pretest-posttest design" (Abdullah, 2018).

Quasi-experimental research is not truly experimental in design, outcome causality cannot be determined, rather associations between interventions and outcomes are made. Pre-test and post-test evaluation also allows for immediate assessment of an intervention and provides a means for rapid refinement of instructor teaching or simulation techniques (Stratton, 2019).

The research mechanism was conducted through three stages. The nature of the quasi-experimental study enables the researcher to determine the technical competence of Grade 10 students in making isometric and orthographic projections using the ISOTOP application. The researcher has given the instruction, size and measurements in making isometric and orthographic projections to determine the technical competence of the participants without using the ISOTOP application, and to evaluate their output the researcher provided scoring rubrics to assess the participant's technical competence when it comes to, workmanship, accuracy, speed, and neatness after a week they had given the intervention which is with the used of ISOTOP application. Using Scoring rubrics researcher determined whether the students enhanced their technical competence using the ISOTOP application compared to the traditional methods of making isometric and orthographic projections.

In a pretest-posttest design, the dependent variable is measured once before the intervention is implemented and once after it is applied, if the average post-test score is better than the average pretest score, It makes sense to conclude that the intervention might be responsible for the improvement.

This study attempted to acertain the effects of using the mobile application ISOTOP and also create design and enhance the technical skills in making isometric and orthographic projections the grade 10 foods major students. The goal afterward was to develop instructional materials for performing isometric drawing and adding digital and high technology which is the ISOTOP application to the existing method of teaching drawing subjects also to help students with their hardship in drawing and catch their interest in performing.

Participants of the Study

The participants of the study were the seventeen (17) Grade 10 Food major students of the Laboratory High School at Capiz State University-Main Campus, taking the subject Trade Drawing IV during the Academic Year 2023 – 2024.

Research Instrument

The data needed for this study were obtained by providing instructions in making isometric and orthographic projections that were presented during the class discussion based on the topic.

For the assessment of isometric and orthographic projections, the research instrument was a scoring rubrics validated by the advisory and the examining committee. Remarks and suggestions for the revision or enhancement of the rubrics were consolidated, incorporated, and submitted for approval. The scoring rubric was composed of four categories: workmanship, accuracy, neatness, and speed. Workmanship (10 points) is assessed based on whether the isometric and orthographic projections are unique and complicated, moderately unique, simple, and very simple, or if no isometric or orthographic projections are observed. Accuracy (5 points) is assessed based on how well the steps and principles in the drawing are applied, following the precedence of lines. Neatness (5 points) is measured based on how the students keep

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their drawing clean, which means no excess lines or double strokes of lines will be observed. Speed (5 points) measured whether the drawing is completed and handed in on time.

After the validation and approval of the instrument, the finalized rubrics was used for gathering the data. The researcher then conducted a face-to-face validation of students' output with the use of scoring rubrics.

The scoring rubric used has a total of 25 points which assessed students' isometric and orthographic projections created before and after using the ISOTOP application. Scores translated to technical competence: 20.2125.00 points indicated excellent work, 15.41-20.20 points very satisfactory, 10.61-15.40 points satisfactory, 5.81-10.60 points needing improvement, and 1.00-5.80 points considered poor.

Score Interval	Descriptive Rating	Description
21-25	Excellent	Isometric and orthographic projections are unique and complicated. and have adequate knowledge. Line, weights, and styles are accurate. arrangement, sizes, and proportions of the object accuracy, neatness, and speed are performed excellently.
16-20	Very Satisfactory	Isometric and orthographic projections are moderately unique and complicated, and line weights and styles are mostly accurate. The arrangement, sizes, and proportions of the object are very satisfactory.
11-15	Satisfactory	Isometric and orthographic projections are moderately unique and simple, and line weights and styles are fairly accurate. The arrangement, sizes, and proportions of the object are satisfactory.
6-10	Needs Improvement	Isometric and orthographic projections are very simple. Line weights and line styles are less accurate. The arrangement, sizes, and proportions of the object need improvement.
1 - 5	Poor	Uniqueness of drawings and projection is not observed, and the line weights and line styles, arrangement, sizes, and proportions of the object are inaccurate..

Data Gathering Procedure

The data gathering procedure of this study was divided into 3 phases, namely Phase 1– pre-experimental; Phase 2 – the experimental; Phase 3 – post-experimental.

In the Phase 1 pre-experimental phase, the researcher identified the participants as the Grade 10 Foods major students of Laboratory High School at Capiz State University Main Campus for Academic Year 2023-2024. Rubrics validation (validating scoring rubrics by experts, and preparing the final draft) of the researcher was made to be used for evaluation. In the Phase 2 experimental, the researcher administered the pre-test to determine the students' technical competence in making isometric and orthographic projections before using the ISOTOP application. After gathering the pre-test result, the researcher gave it to the experts for evaluation, and the results were gathered and get the mean score using SPSS.

In the Phase 3 post-experimental, a posttest was administered to the same group but this time participants used the ISOTOP application as an intervention in making isometric and orthographic projections. The results of the posttest were gathered and compared. The mean results of the pretest and post-test were use to analyze the effects of using the intervention in making isometric and orthographic projections before and after using the ISOTOP application.

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Data Analysis Procedure

Several statistical treatments were utilized to analyze the data. With the use of SPSS version 20, all computations were appropriately done.

For the descriptive part, the mean was utilized, and the Paired T-Test was used for the test of difference.
Mean. This was used to determine the students' increase in performance relative to their scores before and after the intervention.

Paired t-test Samples. A paired t-test is a statistical procedure used to compare the mean scores, normally from the study, using one group pretest and post-test results. A Paired t-test examines the within-group differences of a single group. So the same subjects are the respondents for both pairs of measurements. This means that the "related groups" are the same participants producing the same scores or measurements in both groups. The researcher can measure the same participants in each level of the independent variable because the measurement or scoring for each participant will be taken at two distinct time points.

In the decision to reject or accept the null hypothesis, this study used a two-tailed test set 0.05 level of significance.
Both data from one-shot pretest and posttest mean results were analyzed using the Statistical Package for Social Science (SPSS) Software.
One-shot study case- A single group is studied at a single point in time after some treatment that is presumed to have caused change. The carefully studied single instance is compared to general expectations of what the case would have looked like had the treatment not occurred and to other events casually observed. No control or comparison group is employed.

III. RESULT AND DISCUSSION

Based on the results and discussions of the study, the researcher found the following key findings:
The mean score of the participants before using the ISOTOP application for technical competence in making isometric and orthographic projections was Satisfactory.

The mean score of the participants after using the ISOTOP application for technical competence in making isometric and orthographic projections was Excellent.

There was a significant difference before and after the use of the ISOTOP application. The mean score after the use of the intervention was higher than the mean score before the intervention. This showed that the participants remarkably improved in making isometric and orthographic projections. From satisfactory with the use of the ISOTOP application and excellent results after the use of the ISOTOP application.

IV. CONCLUSION AND RECOMMENDATION

Conclusions

The following conclusions were drawn based on the summary of findings of the results in the study:
The study result indicates that while the students grasped the basic concepts, there is a room for improvement in their technical skills. The study's findings suggest that the intervention using the ISOTOP application has the potential to address this by significantly enhancing students' abilities in these areas.

The results demonstrate that the ISOTOP application is a successful intervention for improving students' isometric and orthographic drawing skills. Compared to their pre-test scores, students' performance significantly increased after using the application, achieving an average score categorized as excellent with a low standard deviation, indicating overall improvement and consistency across the participants.

The ISOTOP application is valuable for improving students' isometric and orthographic drawing skills. This
study found a statistically significant improvement in students' isometric and orthographic drawing skills after using the ISOTOP application and the results strongly suggest that the ISOTOP application is an effective tool for enhancing students' technical abilities in these areas.

Recommendations

The study's findings suggest several avenues for improvement.
Students are encouraged to actively explore the ISOTOP application, utilizing its interactive features and practice exercises to solidify their understanding of isometric and orthographic drawing. When encountering challenges, they may seek help from teachers or classmates.

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For teachers, integrating the ISOTOP application into their curriculum as a supplementary learning tool is recommended. It can be used for guided practice, independent learning activities, or homework assignments. However, before implementing it, teachers may familiarize themselves with the application's functionalities and offer guidance to students on navigating and utilizing it effectively.

Art enthusiasts interested in learning isometric and orthographic drawing can benefit from exploring the ISOTOP application for self-learning. Its interactive nature offers an engaging and efficient learning experience. Additionally, joining online communities dedicated to these drawing techniques can provide valuable resources for sharing experiences, asking questions, and receiving feedback.

Curriculum developers are encouraged to investigate the potential of including the ISOTOP application as a recommended learning resource in curriculum materials. Developing complementary learning materials that can be used in conjunction with the application can further enhance the learning experience.
Finally, future researchers may explore the long-term impact of the ISOTOP application on students' knowledge and skill retention. Additionally, investigating the application's effectiveness in different learning contexts, such as with varying learning styles or educational settings, would be valuable. Comparative studies assessing the ISOTOP application against traditional methods or other technology-aided learning tools would also contribute to a deeper understanding of its effectiveness.

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