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Research on Proposing Solutions and Advanced Tools to Support Digital Learning Material Production at Education Technology and Adaptive Learning Institute (ETALI)

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ABSTRACT
This study proposes and implements a solution for digital learning material (DLM) production at Education Technology and Adaptive Learning Institute(ETALI) to meet the growing demand for high-quality digital educational resources. Based on the application of modern technologies such as Artificial Intelligence (AI), Big Data, and multimedia design tools, the production model is constructed according to an optimized process that minimizes time and costs. The experimental results show a 30% reduction in production time, a 20-25% decrease in costs, and a user satisfaction level exceeding 89%. The study also provides recommendations for scaling up implementation, upgrading technological infrastructure, and continuous improvements to enhance the effectiveness and applicability of the solution in digital education.

Keywords: Digital learning materials, artificial intelligence, digital education, big data, production process.

I. INTRODUCTION

In the context of the global digital transformation, education is witnessing profound changes in the way knowledge is transmitted and learning processes are organized. Specifically, the production of digital learning materials has become a core component in building a modern, high-quality, and flexible educational ecosystem.

Education Technology and Adaptive Learning Institute(ETALI) at Thai Nguyen University of Technology (TNUT) has recognized the importance of applying technology to digital learning material production. However, challenges such as the lack of advanced tools, the lack of synchronized automation processes, and ineffective workflows have reduced competitiveness in the creation of high-quality learning materials. Therefore, there is a pressing need to propose comprehensive solutions that apply modern technology to address these limitations.

Digital learning materials (DLM), synonymous with educational resources optimized by digital technology, include training content developed in various formats such as videos, e-books, interactive presentation slides, quizzes, and more. In the digital age, DLMs not only enable learners to access knowledge flexibly but also allow instructors to personalize the teaching process to meet the needs and abilities of individual learners.

Currently, many new technologies have been applied to optimize the process of producing digital learning materials, including Artificial Intelligence (AI), Virtual Reality (VR), Augmented Reality (AR), automation of production processes, and tools supporting content creation. For example, AI can automatically suggest optimal learning content, assess the difficulty level of lessons, or analyze learning habits to optimize personalized learning paths.

ETALI, with its mission of researching and developing open education, has made significant investments in building a modern learning material production process. However, challenges such as process disintegration, limited

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resources, and insufficient supporting technologies remain significant barriers to ensuring the quality of learning materials. Therefore, this study is conducted to assess the current situation and propose effective solutions to overcome these limitations.

Globally, the research and development of solutions and advanced tools to support digital learning material production (DLM) have become one of the top priorities in the context of global digital transformation. Major educational organizations, from prestigious universities to technology corporations, are focusing on developing platforms and tools to facilitate digital learning.

For example, Learning Management Systems (LMS) such as Moodle, Blackboard, and Canvas have been widely researched and implemented to standardize the production, management, and distribution of learning materials. Additionally, the development of AI technologies has enabled the personalization of learning content according to the needs of individual learners. Research has shown that the application of AI, machine learning, and Big Data analytics can create automated DLMs with content optimized to match users' learning styles and abilities.

Notably, Virtual Reality (VR) and Augmented Reality (AR) technologies are being strongly integrated into DLMs at major universities such as MIT and Stanford, as well as online learning platforms like Coursera and edX. These technologies not only provide engaging and immersive learning experiences but also allow learners to access simulated environments, thereby enhancing knowledge acquisition.

Some studies highlight that the application of modern tools not only improves training effectiveness but also reduces operational costs and expands educational access. This is particularly important in the context of the rapid growth of online education after the COVID-19 pandemic.

However, international research also points out significant challenges, such as the digital divide between regions, high implementation costs, and the technical competence required of staff. These issues create a demand for more comprehensive, effective, and cost-efficient solutions for educational institutions.

In Vietnam, digital transformation in education is considered a strategic task to achieve the goal of building a learning society. Domestic research has focused on improving technology and developing digital learning materials to enhance training quality and the self-learning capacity of learners.

Domestic online learning platforms such as VNPT E-Learning, VioEdu, ViettelStudy, and K12Online have been deployed in many schools and training institutions. These platforms offer content management systems, support remote teaching, and facilitate interaction between learners and instructors. Notably, FUNiX, one of the pioneering online training platforms in Vietnam, has focused on developing digital courses meeting international standards, expanding learning opportunities for various groups, from students to working professionals.

Research at universities, such as Hanoi National University and Ho Chi Minh City University of Technical Education, has focused on integrating digital technologies into the design and implementation of digital learning materials. Projects have emphasized the use of AI, Big Data, and supporting tools such as Adobe Captivate and Articulate 360 to optimize the production process.

Despite significant progress, domestic research faces several limitations. Smaller educational institutions struggle to invest in advanced equipment and technology for high-quality digital learning material production. The lack of in-depth training in new technologies among staff leads to delays in adopting and applying advanced technologies. Variations in tools and production standards between institutions hinder the sharing and reuse of learning materials.

However, these challenges also present an opportunity for Vietnam to develop optimized models and solutions that align with the country’s socio-economic conditions and the needs of domestic learners.

Compared to international research, domestic projects still have a significant gap in terms of technology advancement and application scale. While international organizations have widely adopted new technologies such as VR/AR, machine learning, and personalized learning content, most domestic research has focused on digitizing learning content and developing basic training management systems.

Additionally, the adoption of international standards in the production of digital learning materials in Vietnam remains limited, primarily due to the lack of technical infrastructure and human resource capacity. This affects Vietnam’s ability to integrate and compete in the global digital education market.

However, domestic research is making positive strides, thanks to the support of the

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government and large educational organizations. Policies encouraging digital transformation, along with the emergence of international collaboration projects, are opening up many opportunities to improve the quality of learning materials.

Based on the current research situation, several issues need to be addressed, including: building a modern, synchronized, and easily deployable digital learning material production model; integrating advanced tools and technologies like AI and VR/AR to enhance the quality and interactivity of learning materials; training and enhancing the professional skills of material production staff; and improving access to technology while optimizing implementation costs, especially for small-scale educational institutions.

Addressing these issues will not only improve training quality in Vietnam but also contribute positively to Vietnam's integration into the global digital education era.

II. RESEARCH OBJECTIVES, APPROACH, AND METHODS

2.1. Research objectives

This study aims to develop a modern and optimized infrastructure model to support the production of digital learning materials at Education Technology and Adaptive Learning Institute(ETALI), Thai Nguyen University of Industry (TNUT). The research objectives include evaluating the current state of digital learning material production at ETALI by analyzing challenges, limitations, and urgent needs in the design, development, and deployment processes. Based on this analysis, the study proposes an integrated infrastructure model utilizing advanced technologies to ensure modernity, flexibility, and efficiency across the entire production process. Additionally, technological solutions and supporting tools, such as Artificial Intelligence (AI), Big Data, and the Internet of Things (IoT), will be developed to optimize the process from design, content management, to deployment and distribution. The study will also propose mechanisms to ensure data security and system protection to maintain the platform's stability and security throughout its operation. Finally, effective and feasible system implementation methods, tailored to the actual conditions at ETALI, will be developed, with the potential for scalability to other educational institutions.

In terms of significance, this research provides immense value to ETALI, TNUT, and the broader Vietnamese education system. For ETALI and TNUT, the study enhances training quality by improving the capacity to produce high-quality learning materials that meet students' diverse learning needs. The application of modern technologies will also help reduce operational costs and development time for learning materials, while improving the digital learning experience for students, thereby enhancing the university's reputation in the higher education system. For the Vietnamese education sector, in the context of ongoing digital transformation, this research addresses the limitations of digital learning materials, such as a lack of synchronization, limited access to modern technology, and a shortage of qualified human resources. The proposed infrastructure model not only meets ETALI's internal needs but can also be expanded to other educational institutions, supporting teachers and training staff in utilizing modern learning material production tools while meeting the growing demand for online learning, particularly in the post-COVID-19 era.

Furthermore, the research has scientific significance by contributing a new approach to integrating AI, Big Data, and IoT technologies into the production of digital learning materials. This creates a foundation for further studies on the application of technology in education and opens up new directions for the development of digital learning materials in Vietnam and Southeast Asia. The study not only addresses current challenges but also aims to create long-term, sustainable value for ETALI, TNUT, and the Vietnamese education system. The research findings are expected to accelerate digital transformation, enhance educational quality, and affirm the role of higher education institutions in technological innovation within the field of educational technology.

2.2. Research approach

This study adopts a multidimensional approach, combining theoretical and practical perspectives to develop a modern infrastructure model supporting the production of digital learning materials, tailored to the context of Education Technology and Adaptive Learning Institute(ETALI). First, the research is based on surveying and analyzing the current state of digital learning material production at ETALI, including identifying the limitations, challenges, and needs of staff, faculty, and students. Next, the study applies theories on information systems, digital transformation, and educational technology to establish a strong theoretical foundation for model design. The integration of advanced technologies such as AI, Big Data, and IoT is a key focus,

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ensuring that the model not only meets current needs but is also scalable and adaptable to future educational trends.

Additionally, the research employs a systems approach to comprehensively examine the factors influencing the digital learning material production process, from design, content management, to deployment and distribution. This approach allows for the integration of technology, human resources, and processes within a unified ecosystem, optimizing the system's operational effectiveness. At the same time, data security and safety considerations are carefully integrated into the model design to ensure the system's sustainability and reliability.

2.3. Research methods

The research uses a mixed-methods approach, combining qualitative and quantitative methods to ensure a comprehensive and objective evaluation of the research objectives.

Qualitative methods are employed during the survey phase and needs analysis. Specifically, in-depth interviews are conducted with leadership, faculty, and technical staff at ETALI to gather information on challenges and expectations related to the digital learning material production process. Additionally, document analysis is performed on internal reports, educational policies, and previous research to build the theoretical foundation and reference points for the proposed model.

Quantitative methods are used to evaluate and measure the effectiveness of the proposed solutions. A large-scale survey is conducted, using questionnaires to collect data from staff, faculty, and students about their satisfaction with the feasibility and effectiveness of the tools and solutions supporting digital learning material production. The collected data are analyzed using statistical tools such as SPSS or R to draw accurate and reliable conclusions.

Moreover, simulation methods are applied to test the feasibility of the proposed infrastructure model in a virtual environment. By creating a prototype model, the research team can assess the system's integration capabilities, performance, and security before real-world implementation. This method helps minimize risks and ensures that the technical components are optimized.

2.4. Research implementation process

The research process includes three main stages: Stage 1 is the survey and analysis of the current situation, in which data from interviews, surveys, and documents are synthesized to identify the issues to be addressed. Stage 2 involves designing the infrastructure model and developing supporting tools using a systems approach and integrating advanced technologies. Finally, Stage 3 focuses on testing and evaluation, including the deployment of a prototype model and collecting user feedback for adjustments and model refinement.

By tightly integrating theoretical and practical approaches, and using a diverse range of research methods, this study ensures the feasibility of the proposed model and makes a significant contribution to the development of the field of educational technology in Vietnam.

III. TECHNOLOGICAL TOOLS SUPPORTING DIGITAL LEARNING MATERIAL PRODUCTION

- **Learning management system (LMS) tools**Learning Management Systems (LMS) such as Moodle, Blackboard, or Canvas are indispensable tools in the production and management of digital learning materials. These tools assist instructors and technical staff in organizing, storing, and distributing learning content efficiently. LMS not only provides a user-friendly interface but also integrates features such as course management, student progress tracking, and detailed reporting. A key advantage of LMS is its ability to integrate with third-party tools, expanding functionality from test management to learning analytics based on Big Data. For this study, LMS will serve as the foundational platform within the infrastructure model, ensuring flexibility and ease of implementation at ETALI.
- **Content authoring and multimedia design tools:**The production of digital learning materials requires powerful tools for designing and editing multimedia content, ranging from text, images, and audio to video. Software such as Adobe Creative Cloud (including Photoshop, Illustrator, Premiere Pro) or Canva enables instructors to create high-quality, dynamic, and engaging learning materials. Additionally, tools like Articulate Storyline or iSpring Suite allow for the creation of interactive lessons that actively engage learners. With the development of Virtual Reality (VR) and Augmented Reality (AR) technologies, software such as Unity or Unreal Engine is increasingly used to build immersive and realistic learning simulations. These tools not only enhance the quality of learning

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materials but also meet the growing demands of learners in the digital transformation era.

- **Video production and management tools**Video is one of the most popular and effective forms of digital learning material, especially for conveying complex content or practical skills. Tools such as Camtasia, OBS Studio, or Adobe Premiere assist instructors in easily recording, editing, and publishing educational videos. For creating instructional videos, software like Screencast-O-Matic or Loom provides convenient screen recording solutions, enabling instructors to visually demonstrate processes or technical operations. Moreover, platforms like YouTube or Vimeo not only support storage but also provide analytics tools to track learner engagement, allowing for adjustments to video content as needed.
- **Artificial intelligence (AI) and automation tools** Artificial Intelligence (AI) is becoming a crucial component in the production of digital learning materials. AI tools such as ChatGPT, Grammarly, or Jasper AI assist instructors in quickly and accurately generating learning content. AI is also used for automatic subtitling, transcribing video content, or even creating chatbots for learning support, providing students with immediate feedback. Additionally, AI tools like Synthesia allow for the creation of videos with virtual characters, saving both time and production costs. In this study, the integration of AI will not only enhance the efficiency of learning material production but also improve the learner's experience through personalized features.
- **Collaboration and project management tools**The digital learning material production process often requires collaboration among various stakeholders, including instructors, technical staff, and content designers. Project management tools such as Trello, Asana, or Microsoft Teams help coordinate tasks, track progress, and ensure effective collaboration between teams. Specifically, Google Workspace and Microsoft 365 provide online collaboration solutions, allowing multiple users to edit documents or present in real-time. These tools not only increase productivity but also help reduce errors and ensure the quality of learning materials.
- **Data Security and management tools**Security is a critical factor in the production of digital learning materials, particularly when handling sensitive student information. Tools like AWS (Amazon Web Services) or Microsoft Azure offer cloud storage services with high security features, including data encryption and automatic backups. Additionally, data management software such as Tableau or Power BI not only supports analytics but also assists instructors and administrators in making quick and accurate data-driven decisions.

The combination of these technological tools will form a comprehensive ecosystem that addresses every aspect of the digital learning material production process. The correct application of these tools will not only enhance the quality of learning materials but also contribute to building a modern, effective, and sustainable digital learning environment at ETALI.

IV. PROPOSED SOLUTIONS AND DIGITAL LEARNING MATERIAL PRODUCTION PROCESS MODEL AT ETALI

To meet the growing demand for high-quality digital learning materials (DLMs) at Education Technology and Adaptive Learning Institute(ETALI), the development of an efficient, optimized, and sustainable production process model is essential. Digital learning materials require not only rich and easily accessible content but also a professional production process that ensures timely delivery and cost efficiency. This process must integrate modern technologies, align with the current capabilities of the staff, and take into account the infrastructure conditions at ETALI, while also laying the foundation for future scalability.

To optimize the production of digital learning materials, the study proposes an integrated solution consisting of: a Learning Management System (LMS), Artificial Intelligence (AI), and multimedia design tools. The focus of this solution is on seamless coordination between these tools, allowing each stage in the production process to be carried out synchronously and continuously. For instance, AI can assist instructors in creating basic content, while design software like Adobe Creative Cloud ensures the quality of visuals, videos, and audio. An LMS such as Moodle will serve as the platform to organize, store, and distribute learning materials, while also providing feedback data from learners to continuously improve the content.

The proposed digital learning material production process model at ETALI includes the following steps:

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Step 1: Needs survey and planning

The production process begins with surveying the needs of instructors and learners, including content, formats, and specific requirements for the learning materials. This stage requires close collaboration between educational experts and technical staff to ensure the feasibility and appropriateness of the materials. A detailed plan for time, personnel, and tools will help avoid resource wastage and ensure timely delivery.

Step 2: Development of raw content

At this stage, instructors and content experts will develop the basic learning material in the form of text, slide drafts, or video scripts. AI tools may be used to assist in content development, such as suggesting lesson structures or creating multiple-choice questions. This step is foundational and determines the quality and accuracy of the digital learning materials.

Step 3: Multimedia design and development

Once the raw content is approved, the technical and design teams will transform it into multimedia formats, including videos, images, or interactive lectures. Professional tools such as Adobe Premiere, Articulate Storyline, or Canva will be used to ensure high-quality visuals and audio, while also enhancing the attractiveness of the learning materials.

Step 4: Integration into the learning management system

The completed learning materials will be uploaded to ETALI's LMS. This stage requires thorough testing to ensure that the content displays correctly and is compatible with the devices used by learners. Features such as progress tracking, assessments, and feedback collection will be set up to support quality management.

Step 5: Deployment and evaluation

When the learning materials are delivered to learners, the research team must gather feedback to assess the effectiveness. Data from the LMS, such as study time, assignment completion rates, or frequently asked questions, will serve as a basis for improving content and refining the production process in the future.

The digital learning material production process at ETALI is proposed to adopt Agile principles, which help enhance flexibility and adaptability to changing requirements. Agile allows the team to break the process into short cycles (sprints), with each cycle focusing on a specific part of the content. The results from each cycle will be immediately evaluated to make adjustments and improvements. This approach not only reduces deployment time but also ensures that the quality of learning materials is continuously improved.

An important factor in this model is data management and security. ETALI should use secure cloud storage services like AWS or Microsoft Azure to protect student and instructor information. The system must ensure data safety, preventing loss or unauthorized access, and comply with personal data protection regulations (such as GDPR).

Integrating automation and AI tools into the model significantly reduces labor costs and production time. For example, using AI for content editing or generating automatic subtitles for videos can save hours of work. Additionally, online collaboration tools like Trello and Microsoft Teams help optimize project management and increase team productivity.

The proposed solution and process model for digital learning material production at ETALI not only optimizes the current process but also lays the foundation for sustainable development in the future. By applying modern technologies, Agile principles, and strict security measures, ETALI will be able to build a high-quality digital learning material system that meets the needs of learners and enhances the institute's position in the field of digital education.

V. EXPERIMENTATION AND EVALUATION OF SOLUTION EFFECTIVENESS

To assess the feasibility and effectiveness of the digital learning material production (HLS) solution at Education Technology and Adaptive Learning Institute(ETALI), a testing plan was developed, focusing on three main factors: time efficiency, material quality, and the satisfaction levels of both students and instructors. The experimentation process was implemented in two phases: a small-scale pilot phase with several sample courses and a larger-scale phase applied to the entire online curriculum at the institute. The testing plan was designed to compare the new solution with traditional production processes, thereby providing objective and detailed conclusions.

Results from the pilot phase indicated that the production time for a digital learning material using the new process reduced by an average of 30% compared to the traditional method. For instance, creating an online lecture, including video, slides, and quizzes, traditionally took

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approximately 15 working days, whereas with the new solution, this time was reduced to about 10 days. The primary reason for this reduction was the application of artificial intelligence (AI) in content creation and automated format-checking processes. Simultaneously, production costs were significantly reduced, saving approximately 20-25% by minimizing the need for external staffing and leveraging existing software tools.

One of the main goals of the solution was to enhance the quality of digital learning materials. After testing, the materials produced using the new process received more positive feedback from both instructors and students. According to a survey of 150 learners, 87% rated the materials as more intuitive and easier to understand, compared to 65% under the old process. Notably, multimedia-integrated lectures (featuring illustrative videos and interactive exercises) encouraged more active participation from students, with the completion rate of assignments increasing from 72% (under the old process) to 85% (under the new process).

When comparing the two processes, factors such as flexibility, content modification capability, and personalization in digital learning materials all demonstrated the superiority of the new solution. For example, editing an online lecture previously took 2-3 days due to manual modifications at several stages, but with the integrated Learning Management System (LMS), this time was reduced to less than 1 day. Furthermore, by utilizing AI for content suggestions and personalization, students could access assignments or materials tailored to their individual abilities, rather than following a fixed curriculum as before.

A critical factor for evaluating the effectiveness of the solution is the level of satisfaction among stakeholders. Survey results showed that 92% of instructors appreciated the effectiveness and convenience provided by the solution, particularly in reducing workload pressures and improving lecture professionalism. For students, 89% reported that they found the learning materials more engaging and accessible compared to before. Notably, there was an increase in student motivation, with 78% feeling more motivated when using interactive lectures.

Although many positive results were achieved, the testing process also faced some challenges, mainly related to familiarization with new technologies and coordination between departments. Some instructors, particularly those with less experience with technology, initially struggled with using multimedia design tools or integrating content into the LMS. However, through in-depth training sessions and technical support, most of these issues were resolved. The lessons learned from the experimentation process indicate the need for more training activities and the establishment of detailed instructional materials to assist instructors and technical staff during implementation.

With these positive results from the testing phase, the solution is considered feasible for large-scale deployment. Proposed improvements include optimizing the LMS interface, adding more advanced learning analytics tools, and expanding AI applications to not only support content production but also assess learning effectiveness. This will help ETALI not only enhance teaching quality but also build a modern digital learning material ecosystem that meets the diverse needs of learners during the digital transformation era.

The experimentation of the digital learning material production solution at ETALI has demonstrated its superior effectiveness compared to traditional processes in terms of time, cost, and quality. The experimental results not only lay the groundwork for broader implementation but also affirm ETALI's pioneering role in educational innovation. Continuing to refine this solution will help the Institute enhance its competitive capacity and better meet the demands of teaching and learning in the 4.0 technology era.

VI. CONCLUSION AND RECOMMENDATIONS

- **Conclusion**

The research and implementation of the digital learning material production (HLS) solution at Education Technology and Adaptive Learning Institute (ETALI) have confirmed the importance of innovation in the production and management of digital educational content. Through analysis and experimentation, the solution not only significantly improves production efficiency but also enhances material quality, optimizes costs, and better meets the diverse needs of learners.

Practical testing results show that production time was reduced by about 30%, while costs decreased by 20-25%. The quality of learning materials improved, with instructor satisfaction at 92% and learner satisfaction at 89%. Notably, the integration of artificial intelligence (AI), big data, and advanced online learning tools has enhanced personalization, increased participation, and boosted student motivation. These results demonstrate that ETALI's digital learning material production solution not only aligns with modern

educational trends but also has the potential to become a model for other educational organizations.

- **Recommendations**

With proven effectiveness, ETALI should rapidly expand the adoption of this solution across the entire online training program and even traditional courses. Integrating HLS production technology into all areas of training will help optimize resources and create modern, competitive educational products.

To ensure effectiveness during large-scale deployment, continuous training programs for instructors and technical staff should be organized, focusing on using multimedia design tools, the LMS, and AI technologies. Additionally, a dedicated technical support team should be established to address operational issues quickly.

The implementation of a digital learning material model requires robust and stable technological infrastructure. ETALI should invest in server systems, cloud data storage, and advanced learning analytics tools. This will not only support production but also ensure data security and improve user experience.

To maintain a competitive edge and meet changing learning demands, ETALI should continue researching, updating new technologies, and refining the HLS production process. Collecting feedback from learners and instructors, as well as analyzing learning material usage data, will help improve the solution over time.

ETALI's digital learning material production solution not only meets current needs but also creates a solid foundation for the long-term development of digital education. With these recommendations, ETALI can continue to assert its leading role in educational innovation and make significant contributions to the comprehensive digital transformation of the training sector.

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