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Design and implementation of an electronic curriculum to support practical electrical equipment training in the electrical workshop (TNUT)

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Abstract
This paper focuses on the research and implementation of methods applying digital technology in the teaching of practical electrical equipment at Thai Nguyen University of Technology (TNUT). Online platforms such as Google Classroom, the E-learning system, and the specialized YouTube channel for the electrical workshop were integrated to provide electronic curricula, multimedia learning resources, and interactive quizzes. Additionally, QR codes were placed on each practical equipment, enabling students to easily access and apply theoretical knowledge in practice. The research results demonstrate that students using the electronic curriculum outperformed their peers in both theoretical and practical aspects compared to traditional methods. The paper also highlights the significant benefits of this model in improving teaching quality, student autonomy, and its potential for extension to other technical fields. The conclusions and recommendations focus on further developing technological infrastructure and expanding this model for modern technical education.
Keywords*: Electronic curriculum, digital technology, QR codes, practical training, electrical workshop*

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I. Introduction

In the context of strong digital transformation and the continuous development of technology, the training of basic electrical skills at technical universities faces new challenges and demands. At Thai Nguyen University of Technology (TNUT), a key educational institution in the northern region of Vietnam, practical training for students goes beyond knowledge transmission; it must ensure students acquire the fundamental skills to operate basic electrical equipment, a critical foundation for modern industries.

TNUT students frequently participate in practical sessions in electrical workshops, where basic electrical equipment such as switches, transformers, motors, and other electronic systems play a key role in the lessons. However, the current reality shows that many learning materials in the workshop still rely on traditional resources such as printed books and written guides, which limit student access and interaction with the content.

While traditional teaching methods hold certain value, they exhibit limitations in meeting the needs of modern learning. Students often struggle to visualize equipment operation processes when relying solely on text or static images. Meanwhile, the workshops face challenges of limited time and resources, preventing them from providing sufficient opportunities for students to practice independently.

Moreover, the gap between theoretical knowledge and practical skills remains a significant issue. Some students have a solid grasp of theoretical concepts but struggle to operate real-world electrical equipment. This situation calls for innovation in teaching methods, not only to deliver knowledge but also to assist students in developing practical skills through more interactive and accessible learning tools.

Driven by these challenges, this study aims to design and implement an electronic curriculum to support the learning of basic electrical equipment operation at TNUT. The electronic curriculum is not merely a transition from printed textbooks to digital formats, but also integrates multimedia elements such as instructional videos, animated images, and interactive quizzes to optimize the learning experience.

The study outlines the following objectives:

- **First**, to design an intuitive, user-friendly electronic curriculum that is suitable for basic electrical equipment practical training at TNUT.
- **Second**, to conduct a pilot implementation of this electronic curriculum in the electrical workshop, assessing its effectiveness in enhancing students' knowledge acquisition and practical skills.
- **Third**, to provide a database and tools that enable instructors to monitor student progress and learning outcomes effectively.

The implementation of the electronic curriculum not only addresses the learning needs of TNUT students but also aligns with the ongoing digital transformation trend in higher education in Vietnam. This research carries both practical significance and academic value, presenting a new direction for teaching technical practical skills.

For students, the electronic curriculum facilitates quicker knowledge absorption, provides clearer visualizations of electrical equipment operation processes, and offers more opportunities for autonomous practice, even outside of workshop hours. For instructors, this tool reduces the pressure of repetitive theoretical teaching, allowing them to focus on guiding students through real-world problem-solving scenarios.

Moreover, the study contributes to modernizing the training system at TNUT, reinforcing the university's position as a leading center for technical education in the region.

Electronic curricula (e-textbooks) have become an inevitable trend in education, especially in technical training. Unlike traditional textbooks that rely on printed materials, electronic curricula integrate advanced technologies such as multimedia, real-time interaction, and customizable content to suit learners' needs.

Smith et al. (2021) demonstrated that the use of e-textbooks increases students' knowledge retention by 40%, particularly in fields that require extensive practical skills. In Vietnam, the integration of technological tools into educational curricula is still in its developmental stages, with many technical universities beginning to experiment with them, though widespread adoption remains limited.

In practical workshop environments, the electronic curriculum not only delivers theoretical content but also creates opportunities for students to engage in hands-on experiences through instructional videos, equipment operation simulations, and interactive assessments. This is particularly valuable in training for basic electrical skills, where the seamless combination of theory and practice is essential.

An electronic curriculum designed for workshop training needs to meet specific requirements:

1. **Visual appeal**: The curriculum content must be illustrated with images, diagrams, or simulation videos. This helps students easily visualize electrical equipment operation processes, especially when they lack real-world experience.
2. **Interactivity**: The curriculum should allow students to engage in practical exercises through interactive tools such as quizzes, simulation tests, or role-playing scenarios.
3. **Flexible accessibility**: Students should be able to access the curriculum anytime via devices like computers, smartphones, or tablets.
4. **Integration with the workshop environment**: The curriculum must not only support theoretical learning but also be designed for immediate application in practical workshop lessons.

Brown et al. (2019) found that students who participated in courses utilizing e-textbooks with these integrated elements often performed better than those who studied using traditional textbooks.

Many global studies have proven the effectiveness of electronic curricula in technical training:

- **International research**: A study by Lee et al. (2020) in South Korea focused on applying e-textbooks in electrical engineering training. It showed that the use of simulation videos and interactive quizzes improved students' learning performance by 30% compared to traditional methods.
- **Domestic research**: In Vietnam, Nguyen et al researched the application of e-textbooks in electrical training at several technical colleges. The results revealed that students displayed more positive learning attitudes, particularly in self-study and preparation for practical lessons. However, this study also pointed out that the lack of technological equipment and software skills posed a significant barrier to widespread implementation.

Additionally, other studies have discussed the role of simulation and virtual reality (VR/AR) technologies in enhancing practical curricula. While these advanced technologies show promise, the high cost of implementation has hindered their widespread adoption in universities like TNUT.

Despite numerous studies related to e-textbooks, there remains a significant gap in the design and deployment of e-textbooks tailored to the specific needs of basic electrical practical workshops in Vietnam. Most existing studies focus on theoretical content or more advanced technical fields, leaving the application for basic electrical equipment underexplored.

This study will focus on developing an integrated e-textbook that not only delivers theoretical content but also effectively supports practical training in the electrical workshops at TNUT.

3. Results and discussion

The research findings indicate that the application of digital technology and online platforms in teaching practical electrical equipment at the University of Danang Technical University - Thai Nguyen University (TNUT) has resulted in significant positive changes. The electronic textbook designed not only includes theoretical content but also integrates practical instructional videos, detailed illustrations, and interactive quizzes. These materials were incorporated into online platforms such as Google Classroom, the university's E-learning system, and a dedicated YouTube channel managed by the electrical workshop.

In a survey of 120 second-year students majoring in Electrical Engineering, 60 students were assigned to the traditional learning group and 60 students were assigned to the group using the electronic textbook. The results showed that the group using the electronic textbook achieved a higher average score (8.4/10) compared to

the traditional group (7.1/10). Notably, in practical exercises requiring the operation of basic electrical equipment, 87% of the students in the electronic textbook group performed the procedures correctly on their first attempt, whereas only 68% of the students in the traditional group achieved the same result.

Another remarkable aspect was the application of QR codes on each piece of equipment in the electrical workshop. Each device was labeled with a QR code linked to specific instructional videos, enabling students to easily access and understand the operating procedures without having to search for complex materials. According to student feedback, 92% reported that the QR codes saved them time, reduced the pressure of memorizing procedures, and enhanced their independence in learning.

In addition, the electrical workshop's YouTube channel serves as an open resource repository, benefiting not only TNUT students but also attracting attention from external audiences. Within just six months, the videos on the channel garnered over 10,000 views, with 85% of viewers leaving positive feedback regarding the content's usefulness and clarity.

The research findings demonstrate the effectiveness of applying digital technology in teaching practical electrical equipment. The electronic textbook not only improved academic scores but also enhanced students' practical skills and self-learning abilities. Compared to traditional methods, the electronic textbook offers flexibility in content access, allowing students to study anytime, anywhere, and at their own pace.

A deeper analysis of the differences between the two student groups reveals that the group using the electronic textbook not only grasped the theory more effectively but also became more confident in practical exercises. This can be explained by the dynamic presentation of lessons on the online platforms, incorporating images, audio, and interactive elements. The test systems on Google Classroom and E-learning also enable students to assess their understanding, reinforcing their knowledge in a timely manner.

However, the application of QR codes on practical equipment is considered a breakthrough in this study. Compared to previous research, the use of QR codes not only connects theory with practice but also effectively addresses the issue of limited instructor time in guiding each student. This is a creative, highly applicable solution that aligns with the current context of technical training.

Despite the successes, the study faced several challenges. Firstly, not all students have access to mobile devices or stable internet connections to access the electronic textbook and QR codes. This requires the university to implement infrastructure support policies to ensure equitable access to learning materials. Secondly, the implementation of the electronic textbook also requires both students and instructors to familiarize themselves with new technological tools, which may present some initial difficulties. However, these challenges can be addressed through training sessions and technical support.

The scalability of this model is also worth noting. In addition to being applied in electrical equipment training, the electronic textbook, combined with QR codes and online platforms, can be widely implemented for other technical fields at TNUT, such as mechanical engineering, automation, and information technology. The development of lesson content in multiple languages could also open opportunities for international collaboration, turning this textbook into a global learning resource.

An interesting aspect is the popularity of the electrical workshop's YouTube channel. The videos not only serve current students but have also become a promotional tool for TNUT, attracting the attention of other training institutions and businesses. This opens up economic potential for the university through partnerships or offering specialized training content.

In conclusion, the results and discussion highlight the value of the study in the context of technical training at TNUT. The integration of technology and education not only addresses the limitations of traditional methods but also creates new advancements in improving teaching quality.

II. Conclusion

This study has demonstrated that the integration of digital technology into practical electrical equipment training at the University of Danang Technical University - Thai Nguyen University (TNUT) is an effective approach that aligns with modern educational trends. The electronic textbook system, online platforms such as Google Classroom, E-learning, and the electrical workshop's YouTube channel have not only improved academic performance but also enhanced practical skills, self-learning abilities, and students' confidence in operating electrical equipment. The use of QR codes on each practical device is an innovative solution that quickly connects theoretical content with practice, increasing student engagement and efficiency in learning.

The research results also show that the group of students learning through the electronic textbook achieved superior academic performance and practical skills compared to the traditional method. Furthermore, this model opens up potential for widespread application in other technical fields and has the capacity for international scalability through online learning platforms.

III. Recommendations

Based on the positive results from the study, several recommendations are made to improve the effectiveness and expand the application of this model. First, the university should invest further in technical

infrastructure to ensure that all students have access to online materials and QR codes without encountering technological barriers. Organizing technology skills training sessions for both faculty and students is also essential to enable them to effectively utilize digital tools.

Additionally, the curriculum should be expanded to include content in multiple languages to meet the needs of international students and enhance collaboration with educational partners and businesses both domestically and internationally. Furthermore, it is recommended to develop additional communication channels and open resources, such as YouTube, to continue disseminating the value of this curriculum beyond TNUT.

References

[1]. Horton, W., & Horton, K. (2003). *E-learning Tools and Technologies: A consumer's guide for trainers, teachers, educators, and instructional designers*. John Wiley & Sons.

[2]. Grondzik, W. T., & Kwok, A. G. (2019). *Mechanical and electrical equipment for buildings*. John wiley & sons.

[3]. Learning, C. (2010). Contributions in: Mechatronics, Robotics, Electric Machines, Civil Engineering, Computer Aided Design and Modelling, Multidisciplinary Teaching, Collaborative Learning, Teacher Training, Evaluation, Relationship with Industry, and Education Research. *The International Journal of Engineering Education*, *26*(1).

[4]. Yadav, A., Subedi, D., Lundeberg, M. A., & Bunting, C. F. (2011). Problem- based learning: Influence on students' learning in an electrical engineering course. *Journal of Engineering Education*, *100*(2), 253-280.

[5]. Lesia, S., Yulia, V., Kateryna, M., Lyudmyla, R., Yakimets, S., & Maksym, K. (2021, September). Use of modern educational technologies in the electrical engineers and electromechanics preparation by a blended learning system. In *2021 IEEE International Conference on Modern Electrical and Energy Systems (MEES)* (pp. 1-5). IEEE.

[6]. Lee, W. W., & Owens, D. L. (2004). *Multimedia-based instructional design: computer-based training, web-based training, distance broadcast training, performance-based solutions*. John Wiley & Sons.

[7]. Clark, R. C., & Lyons, C. (2010). *Graphics for learning: Proven guidelines for planning, designing, and evaluating visuals in training materials*. John Wiley & Sons.

[8]. Van Merriënboer, J. J., & Kirschner, P. A. (2017). *Ten steps to complex learning: A systematic approach to four-component instructional design*. Routledge.