Design of Information and Communication Technology Teaching Materials Based on Contextual Teaching and Learning

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Abstract

Online learning during the COVID-19 pandemic has required the teaching and learning process to be conducted without face-to-face interaction. This condition has increased the demand for digital teaching materials that can effectively support students' understanding, particularly in Information and Communication Technology (ICT) subjects. SMP Patra Mandiri 2 Palembang is equipped with a computer laboratory and internet facilities; however, these facilities have not been optimally utilized because teachers still rely on manual guidebooks for practical learning activities. This study aimed to design ICT teaching materials based on the Contextual Teaching and Learning (CTL) approach in the form of a website to support online learning. The system development employed the Extreme Programming (XP) method, which consists of the stages of planning, design, coding, and testing. The results of the study produced a CTL-based ICT teaching materials system that provides features for uploading learning materials, assignments, quizzes, question-and-answer interactions, and assessments that are accessible to both teachers and students. The system is expected to enhance the effectiveness of online learning and to promote active student engagement in understanding learning materials through a contextual approach.

Keywords

Teaching materials; Information and Communication Technology; Contextual Teaching and Learning

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Introduction

The rapid development of information technology has significantly transformed the education sector, encouraging institutions to integrate digital tools as essential learning support media. Technological integration is no longer optional but has become a fundamental requirement for ensuring educational quality, equity, and accessibility (UNESCO, 2020; Anderson, 2018). As mandated by Law of the Republic of Indonesia Number 20 of 2003 concerning the National Education System, education must be supported by adequate learning resources as an integral component of the teaching and learning process. The COVID-19 pandemic further accelerated this transformation by forcing schools to shift abruptly from conventional face-to-face instruction to fully online learning environments, making the availability of effective digital learning media increasingly urgent (Dhawan, 2020; Basilaia & Kvavadze, 2020).

During the pandemic, online learning emerged as the primary solution to maintain educational continuity. However, this sudden transition also revealed significant limitations in instructional readiness, particularly in the availability of suitable digital teaching materials and teachers' digital pedagogical competencies (Hodges et al., 2020; Rasmitadila et al., 2020). Many learning activities that were previously conducted in physical classrooms and laboratories became difficult to implement remotely. As a result, both teachers and students were required to adapt rapidly to new digital learning ecosystems that demand not only access to internet infrastructure but also well-designed instructional content that supports independent and meaningful learning (König et al., 2020; Kementerian Pendidikan dan Kebudayaan, 2020).

In the learning process, teaching materials play a crucial role as structured references that guide students in understanding subject matter in accordance with the curriculum. Teaching materials also function as a bridge between learning objectives and student achievement (Prastowo, 2015; Arsyad, 2017). In Information and Communication Technology (ICT) subjects, learning activities are generally conducted in computer laboratories as they emphasize practical skills. However, many teachers still depend on conventional printed guidebooks, which limits the flexibility of learning and reduces the effectiveness of practical material delivery—especially during the pandemic when laboratory access has been severely restricted (Suyanto & Jihad, 2013; Fitriani, 2021).

To address these instructional challenges, an innovative pedagogical approach is needed. The Contextual Teaching and Learning (CTL) model is a learning approach that connects academic material with real-life experiences, encouraging students to actively construct knowledge based on their own understanding. According to Sukmawati (2015) and Susiloningsih (2016), CTL enhances students' critical thinking skills, creativity, independence, and problem-solving ability. This perspective is also supported by Johnson (2014) and Berns & Erickson (2012), who emphasize that contextual learning strengthens student engagement and long-term knowledge retention. By applying CTL, students are not only passive recipients of information but become active participants in the learning process. Therefore, the integration of CTL into digital teaching materials is expected to significantly improve the quality of ICT learning in online environments (Sari & Purnomo, 2020).

SMP Patra Mandiri 2 Palembang is equipped with internet facilities that potentially support the implementation of digital learning. However, these facilities have not yet been optimally utilized to develop structured web-based learning content. The absence of interactive

and online-accessible CTL-based ICT teaching materials has limited students' ability to engage effectively in independent learning. Consequently, students experience difficulties in understanding practical ICT concepts, while teachers face challenges in delivering instructional content optimally in an online format (Putra & Wardana, 2020; Handayani, 2021).

Based on these conditions, this study focuses on designing and developing CTL-based ICT teaching materials in the form of a website as a solution to overcome the limitations of online learning and to improve instructional effectiveness. The system is developed using the Extreme Programming (XP) method, which is highly suitable for software development projects with rapidly changing requirements and continuous user feedback (Borman et al., 2020; Carolina et al., 2019; Pressman & Maxim, 2019). The resulting web-based teaching materials are expected to enhance learning accessibility, improve student engagement, and support effective ICT instruction in both online and blended learning environments.

Methodology

Research Location and Time

The study was conducted at SMP Patra Mandiri 2 Palembang, located on Flamboyan Street, Pertamina Sungai Gerong Complex, Plaju District, Palembang City, South Sumatra, Indonesia. The research activities were carried out for eight months, from February to September 2021.

Data Collection Techniques

Four data collection techniques were employed in this study:

1. Observation
   Direct observation was conducted to obtain an overview of the learning process, the utilization of school facilities, and system requirements.
2. Interviews
   Interviews were conducted with ICT subject teachers to identify constraints, information needs, and the required system features.
3. Literature Study
   Relevant references were collected through the review of books, scientific journals, and other sources related to teaching materials, CTL, and information system development.
4. Documentation
   Documentation involved the collection of school data, learning archives, and other supporting documents.

System Development Method

The system development method used in this study was Extreme Programming (XP), which consists of the following four stages:

1. Planning
   This stage involved problem identification, user requirements analysis, and the formulation of the main system functions.

2. Design
   The design stage was carried out using Unified Modeling Language (UML), including use case diagrams, activity diagrams, class diagrams, and database design.
3. Coding
   System implementation was developed using the PHP programming language and a MySQL database.
4. Testing
   System testing was conducted using the black box testing method to ensure that each function operated according to the specified requirements.

System Design

The system design employed UML to describe user interactions (administrator, teacher, and student), system activities, and functional specifications, including the management of teacher data, student data, subjects, schedules, learning materials, assignments, quizzes, and assessment results.

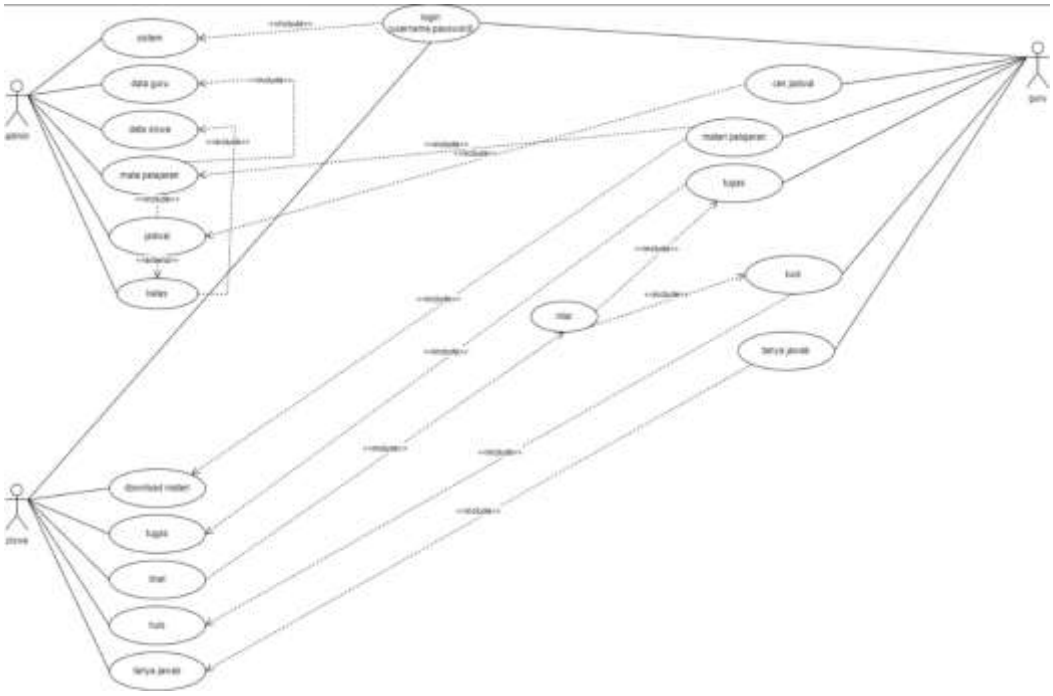

Figure 1. Use Case Diagram

Results

The developed CTL-based ICT teaching materials system consists of several main interfaces and functional features, as described below:

1. Teacher Login Page
   Teachers and administrators access the system through the address:http://localhost/smppm2bahanajar/sistem/
2. Student Login Page
   Students access the system through the address:http://localhost/smppm2bahanajar/

3. CTL-Based Teaching Materials Page
   This page presents ICT learning materials organized according to CTL principles and supports independent online learning.
4. Assignment Menu
   The assignment menu displays information on tasks assigned by teachers, including assignment files, class information, and submission deadlines.
5. Grade Menu
   The grade menu is used by teachers to input daily assessment scores, mid-semester examination scores, final semester examination scores, and to generate student report grade recapitulations.
6. Quiz Data Menu
   This menu displays a list of quiz questions, answer options, and explanations to assist students in understanding the correct answers.
7. Question and Answer Menu
   This feature provides an online interaction space between teachers and students related to the learning materials.
8. Student Assignment Menu
   Students can download assignments, complete them, and upload the results through this menu.
9. Student Quiz Menu
   The quiz page displays a list of questions along with the allocated working time, which appears automatically based on the teacher's settings.
10. Student Grade Page
    This page displays complete student assessment results, ranging from daily scores to final report grades.
11. Student Question and Answer Menu
    This feature allows students to submit questions related to the learning materials to the teacher in an online format.

Discussion

The development of the CTL-based ICT teaching materials system using the Extreme Programming (XP) method has proven to be an effective solution in addressing the limitations of online learning at SMP Patra Mandiri 2 Palembang. Prior to the implementation of this system, learning activities were heavily dependent on printed guidebooks and direct laboratory practice, which became highly constrained during the COVID-19 pandemic. Through the newly developed web-based system, learning materials can now be delivered digitally, enabling teachers to conduct instruction more efficiently without requiring physical attendance in the computer laboratory. This shift significantly improves learning accessibility and ensures instructional continuity under restricted learning conditions.

The integration of the Contextual Teaching and Learning (CTL) approach into the digital teaching materials has successfully enhanced the relevance and meaningfulness of ICT learning. By linking theoretical ICT concepts with real-life applications, students are encouraged to understand not only how technology works, but also how it is applied in everyday situations. This finding supports the perspectives of Sukmawati (2015) and Susiloningsih (2016), who state that CTL strengthens students' critical thinking, problem-

solving abilities, and learning independence. As a result, the learning process becomes more student-centered, where learners actively construct knowledge based on contextual experiences rather than passively receiving information.

The availability of interactive features such as assignment uploads, online quizzes, discussion forums, and digital assessments further supports active learning. These features allow teachers to monitor student progress continuously and provide timely feedback. Students, on the other hand, are given greater flexibility to access learning materials anytime and anywhere, encouraging self-paced learning and responsibility. The integration of online evaluations also improves transparency and efficiency in assessing student performance, which is especially important in fully digital learning environments.

From a software engineering perspective, the adoption of the Extreme Programming (XP) method played a crucial role in ensuring system adaptability and reliability. The iterative development process allowed continuous communication between developers and users (teachers and administrators), which ensured that the system evolved according to real classroom needs. This finding is consistent with the studies of Borman et al. (2020) and Carolina et al. (2019), which emphasize that XP is highly effective for educational software development due to its emphasis on user feedback, rapid prototyping, and incremental improvement.

Furthermore, the web-based nature of the system ensures scalability and sustainability for long-term use beyond the pandemic. The platform can continuously be enhanced with additional features such as multimedia learning content, simulation-based practices, and advanced analytics for student performance tracking. This provides the school with a strategic digital learning infrastructure that supports blended and hybrid learning models in the future.

Overall, the implementation of the CTL-based ICT teaching materials system using the XP method has significantly improved the effectiveness of online learning at SMP Patra Mandiri 2 Palembang. The system not only addresses technical and instructional limitations caused by the pandemic but also strengthens pedagogical quality through contextual learning. These results demonstrate that the combination of contextual pedagogy and agile software development provides a robust framework for developing sustainable digital learning systems in secondary education environments.

Conclusion and Recommendations

Based on the results of the study, it can be concluded that the CTL-based ICT teaching materials system was successfully designed and can be used as a supporting medium for online learning. The system is intended for teachers and students of SMP Patra Mandiri 2 Palembang. It provides features for user login, lesson schedules, learning materials, assignments, quizzes, question-and-answer interactions, and assessments. The system is capable of improving the effectiveness, orderliness, and interactivity of online learning. The system was developed using the PHP programming language and a MySQL database with the Extreme Programming (XP) development method.

Disclosure Statement

The author declares that there is no conflict of interest related to this research and its publication.

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References

Anderson, T. (2018). The Theory and Practice of Online Learning. Athabasca University Press.
Arsyad, A. (2017). Media Pembelajaran. Jakarta: RajaGrafindo Persada.
Basilaia, G., & Kvavadze, D. (2020). Transition to online education in schools during COVID-19. Pedagogical Research, 5(4).
Berns, R. G., & Erickson, P. M. (2012). Contextual teaching and learning. National Center for Research in Vocational Education.
Borman, R. I., et al. (2020). Implementation of Extreme Programming in educational software development. Journal of Information Systems Education.
Carolina, I., et al. (2019). Agile software development using XP approach. International Journal of Software Engineering.
Dhawan, S. (2020). Online learning: A panacea in the time of COVID-19. Journal of Educational Technology Systems, 49(1).
Fitriani, Y. (2021). Analisis kesiapan pembelajaran daring di sekolah menengah. Jurnal Pendidikan.
Handayani, S. (2021). Digital teaching materials in secondary schools. Jurnal Teknologi Pendidikan.
Hodges, C., et al. (2020). The difference between emergency remote teaching and online learning. Educause Review.
Johnson, E. B. (2014). Contextual Teaching and Learning. California: Corwin Press.
Kementerian Pendidikan dan Kebudayaan RI. (2020). Pedoman Pembelajaran Jarak Jauh.
König, J., et al. (2020). Teachers' preparedness for online teaching during COVID-19. Educational Research.
Prastowo, A. (2015). Panduan Kreatif Membuat Bahan Ajar Inovatif. Yogyakarta: Diva Press.
Pressman, R. S., & Maxim, B. R. (2019). Software Engineering: A Practitioner's Approach. McGraw-Hill.
Putra, A., & Wardana, I. (2020). Implementasi pembelajaran berbasis web di SMP. Jurnal Pendidikan Teknologi.
Rasmitadila, et al. (2020). Teachers' perceptions of distance learning during COVID-19. Journal of Education and Learning.
Sari, R., & Purnomo, S. (2020). Digital learning media for ICT subjects. Journal of Educational Technology.
Sukmawati. (2015). Pembelajaran berbasis kontekstual dalam pendidikan. Jurnal Pendidikan.
Susiloningsih. (2016). Contextual teaching and learning dalam pembelajaran abad 21. Jurnal Inovasi Pendidikan.
Suyanto, & Jihad, A. (2013). Menjadi Guru Profesional. Jakarta: Erlangga.

UNESCO. (2020). Education in a Post-COVID World.

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Biographical Notes

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