STATICALC: AN INTERACTIVE WEB-BASED LEARNING TOOL WITH INTEGRATED CALCULATORS FOR STATICS OF RIGID BODIES FOR CIVIL ENGINEERING STUDENTS OF MSU-GENERAL SANTOS

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IAN CARL P. COÑA
SOPHIA DAPHNE C. FAELNAR

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Chapter 1
Introduction

1.1 Background of the Study

Engineering education is the process of acquiring the knowledge, skills, and competencies necessary to prepare individuals for professional engineering practice. One of its foundational areas is *Engineering Mechanics*, which concerns the effects of forces and energy on bodies. It is divided into two branches: *Statics* and *Dynamics*. Among these, *Statics of Rigid Bodies* plays a crucial role in the engineering curriculum because it establishes the principles of equilibrium and force analysis, which are required in advanced engineering courses. It focuses on analyzing how forces and moments act on particles and rigid bodies that remain at rest or in equilibrium.

In the Civil Engineering curriculum of Mindanao State University – General Santos (MSU-Gensan), as stated in *MSU Board Resolution No. 375, s. 2017*, *Statics of Rigid Bodies (ENS 161)* serves as one of the core foundation courses in Engineering Mechanics. It is a prerequisite for *Dynamics of Rigid Bodies (ENS 162)* and *Mechanics of Deformable Bodies (CVE 155)*, both of which are essential for higher-level design and analysis. In other engineering programs, such as Mechanical, Electrical, and Agricultural and Biosystems Engineering, Statics also functions as a preparatory course that cultivates analytical and problem-solving skills fundamental to engineering education. Failure in this subject often results in academic delays, as it serves as a prerequisite for subsequent major engineering courses. (Salami and Perry)

Despite its foundational importance, *Statics of Rigid Bodies* remains one of the most conceptually and mathematically demanding subjects in the engineering curriculum. The discipline requires a solid grasp of trigonometry, geometry, and algebra. Without this mathematical foundation, students struggle to analyze forces, moments, and equilibrium conditions accurately.

A study conducted at Baguio Central University revealed that incoming first-year students exhibited mathematical difficulties that affected their readiness for college-level subjects, particularly in algebra (Felix). Similarly, research among first-year students at Mandaue City College found that math anxiety, a feeling of tension and apprehension when solving mathematical problems, negatively correlates with academic performance, meaning that higher levels of math anxiety are associated with lower academic achievement. (Incierto et al.)

The use of calculators and digital tools has been shown to help reduce computational errors and mitigate math anxiety by allowing students to focus on conceptual understanding rather than manual computation. (Segarra and Cabrera-Martínez) Studies further indicate that combining calculator use with structured instruction enhances problem-solving confidence and overall comprehension.

In addition to mathematical difficulties, students face several conceptual and procedural challenges in learning Statics of Rigid Bodies. Many struggle to connect physical concepts with their mathematical representations, often perceiving forces and moments as abstract quantities rather than as real interactions between bodies. This lack of conceptual understanding frequently leads to errors in constructing Free Body Diagrams (FBDs), such as omitting essential forces, misplacing directions, or confusing internal and external forces. Learners also experience difficulty distinguishing between related concepts such as moments, couples, and resultant forces, as well as visualizing how forces act within two- and three-dimensional structures. Moreover, students often rely on rote memorization of formulas and procedural steps without fully grasping their physical meaning, resulting in shallow learning and difficulty applying knowledge to new problem situations. These difficulties are further compounded by traditional lecture-based teaching methods, which limit interaction, visualization, and engagement, factors essential for developing a deeper understanding of statics principles (Salami and Perry).

Students currently taking *Statics of Rigid Bodies* at MSU-Gensan are generally second-year Civil Engineering students, typically aged 19 to 20. This group belongs to Generation Z, often referred to as digital natives, individuals who have grown up surrounded by computers, smartphones, and the internet. According to Szymkowiak et al., educators should integrate modern, Internet-based learning tools, such as mobile applications and online videos, alongside traditional instruction to align with this generation's learning preferences. Similarly, Zeichner emphasized that learning through simulations fosters a deeper understanding of abstract concepts than conventional teaching methods. Consistent with the findings of De La Hoz et al., traditional lecture-based approaches in statics are insufficient to address these learning barriers, highlighting the need for innovative digital tools that enhance engagement, comprehension, and problem-solving skills among engineering students. In the context of *Statics of Rigid Bodies*, where students often struggle with visualization and conceptualization, these insights underscore the need for interactive, technology-supported learning environments.

Given these mathematical and conceptual challenges, there is a clear need for a supplementary, technology-driven learning resource that can combine computational assistance, visualization, and interactivity. To address this need, the researchers developed *StatiCalcs*, an interactive web-based learning tool designed specifically for *Statics of Rigid Bodies*. The platform organizes topics according to the major chapters of the course: Introduction to Statics, Force Systems, Equilibrium, Structures, and Distributed Loads. And it integrates calculators that generate step-by-step solutions, results, and free-body diagrams in real time. By merging conceptual explanations with computation and visualization, *StatiCalc* aims to enhance students' understanding, reduce learning anxiety, and reinforce classroom instruction.

Recognizing students' characteristics, the researchers saw potential in developing a digital learning platform that aligns with students' familiarity with technology while addressing learning challenges in *Statics of Rigid Bodies*. Through this innovation, the study seeks to bridge the gap between traditional teaching methods and digital learning practices by providing MSU-Gensan Civil Engineering students with an accessible, interactive, and effective academic support tool for studying *Statics of Rigid Bodies*.

1.2 Statement of the Problem

This study aims to determine the level of perception of Civil Engineering students and instructors of MSU-General Santos on the developed web-based learning tool, *StatiCalc*, designed for the subject *Statics of Rigid Bodies*. The study seeks to assess how the tool performs in terms of usability, accessibility, and user satisfaction.

Specifically, this study aims to answer the following questions:

1. What is the level of perception of Civil Engineering students of MSU-General Santos regarding *StatiCalc* in terms of:
   - 1.a. Usability
   - 1.b. Accessibility
   - 1.c. Satisfaction
2. What is the level of perception of Civil Engineering instructors of MSU-General Santos regarding *StatiCalc* in terms of:
   - 2.a. Usability
   - 2.b. Accessibility
   - 2.c. Satisfaction
3. Is there a significant difference between the level of perception of students and instructors in terms of usability, accessibility, and satisfaction?

1.3 Scope and Limitations

This study focuses on the design, development, and evaluation of a web-based learning tool, StatiCalc, intended to assist Civil Engineering students of Mindanao State University – General Santos in studying the subject Statics of Rigid Bodies. The website covers all major topics in Statics, including force systems, equilibrium, structures, centroids, moments of inertia, and friction. It integrates conceptual explanations and calculators to help users understand and solve problems interactively. The evaluation of the tool focuses on three aspects: usability, accessibility, and user satisfaction.

The respondents of the study are limited to Civil Engineering students, specifically second-year students currently enrolled in Statics of Rigid Bodies and senior students who have already taken the subject, as well as instructors teaching the same course in the College of Engineering of MSU-General Santos during the Academic Year 2025–2026. The data were collected through survey questionnaires administered after the respondents had explored and used the developed website

The study does not measure students' academic performance or actual improvement in examination results. It also excludes students and instructors from other engineering programs and subjects such as Dynamics and Mechanics of Materials. Moreover, the study focuses solely on perceptions regarding the usability and effectiveness of the developed tool and does not account for external factors such as internet connectivity, learning motivation, or prior knowledge of the respondents.

1.4 Significance of the Study

This study is conducted to develop a web-based learning tool, *StatiCalc*, which aims to support the teaching and learning of Statics of Rigid Bodies among Civil Engineering students of Mindanao State University – General Santos. The results and outcomes of this research are expected to benefit the following:

Students. The developed website serves as a supplementary learning tool that allows students to practice problem-solving in Statics of Rigid Bodies through an interactive and user-friendly platform. As learners today are inclined toward technology-based education, *StatiCalc* provides an accessible and engaging way to enhance understanding and reinforce classroom instruction.

Teachers. The tool can be integrated into teaching strategies to improve the delivery of complex statics concepts. It may also assist instructors in providing visual and computational demonstrations that complement lectures and classroom exercises.

School Administration. The study may provide the institution with an example of how digital learning tools can be developed and implemented to improve academic performance. It may also encourage future initiatives that promote technology-driven learning in other engineering courses.

Future Researchers. This study may serve as a reference for future studies that aim to develop similar educational tools or further improve *StatiCalc* by adding new features, expanding its scope, or evaluating its long-term impact on student learning.

1.5 Conceptual Framework

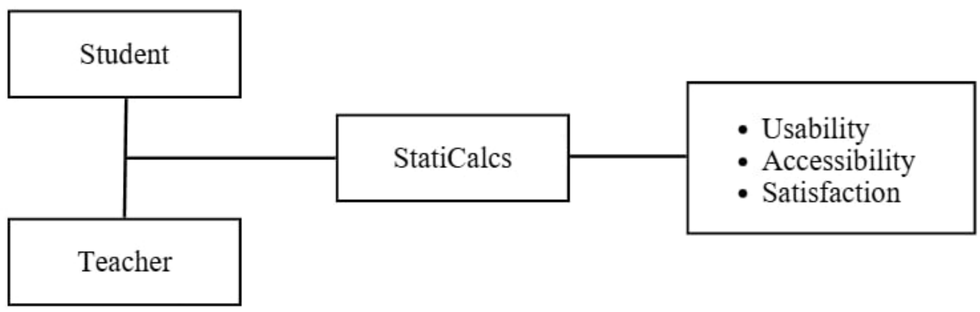

Figure 1. Conceptual Framework

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Statics of Rigid Bodies

Statics of Rigid Bodies is a branch of engineering mechanics that deals with the study of forces and their effects on bodies that are assumed to remain perfectly rigid. It focuses on determining the conditions of equilibrium, where the sum of all forces and moments acting on a body equals zero to ensure structural stability. This is the course that serves as the primary focus of the web-based learning tool developed by the researchers. It involves the study of forces, moments, and their effects on bodies that are assumed to remain perfectly rigid.

Equilibrium

Equilibrium refers to the condition of a body when the sum of all forces and the sum of all moments acting upon it are equal to zero, meaning the body remains at rest or moves with constant velocity.

Free Body Diagram (FBD)

A Free Body Diagram (FBD) is a simplified graphical representation of a body or system isolated from its surroundings, showing all external forces and moments acting on it. It is used to visualize and analyze the forces acting on the body.

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Web-Based Learning Tool A web-based learning tool is an interactive educational platform or software accessible through the internet, designed to facilitate learning through engagement, visualization, and feedback.

Developmental Research Developmental research is a methodological approach that focuses on the systematic design, development, and evaluation of instructional programs, processes, or products to improve educational practice.

Perception Perception is the process by which individuals interpret and organize sensory information to create meaning and understanding of their environment. In educational research, it often refers to how learners view or experience a certain tool, concept, or environment.

Usability Usability refers to the degree to which a product, tool, or interface allows users to achieve specific goals effectively, efficiently, and satisfactorily in a defined context.

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Accessibility	Accessibility is the design of products, systems, or environments that can be used by people of all abilities, including those with disabilities, to perceive, understand, navigate, and interact effectively.
Satisfaction	Satisfaction refers to the degree to which users feel content or fulfilled with a product, service, or experience, often reflecting how well it meets their expectations and needs.
Supplementary	Supplementary refers to something that is added to complete, enhance, or support something else. In the context of education or research, supplementary materials or tools provide additional resources that aid in understanding, reinforcement, or enrichment of learning.

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Digital Natives

Digital natives are individuals who have grown up during the age of digital technology, such as computers, smartphones, and the internet, and are thus comfortable using these tools in daily life. These refer to the generational group that represents the target population of the study. They are individuals who have grown up in the age of digital technology and are highly familiar with the use of computers, the Internet, and web-based applications.

Generation Z

Generation Z refers to the demographic cohort born roughly between the mid-to-late 1990s and the early 2010s. They are characterized by their familiarity with digital technology, internet connectivity, and social media from an early age. Generation Z is often described as tech-savvy, socially aware, and highly engaged with online communication and learning environments. These refer to individuals belonging to Generation Z, the target population of the study. They grew up in the digital age, making them highly adept at using technology, the Internet, and web-based learning platforms.

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Chapter 2
Review of Related Literature

Statics of Rigid Bodies

Statics of Rigid Bodies, commonly referred to as *Engineering Statics*, is a branch of engineering mechanics that focuses on the study of forces, moments, and their effects on bodies that remain at rest or in equilibrium. It serves as one of the most fundamental subjects in engineering education, as it establishes the foundational principles necessary for advanced engineering courses.

In the Civil Engineering curriculum of Mindanao State University – General Santos (MSU-Gensan), as stated in MSU Board Resolution No. 375, s. 2017, *Statics of Rigid Bodies (ENS 161)* serves as a core foundation course and a prerequisite to *Dynamics of Rigid Bodies (ENS 162)* and *Mechanics of Deformable Bodies (CVE 155)*, both of which are essential for advanced design and analysis. Similarly, in other engineering disciplines, such as Mechanical, Electrical, and Agricultural and Biosystems Engineering, *Statics* also serves as a preparatory course that cultivates the analytical and problem-solving skills fundamental to engineering education. Failure in this subject often results in academic delays, as it serves as a prerequisite for subsequent major engineering courses. Overall, mastering *Statics of Rigid Bodies* is essential not only for academic progression but also for developing the critical thinking and analytical reasoning required of future engineers.

Beyond academics, the principles of *Statics* are extensively applied in real-world engineering practice. They are used in designing safe and efficient systems such as buildings, bridges, dams, machines, and various mechanical components. Civil engineers use *Statics* to ensure that structural loads are properly supported, mechanical engineers apply it to design stable machine elements, and electrical engineers use it to develop reliable mounting and support systems. Mastery of *Statics* thus enables engineers to design structures and mechanisms that remain safe, stable, and functional under various loading conditions.

Challenges in Learning Statics

Learning *Statics of Rigid Bodies* has been widely recognized as one of the most challenging areas in engineering education due to its high conceptual and analytical demands. Salami and Perry (2025) explored the perceptions of students regarding the difficulties they face in *Statics* and identified a wide range of conceptual, procedural, and affective barriers. Students often struggled to connect mathematical symbols with their physical meanings, treating forces and moments as abstract quantities rather than as real interactions between bodies. Many had difficulty constructing *Free Body Diagrams (FBDs)*, frequently misplacing force directions, omitting reactions, or confusing internal and external forces. They also expressed challenges in distinguishing between related concepts such as moments, couples, and resultants, and in visualizing force systems within two- or three-dimensional contexts. Beyond conceptual gaps, the study also highlighted emotional and instructional factors: students often described *Statics* as a difficult and anxiety-inducing subject, with fast-paced lectures and heavy workloads compounding their struggles. The authors concluded that these issues call for more interactive, visualization-based, and student-centered learning environments to promote deeper comprehension and engagement.

Complementing the students' perspective, Salami, Oladipo, and Perry (2024) examined *Statics* instruction from the viewpoint of faculty members and teaching assistants. Their findings revealed that educators recognized similar conceptual deficiencies among students, particularly in applying theoretical principles to problem-solving and in constructing logical reasoning processes. Faculty respondents attributed these difficulties to gaps in prerequisite mathematical knowledge, limited spatial visualization skills, and a tendency among students to rely heavily on memorization. Furthermore, instructors noted that traditional lecture-based instruction often fails to engage students or accommodate diverse learning styles. Faculty members also cited structural challenges such as large class sizes, limited time for individualized feedback, and insufficient resources for implementing interactive or simulation-based teaching methods. The study emphasized that overcoming these persistent learning barriers requires instructional innovations, such as technology-enhanced tools, simulations, and guided visualization platforms, that bridge the gap between abstract theory and practical understanding.

Web-Based Learning

In today's generation, the internet has become widely accessible, allowing people to obtain information more easily than through traditional printed materials. Unlike books, online resources can be accessed anytime and anywhere, using various devices such as computers, tablets, or smartphones, as long as there is an internet connection. This accessibility has transformed how individuals learn and share knowledge.

Web-based learning, also known as *online learning* or *e-learning*, utilizes internet-based platforms to deliver educational content and facilitate interaction between students and instructors. It provides learners with the flexibility to study at their own pace and convenience, overcoming barriers of time and location. Moreover, it encourages the use of multimedia tools—such as videos, simulations, and interactive modules—that enhance engagement and improve understanding of complex topics. As education continues to adapt to technological advancements, *web-based learning* has become an essential component of modern instruction. It supports independent learning, promotes collaboration through virtual classrooms, and offers a more inclusive and adaptive learning environment for digital-native students who are already accustomed to using technology in their daily lives.

According to Mishra *et al.* (2022), the rise of *e-learning* has greatly accelerated the global adoption of online learning, making it a dominant educational model in many countries. Their study revealed that as digital connectivity becomes more pervasive, *e-learning*—particularly the emerging online learning systems—is expected to become the standard mode of instruction across multiple sectors. The widespread availability of web-based technologies enables a seamless, data-driven learning experience that supports continuous access to educational resources worldwide. As education continues to evolve with technological advancements, *web-based learning* remains a vital component of modern instruction, supporting independent learning, promoting collaboration through virtual classrooms, and fostering an adaptive learning environment for students in the digital age.

StatiCalcs

Söllradl (2022), in the study *"Symbolic Calculation of Beam Structures: Digitalisation of Teaching Strength of Materials at University,"* conducted at the Institute for Applied Mechanics, TU Graz, discussed the digitalisation initiative at Graz Technical University (TU Graz) that aims to enhance digital learning in *Engineering Mechanics* across several departments. The researcher developed an automated and scalable system designed to generate individualized assignments for students, supporting a more efficient and interactive approach to learning.

To accomplish this, the researcher utilized a Python-based framework capable of automatically creating, distributing, and solving assignments related to beam structures. Instead of relying solely on numerical solutions, the system emphasized symbolic computation using the *Euler–Bernoulli beam theory* to formulate and solve systems of linear equations. This method provided learners with a clearer understanding of the mechanical behavior of beam structures by reinforcing analytical and theoretical principles rather than focusing only on numerical outputs.

The developed tool also allowed for the modeling of beams with varying flexural and axial rigidity, included stiff elements, and supported the use of different types of joints and bearings at the nodes. Through this approach, the researcher demonstrated how digitalization and automation can be effectively integrated into engineering education to promote personalized learning, minimize manual workload for instructors, and enhance students' analytical and problem-solving skills.

Gfrerer, Michael H., Benjamin Marussig, Katharina Maitz, and Mia M. Banger (2024), in their study titled *"Teaching Mechanics with Individual Exercise Assignments and Automated Correction,"* introduced an automated correction system for exercise assignments designed to address the challenges of manually creating and grading student work in large engineering classes. Traditional assignment methods often limit the number of exercises that can be provided, resulting in a smaller problem pool relative to the number of students. This restriction makes it difficult to assess whether learners can independently solve problems and encourages unreflective task replication, which hinders conceptual understanding and leads to inaccurate self-assessment.

To overcome these limitations, the researchers developed a scalable framework for generating, distributing, and automatically correcting individualized exercises in topics such as *statics, strength of materials, dynamics,* and *hydrostatics.* Their system allows each student to receive a unique set of problems, promoting academic integrity and active engagement. A quantitative survey conducted among students enrolled in a statics course demonstrated strong acceptance of the tool, with feedback indicating that it enhanced self-directed and reflective learning. The authors concluded that the automated correction system provides significant added value in mechanics education by fostering independent learning and reducing instructor workload, thereby improving the overall efficiency and quality of teaching in engineering mechanics courses.

Building upon these findings, the researchers developed *StatiCalcs*, a web-based supplementary learning tool designed specifically for students taking *Statics of Rigid Bodies*. The platform provides an interactive computational environment where users can perform statics-related analyses, visualize results, and verify manual solutions. *StatiCalcs* is not intended to replace traditional instruction but to serve as a supplementary resource that reinforces theoretical and analytical concepts through immediate computational feedback and graphical representation.

The structure and content of *StatiCalcs* are based on key topics presented in *Meriam and Kraige's Engineering Mechanics: Statics, 5th Edition*, one of the most widely used references in engineering education. The system consists of four core chapters: *Force Systems, Equilibrium, Structural Analysis,* and *Distributed Loads*. The *Force Systems* module enables users to determine the resultant of both two-dimensional and three-dimensional force systems using the tip-to-tail graphical method and the analytical component method. The *Equilibrium* module facilitates the analysis of concurrent, parallel, and general force systems by applying the equations of equilibrium. Meanwhile, the *Structural Analysis* module features a Truss Calculator that computes internal member forces using the method of joints and the method of sections, allowing students to verify their manual computations. Lastly, the *Distributed Loads* module supports the analysis of beams and other statically determinate structures subjected to linearly or non-linearly varying loads.

By combining computational accuracy, visual interpretation, and automation, *StatiCalcs* provides a technologically enhanced platform that aligns with modern engineering education practices. As a supplementary educational tool, it bridges the gap between theoretical instruction and applied problem-solving by allowing learners to test, visualize, and confirm their understanding of fundamental statics principles.

Ultimately, *StatiCalcs* contributes to improving student engagement, conceptual comprehension, and analytical proficiency in the study of *Statics of Rigid Bodies.*

Several existing web-based calculators have been developed to support learning in mathematics and engineering. *Symbolab*, for instance, is a widely used online computational platform that focuses primarily on algebraic manipulation, calculus, and introductory physics. It employs symbolic computation to provide step-by-step solutions, helping learners understand the procedural flow of mathematical problem-solving (Symbolab, 2024). Similarly, *GeoGebra* offers a dynamic learning environment that integrates geometry, algebra, and graphing functionalities. Its interactive visualization capabilities make it particularly useful for exploring mathematical relationships and geometric principles in an intuitive manner (Hohenwarter & Lavicza, 2022).

Another notable platform is *SkyCiv*, which serves as a specialized online tool for structural and civil engineering applications. *SkyCiv* allows users to perform two-dimensional and three-dimensional analyses of beams, trusses, and frames, making it a practical choice for both professionals and students. However, its advanced features are typically accessible through paid subscriptions, which can limit accessibility for some learners (SkyCiv, 2024).

In contrast to these existing platforms, *StatiCalcs* was developed as a free, topic-specific web-based learning tool dedicated solely to the study of *Statics of Rigid Bodies.* Unlike general-purpose platforms, *StatiCalcs* focuses exclusively on the fundamental concepts of engineering mechanics, including *Force Systems, Equilibrium, Structural Analysis,* and *Distributed Loads.* This narrow yet specialized scope allows the system to provide a more structured, focused, and educationally aligned approach to problem-solving in statics.

Furthermore, *StatiCalcs* integrates both computational and visualization features tailored to the statics curriculum. Users can input problem parameters, perform step-by-step calculations, and visualize results such as force systems, truss configurations, and distributed load diagrams. These functions make the platform an effective supplementary resource for verifying manual solutions, reinforcing theoretical lessons, and enhancing student understanding of equilibrium and force interaction principles.

By focusing specifically on statics and maintaining open accessibility, *StatiCalcs* addresses a gap in the availability of free, academically oriented web-based tools for engineering education. It provides a targeted, user-friendly, and pedagogically consistent alternative to general-purpose platforms such as *Symbolab*, *GeoGebra*, and *SkyCiv*. Through its combination of computational precision, visual learning support, and subject-specific design, *StatiCalcs* aligns closely with current trends in digital and technology-enhanced learning, contributing to the ongoing evolution of engineering education.

Technology Based Learning

Study of (De La Hoz, J. L., et al.) states how self-explanation activities may support student learning in statics. Specifically, this study examines the characteristics of student self-explanations of worked examples and their relationship with students' conceptual change. The findings suggest a relationship between the type of worked example, students' approaches to self-explaining, and their conceptual change and problem-solving skills in statics. To increase the quality of the students' explanations and to improve their conceptual understanding, additio

El-Shaimaa Talaat Abumandour (2022), *"Applying E-Learning System for Engineering Education – Challenges and Obstacles,"* emphasized the rapid technological advancements of the 21st century that have transformed educational delivery methods. The researcher noted that the continuous improvement of technology has led to the emergence of e-learning as a modern instructional approach widely adopted by educational institutions, public organizations, and academic libraries. The researcher highlighted that engineering education is increasingly moving toward a blended learning model, which effectively integrates traditional “Face to face” instruction with computer-assisted methodologies and internet-based learning. This hybrid approach enhances accessibility, flexibility, and engagement among learners.

The study also outlined several challenges and obstacles that stakeholders, including teachers, professors, and librarians, must address to fully develop and sustain effective e-learning systems. These challenges include ensuring technological readiness, maintaining instructional quality, and supporting both instructors and students in adapting to digital learning environments. The researcher further proposed recommendations aimed at strengthening the connection between e-learning and engineering education, thereby promoting a more adaptive, innovative, and inclusive academic experience.

This correlates with our Web-based learning method that utilizes the Internet as a platform for delivering educational content, simulations, and interactive experiences. It allows learners to access information and perform tasks beyond the limits of traditional classroom settings. This mode of learning promotes flexibility, self-paced study, and accessibility, which are highly beneficial in modern education. With the continuous advancement of technology and the widespread availability of the Internet, it has become increasingly important for educational institutions to adopt innovative tools and platforms that enhance the learning process. Integrating technology into education not only broadens access to knowledge but also encourages independent learning and practical application of theoretical concepts.

The target population of this web-based learning tool are students currently enrolled in Statics of Rigid Bodies, typically second-year engineering students. This subject is a core component of the engineering curriculum, serving as the foundation for more advanced courses such as mechanics of materials, structural analysis, and dynamics. However, many students find statics challenging due to the complexity of force interactions and the abstract nature of equilibrium concepts. Through web-based tools, learners can engage with interactive calculators, visualizations, and simulations that reinforce computational techniques and problem-solving strategies related to statics.

These students belong to the generation that has grown up alongside rapid technological advancement. Commonly referred to as digital natives, they are accustomed to using online platforms, mobile applications, and digital resources in their daily lives. This familiarity with technology makes web-based learning an appropriate and effective approach for their academic environment. By integrating educational content with interactive computation, web-based learning tools such as StatiCalcs align with the learning habits of modern students, providing a convenient, accessible, and engaging platform for applying engineering principles.

Overall, web-based learning represents a significant shift in educational delivery, supporting the development of both technical competence and digital literacy among engineering students.

Chapter 3
Methodology

This chapter presents the research method, respondents, locale, instrument, and procedure used in the study. It explains how the research will be conducted to determine the perceptions of Civil Engineering students and faculty toward *StatiCalc*, an interactive web-based learning tool developed for the subject Statics of Rigid Bodies.

3.1 Research Method

This study will use a quantitative research method, which focuses on collecting and analyzing numerical data to describe patterns, relationships, and differences among variables. According to Apuke (2017), quantitative research involves a systematic investigation that uses statistical techniques to produce objective and measurable results. This method is appropriate for the present study because it seeks to gather data from Civil Engineering students and instructors to assess and compare their perceptions of the developed web-based learning tool, *StatiCalc*.

Specifically, a correlational quantitative approach will be applied. As defined by Creswell (2014), this approach examines the relationship or difference between two or more variables to determine whether a significant association exists. In this study, it will be used to determine the significant difference between the perceptions of students and instructors regarding the usability, accessibility, and satisfaction of *StatiCalc*. This method will allow the researchers to statistically analyze the degree to which these two groups differ in their perceptions, providing insights into the effectiveness and acceptance of the developed learning tool across users.

3.2 Research Respondents

The respondents of this study will be selected Bachelor of Science in Civil Engineering students and teaching faculty from the College of Engineering at Mindanao State University – General Santos (MSU-Gensan). The student respondents will include second-year and higher-level Civil Engineering students who are either currently enrolled in or have already completed the course Statics of Rigid Bodies (ENS 161). This selection ensures that participants have sufficient background and experience with the subject, allowing them to provide reliable feedback on the developed web-based learning tool, *StatiCalc*. The faculty respondents, on the other hand, will consist of instructors who are currently teaching or have previously taught Statics of Rigid Bodies, as they can provide expert evaluation regarding the tool's usability, accessibility, and relevance to the course content.

3.3 Research Locale

This study will be conducted at the College of Engineering, Mindanao State University – General Santos (MSU-Gensan), located in Fatima, General Santos City. The college offers various engineering programs, including Civil, Mechanical, Electrical, and Agricultural and Biosystems Engineering. The research will primarily focus on the Engineering Building, where most classroom lectures, computer laboratory sessions, and faculty offices are situated. This location is ideal for the study since it houses both the student respondents taking Statics of Rigid Bodies and the faculty members teaching the subject.

3.4 Research Procedure

The researchers will conceptualize, design, and develop a web-based learning tool called *StatiCalc*, an interactive platform with integrated calculators specifically designed for the subject Statics of Rigid Bodies. The system will undergo evaluation and approval by experts in the field to ensure its accuracy, functionality, and relevance to the course. A researcher-made questionnaire will then be developed to measure the level of perception of Civil Engineering students and instructors in terms of usability, accessibility, and satisfaction. Before data gathering, a formal letter of permission to conduct the study will be submitted to the Dean of the College of Engineering at Mindanao State University–General Santos.

The researchers will administer the questionnaire to the selected respondents composed of Civil Engineering students and faculty members. After data collection, the gathered responses will be encoded, organized, and subjected to statistical analysis.

3.5 Statistical Tools

A researcher-made instrument will be utilized in conducting this study. The tool will employ a five-point Likert scale to measure the level of perception of both students and instructors regarding the developed web-based learning tool, *StatiCalc*. The survey will assess their perceptions in terms of usability, accessibility, and satisfaction. Each item in the questionnaire will be rated on a scale ranging from 1 (Strongly Disagree) to 5 (Strongly Agree), allowing for quantitative analysis of the respondents' perceptions toward the tool's overall usability, accessibility, and user satisfaction.

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