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Development of a web-based instructional tool for civil and construction Students

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Abstract

This study aimed to develop a Web-Based Instructional Tool (WBIT) for Rebar Works for Civil and Construction Technology students of Caraga State University Cabadbaran Campus. Utilizing a developmental research design, the research applied an adopted questionnaire to evaluate content quality, usability, and potential effectiveness as an instructional tool. Eight experts, including subject matter specialists, e-learning/IT professionals, and curriculum/pedagogy experts, evaluated the WBIT using a five-point Likert scale. Analysis revealed consistently high ratings, predominantly "Strongly Agree," validating the WBIT's efficacy as a valuable educational resource. The tool's strengths, including clear directions, accurate content, and engaging activities, aligned with established frameworks, confirming the effectiveness of the user-centered design approach. While minor areas for improvement were identified, the overall positive perception underscores the WBIT's potential for wide adoption and its ability to serve as a model for future e-learning initiatives, emphasizing the importance of rigorous evaluation and continuous refinement in digital learning.

Keywords: Civil and construction student, web-based instructional tool, rebar works, developmental research

Introduction

Education is a critical right and a significant investment for any country, reflecting its importance to the economy. The increasing integration of the internet into daily life has revolutionized education, making e-learning a fundamental tool, (Alenezi A., 2020) ^[1]. In addition, (Castro *et al.*, 2021) ^[2] note that online learning offers flexible access to content and instruction, addressing shortages in resources, facilities, and equipment, especially in higher education.

According to (Dhakal, 2020) ^[3], the quality of a nation's education system is largely dependent on the quality of its teaching, which in turn relies on the effective use of instructional materials. These materials are essential for making learning meaningful and promoting significant academic performance. (Kabilito, 2024) ^[4] highlights that the effectiveness of instructional materials is validated by the students' performance on intended learning outcomes, thus ensuring the success of educational interactions.

Despite the recognized benefits of e-learning, Caraga State University Cabadbaran City faces a specific challenge: a shortage of books and learning resources in Rebar Works, a problem exacerbated by the high demand from instructors. To bridge this gap, this study develops web-based learning materials, which have been shown to enhance student motivation and learning outcomes, Rahmawati *et al.*, (2021) ^[6]. Likewise, (Nor, 2018) ^[5] also supports the efficacy of web-based learning in providing faster, more efficient, and satisfying educational experiences.

To address this pressing issue, this study aims to design and develop web-based instructional tool specifically tailored to the needs of Rebar Works students at Caraga State University Cabadbaran City. These digital tools supplement the limited physical resources, providing students with alternative avenues for accessing information and enhancing their learning experience. This approach aligns with the curriculum's learner-centered teaching model, promoting independent exploration and learning. Ultimately, this study aims to improve academic performance and foster a more effective, independent learning environment for

Rebar Works students, thereby contributing to the overall quality of education at the university.

Conceptual Framework

The conceptual framework of this study is presented in Figure 1. The first box shown at the left contains the inputs of the study. The content of this Web-Based Instructional Tool (WBIT) was based on the course Rebar Works, which covers three weeks of learning concepts and activities. The topics covered include Introduction to Rebar Works, Reading and Interpreting Rebar Drawing and Scheduling, and Rebar Fabrication Techniques. The target audience of this WBIT are the Civil and Construction Students in Caraga State University Cabadbaran Campus. Each week has learning activities following Merrill's First Principle of Instruction (FPI) Gardner (2010), which include learning sequence from problem-centered, activation, demonstration, application, and lastly integration. The WBIT is built using Google Site, a web platform compatible for smart phones, tablets, iPads, and laptops.

The second box at the center was the process of the study, which involved developing features such as interactive elements, quizzes, videos, activities, and other components of the instructional tool. The content review and encoding were conducted to ensure the correct formatting of the WBIT. Expert validation of WBIT is essential to ensure accuracy, completeness, and effectiveness of the learning materials. This includes aligning content with competencies and learning theories.

The third box at the right was the output of the study. The WBIT a functional, user-friendly, and validated online learning tool covering Rebar Works, designed for students studying civil and construction, compatible with various devices. This module is prepared for student use and incorporates the relevant learning theories, competencies, and align content.

Figure 1. Schematic Diagram of the study

Materials and Methods

The research utilized a developmental research design to develop the WBIT systematically. Iterative design and evaluation were applied to develop and improve the effectiveness and usability of the instructional tool. Feedback and input from evaluators were integrated at every development stage to ensure improvement on an ongoing basis. Purposive sampling was applied in the selection of

evaluators for the study. This approach permitted the researcher to purposefully approach participants with specified knowledge applicable in the evaluation and development of the web-based instructional content. The evaluators consisted of eight experts, strategically chosen based on their qualifications and relevance to the study. These included two subject matter experts specializing in civil and construction technology, three e-learning and IT specialists with backgrounds in e-learning and information technology, and three curriculum and pedagogy experts specializing in curriculum development and pedagogical strategies. These evaluators provided valuable feedback on various aspects of the web-based learning material, including content accuracy, technical functionality, and instructional design quality.

The primary instrument used to evaluate the quality of the WBIT was an adopted version of a questionnaire developed by Christina Marie Goode (2003). This questionnaire was originally designed for evaluating the quality of applications. The instrument comprised parameters that assessed dimensions such as 1) content quality, 2) content usability, and 3) potential effectiveness as a teaching tool. The questionnaire employed a five-point Likert scale format, enabling evaluators to provide quantitative ratings as well as feedback.

The questionnaire was distributed primarily through digital channels, including email and Facebook messaging. The majority of data collection was facilitated using Google Forms, ensuring efficient and centralized data gathering. This approach was chosen as the most expedient method for reaching respondents located in diverse geographic locations.

The development process followed an iterative approach involving multiple cycles of design, evaluation, and refinement. Initially, the WBIT was conceptualized and developed based on the identified learning objectives and target audience needs. The material was then reviewed by the evaluators, who provided feedback on its strengths and areas for improvement. Based on the evaluators' feedback, the material was revised to address identified issues and enhance its quality. Finally, the refined material underwent further evaluation by the same experts to ensure that the suggested improvements were effectively implemented. This iterative process ensured that the final product met the standards of quality, usability, and educational effectiveness.

Results

Table 1: Quality of Content

	Indicators	Average Weighted Mean	Verbal Description
Quality Of Content	1. Has clear and concise directions on how to complete the module.	4.63	Strongly Agree
	2. Is properly sequence.	4.63	Strongly Agree
	3. has accurate content.	4.75	Strongly Agree
	4. Is detailed enough for a student to progress through the instruction without an instructor.	4.38	Strongly Agree
	5. Provides a complete demonstration of the concept.	4.50	Strongly Agree
	6. Provides opportunities to practice new concepts and skills.	4.63	Strongly Agree
	7. Provides detailed and appropriate feedback for the practice opportunities.	4.13	Agree
	8. Provides consistent feedback.	4.00	Agree
	9. Can be shared across its own academic discipline and/or others.	4.38	Strongly Agree
	10. Instruction follows a logical hierarchy of skill and knowledge development.	4.38	Strongly Agree
	11. Content and text font are easy to read (appropriate size, color, and style).	4.75	Strongly Agree

	12. Content and text are clearly written.	4.88	Strongly Agree
	13. Content engages the learner.	4.00	Agree
	14. Audio and video used are appropriate.	4.88	Strongly Agree
	15. Graphics and titles match content.	4.50	Strongly Agree
	16. Abbreviations and references are consistent.	4.25	Strongly Agree
	17. Content has no spelling errors.	4.25	Strongly Agree
	Average Weighted Mean	4.46	Strongly Agree

Legend: Strongly Disagree (1.00-1.80); Disagree (1.80-2.60); Neither Agree nor Disagree (2.60-3.40); Agree (3.40-4.20); Strongly Agree (4.20-5.00)

The results of Table 1 indicate the high positive perception of the quality of WBIT content with an average weighted mean (AWM) of 4.46, which strongly indicates the effectiveness and acceptability of the WBIT content, indicating that the design and development approaches used were effective in developing a useful learning material. The high and consistent scores in several areas, particularly clarity of directions, content accuracy, and practice opportunities, point towards these areas being the strengths and must be kept the same for future versions. E-learning material design hinges on content quality, which must align with the target level's topics and skills. High-quality content is accurate, logically structured, promotes critical thinking, uses appropriate language, and fosters positive developmental traits (Baraquia, 2024) [7]. This information strongly supports the ongoing usage and distribution of the module. In addition, the strengths identified can be used as a template for creating other learning materials, pointing out best practices in instructional design.

However, while the WBIT is generally well-regarded, the lower scores for feedback, content engagement, detailed

instruction, and consistency in formatting for abbreviations/references and spelling) point to specific areas needing attention. This implies that even though the module is effective overall, improvements in these areas could significantly enhance the learning experience. Specifically, the feedback mechanisms should be reviewed and potentially redesigned to ensure both quality and consistency. Feedback is an integral part of education, and there is a substantial body of trials exploring and confirming its effect on learning (Morris *et al.*, 2021) [10]. Based on the results of Bocos's study (2024), positive feedback is a powerful tool for enhancing students' motivation and engagement in learning activities. Strategies to boost learner engagement, such as incorporating more interactive elements or varied learning activities, should be explored. Finally, a thorough review of the module's content, focusing on the detail of instruction and ensuring consistency in formatting and spelling, is recommended. Addressing these weaknesses could lead to a more impactful and satisfying learning experience for users.

Table 2: Usability of Content

Indicators		Average Weighted Mean	Verbal Description
Usability of Content	1. Interface is easy to navigate.	4.75	Strongly Agree
	2. Navigational options are always available to the user.	4.50	Strongly Agree
	3. Layout is visually appealing (color, text, amount of information per screen).	4.50	Strongly Agree
	4. Load time is sufficient.	4.25	Strongly Agree
	5. Menus, buttons, and icons are easily understood and consistent.	4.63	Strongly Agree
	6. Hyperlinks and buttons work.	4.63	Strongly Agree
	7. Scripts and functions work in multiple browsers and on multiple platforms.	4.38	Strongly Agree
	8. Animations, audio, and video nm in multiple browsers and on multiple platforms.	4.38	Strongly Agree
	9. Plug-ins, software, and platform requirements are specific.	4.38	Strongly Agree
Average Weighted Mean		4.49	Strongly Agree

Legend: Strongly Disagree (1.00-1.80); Disagree (1.80-2.60); Neither Agree nor Disagree (2.60-3.40); Agree (3.40-4.20); Strongly Agree (4.20-5.00)

Table 2 indicates the usability of a WBIT was assessed, and it showed a consistently high level of user satisfaction. With a total average weighted mean of 4.49, labeled as "Strongly Agree," the tool showed outstanding ease of navigation, intuitive interface design, and easily accessible navigational options, as indicated by high scores in these categories. The visual aesthetic and design, such as the use of colors, text readability, and content density, were also found highly pleasing and promoting engagement on the part of users. Strong performance in acceptable load time, working hyperlinks and buttons, and portability across operating platforms further strengthened user experience. Furthermore, the specification of required plug-ins, applications, and operating platforms allowed technical

access impediments to be averted. This aligns with Baraquia's (2024) [7] study, which reported 'very satisfactory' instructional quality (3.90) for e-learning modules, emphasizing the importance of engaging graphics, colors, and sounds. These results imply that the developers could effectively apply user-centered design principles, creating a functional tool that supports a positive and effective learning experience. That high usability has great implications for increased learning, effective implementation in educational environments, and the ability to be an example for e-learning design in the future, so it is highly relevant that user-centered principles be given high priority and extensive usability testing.

Table 3: Potential Effectiveness as a Teaching Tool

	Indicators	Average Weighted Mean	Verbal Description
Potential Effectiveness As A Teaching Tool	1. Has clear and concise learning objectives.	4.75	Strongly Agree
	2. Identifies prerequisite knowledge.	4.50	Strongly Agree
	3. Has activities, practices, or quizzes that reinforce the content.	4.63	Strongly Agree
	4. Offers timely and relevant feedback.	4.13	Agree
	5. Builds on prior concepts.	4.50	Strongly Agree
	6. Demonstrates relationships between concepts.	4.38	Strongly Agree
	7. Is very efficient (one can learn a lot in a short period).	4.38	Strongly Agree
	8. overall, is very effective as a teaching tool.	4.63	Strongly Agree
Average Weighted Mean		4.48	Strongly Agree

Legend: Strongly Disagree (1.00-1.80); Disagree (1.80-2.60); Neither Agree nor Disagree (2.60-3.40); Agree (3.40-4.20); Strongly Agree (4.20-5.00)

Table 3 shows evaluations revealed a strong consensus regarding the web-based instructional tool's potential effectiveness as a teaching resource, yielding an overall average weighted mean of 4.48, categorized as "Strongly Agree." Respondents consistently praised the tool's clear learning objectives, identification of prerequisite knowledge, and integration of reinforcing activities, signifying a structured and effective learning experience. While feedback was generally perceived as positive, a slightly lower score indicated potential for improvement in its timeliness. The tool's ability to build upon prior concepts, demonstrate conceptual relationships, and facilitate efficient learning further contributed to its high perceived value. This aligns with Barri's (2020) framework for LMS content quality, emphasizing currency, completeness, and relevance. The tool's validation as a valuable educational resource underscores the importance of both robust instructional design and adherence to established content quality standards, with feedback timeliness identified as an area for further refinement. This positive evaluation suggests the tool's potential for wide adoption in educational settings, highlighting its clear structure and engaging activities that promote deeper understanding. However, developers should prioritize enhancing feedback mechanisms to maximize their impact. This data validates the tool's design and confirms its potential as a valuable educational resource.

Table 4: Grand Weighted Mean

Indicators	Average Weighted Mean	Verbal Description
1. Quality of Content	4.46	Strongly Agree
2. Usability of Content	4.49	Strongly Agree
3. Potential Effectiveness as a Teaching Tool	4.48	Strongly Agree
Grand Weighted Mean	4.48	Strongly Agree

Legend: Strongly Disagree (1.00-1.80); Disagree (1.80-2.60); Neither Agree nor Disagree (2.60-3.40); Agree (3.40-4.20); Strongly Agree (4.20-5.00)

Table 4 shows the design and effectiveness of a web-based instructional tool were validated by a 'Strongly Agree' evaluation (grand weighted mean 4.48), demonstrating high content quality, usability, and teaching potential. This aligns with Baraquia's (2024) [7] findings, further supporting the development of e-learning tools that effectively meet user needs and facilitate learning. This demonstrates that a systematic approach to design and evaluation, focusing on key metrics like content quality and usability, can lead to the creation of highly effective e-learning tools. It also

encourages the use of established evaluation frameworks to ensure the quality and effectiveness of educational technology.

Conclusion

In conclusion, a comprehensive evaluation of the Web-Based Instructional Tool (WBIT) consistently yielded high ratings for content quality, usability, teaching effectiveness, and overall design, with a majority of respondents expressing "Strongly Agree," thereby demonstrating its efficacy as a valuable educational resource. The WBIT's strengths, including clear directions, accurate content, engaging activities, an intuitive interface, and effective teaching potential, align with established frameworks and previous research, validating the user-centered design and development approaches employed. Even though some small things that could be better were pointed out, like feedback mechanisms and content engagement, the overall positive opinion shows that the WBIT has the potential to be widely used and could be used as a model for future e-learning projects. This shows how important it is to constantly evaluate and improve digital learning.

Recommendations

To maximize the Web-Based Instructional Tool's (WBIT) effectiveness, developers should prioritize enhancing feedback mechanisms, improving content engagement through interactive elements, and refining instructional detail and formatting consistency, while maintaining the WBIT's identified strengths, such as clear directions and accurate content; furthermore, continuous user-centered design, rigorous evaluation, and educator training are crucial for ensuring ongoing improvement and promoting wider adoption of this valuable educational resource.

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