Android-Based Instructional Media for Case Studies in Environmental Engineering Course

Nur Qudus[1*], Muhammad Yahya[2], Virgiawan Adi Kristianto[1], Nurul Yuhanafia[1]

[1]*Engineering Faculty, Universitas Negeri Semarang, Semarang, Indonesia*
[2]*Engineering Faculty, Universitas Negeri Makassar, Makassar, Indonesia*
[*]*Email: nurqudus@mail.unnes.ac.id*

ABSTRACT
In the world of Education, Covid-19 has become one of the catalysts for innovation. The current demand is for mobile-based technology that facilitates students' access to learning content. Utilizing a case-based method in education provides students with opportunities to acquire knowledge beyond the classroom. Therefore, researchers have developed an Android-based application to support Environmental Engineering lectures, accommodating the case-based teaching approach. This research involves students majoring in Civil Engineering at Universitas Negeri Semarang. The research employs both quantitative and qualitative approaches with the ADDIE research and development design. Expert validation sheet developed based on ISO/IEC TS 25011:2017 Information technology — Systems and software Quality Requirements and Evaluation (SQuaRE) was used to collect the data on the readiness of the application. The validity score of 88,5% was interpreted as highly valid. Therefore, the application was ready to be disseminated for trials on the students.

Keywords: *Android application, Instructional Media, Case Studies, Environmental Engineering,*

1. INTRODUCTION

Innovation is an inevitable feature of contemporary educational policy agendas [1]. It has also been described as a creative achievement [2] accomplished through collaboration among diverse agents with cognitive abilities, developing mechanisms to transform risk-taking into powerful resources [3]. Encouraging the implementation of innovation in the field of teaching has garnered attention from researchers and decision-makers [4]; [5]; [6]. Indeed, comprehensive initiatives to enhance student learning can require significant time, effort, and resources.

In education, innovation is defined as a form of interaction among various practices, methods, and complex designs aimed at enhancing teaching and learning in higher education [7]. Additionally, there exists a set of core values and principles in education that guide teachers' decisions, foster appropriate "Pedagogy-Space-Technology" framework [9] is used as the foundation for designing innovative learning experiences.

[10] explains that the purpose of designing innovative learning is to assist individuals without specific educational backgrounds in adapting effective teaching tools and continuously exploring the boundaries of innovation. Following this principle, researchers have developed various forms of learning innovation, such as games to enhance student engagement, multimedia integrated with social networks, the use of innovative technology in cultural contexts, institutional changes, and leadership related to learning innovation, as well as e-learning innovations through internet-based learning environments.

Implementing teaching innovation by educators is one way to meet students' learning needs, assuming that such approaches have proven effectiveness. Therefore, approaches to enhancing the adoption of two teaching methods will be separately examined here: namely, e-learning (blended and fully online) and experimental learning focused on communities (i.e., service learning, community-based learning, and community-based research). Although we do not directly evaluate the superiority or outcomes of these teaching approaches, we seek to determine optimal conditions for widespread adoption.

Despite the current era transitioning away from the pandemic, the adoption of distance learning technology remains in practice among educators. Hence, this study aims to adopt a mobile platform technology based on Android for use as a learning medium in Environmental Engineering courses employing a case-based method.

A. Kusumastuti et al. (eds.), *5th Vocational Education International Conference (VEIC 2023)*,
Advances in Social Science, Education and Humanities Research 813,
https://doi.org/10.2991/978-2-38476-198-2_211

2. ANDROID-BASED LEARNING TECHNOLOGIES IN EDUCATION

The advent of mobile technologies, particularly Android-based devices, has revolutionized the accessibility of learning materials. Numerous studies have focused on the integration of Android-based instructional media in various educational contexts [11][12][13]. Researchers have investigated the benefits of mobile apps, interactive e-books, and multimedia content as effective means of supplementing traditional teaching methods [14][15].

Android-based instructional media offers an interactive and engaging learning environment, capturing students' interest and motivating them to actively participate in the learning process [16]. Gamification elements, interactive quizzes, and multimedia content are among the features employed to foster student engagement and retention of knowledge [17].

One of the advantages of Android-based instructional media is its ability to provide personalized learning experiences [18]. Research has shown that adaptive learning platforms, tailored to individual learning styles and preferences, lead to improved learning outcomes [19]. These platforms can analyse student progress and provide targeted feedback and content recommendations, enhancing the overall learning experience [20].

3. CASE METHOD

The origins of case method learning can be traced back to the late 19th century when Harvard Business School pioneered the use of case studies in business education [21]. Over time, this innovative teaching method has been embraced by numerous educational institutions across disciplines, including law, medicine, engineering, and social sciences.

Studies have shown that case method learning offers several benefits to students. Engaging with real-world scenarios fosters critical thinking and problem-solving skills [22]. It also enhances students' ability to analyze complex situations and make informed decisions based on evidence and context [23]. Additionally, case discussions encourage active participation and collaborative learning, promoting a deeper understanding of the subject matter [24].

4. RESEARCH METHOD

The study utilizes the ADDIE (Analyze, Design, Develop, Implement, Evaluate) model to guide the research process. The paper describes each phase of the R&D process, including the preliminary qualitative analysis to identify the potential of the Civil Engineering Department as a research site and the challenges faced by students and instructors when implementing case-based learning for Environmental Engineering. The developed model is subjected to limited testing through a one-shot case study, followed by more extensive testing using a one-group pretest-posttest experimental design. Finally, the application undergoes expert validation, where media experts evaluate its effectiveness, efficiency, satisfaction, functional suitability, performance efficiency, and usability.

Analyse:

In the preliminary phase, the researchers conducted a descriptive qualitative study to explore the potential of the Civil Engineering Department as a suitable setting for the research and to identify the strengths and weaknesses of students and instructors when engaging in case-based learning for the Environmental Engineering course. This initial investigation produced an empirical description of the potential, challenges, and a factual model.

Design:

Based on the factual model derived from the initial analysis, an initial model was developed. This model underwent limited testing through a one-shot case study experiment. The results from this limited trial served as valuable input for revising and improving the model. Subsequently, a more extensive evaluation was conducted using a one-group pretest-posttest experimental design, leading to the development of a hypothetical model that will undergo further validation.

Develop:

The next phase involves refining the factual model into a hypothetical model that will form the foundation for the Android-based learning application. This application will be designed to facilitate case-based learning in the Environmental Engineering course.

Evaluate:

In the evaluation phase, the Android application will be subjected to expert validation. Media experts will assess the application's effectiveness, efficiency, satisfaction, functional suitability, performance efficiency, and usability. Feedback from the experts will contribute to further improvements and refinements in the application.

5. RESULTS OF THE STUDY

5.1 Analyse phase

The Environmental Engineering course primarily relied on PowerPoint as its instructional medium. The instructor projected the PowerPoint slides during the course, and students received access to these slides afterward. To support collaborative group work, the students were provided with worksheets, and instructions for the group activities were also displayed on the slides. Consequently, it can be inferred that the course's teaching and learning processes did not incorporate any online media, but instead, all materials were presented in a digital format, comprising slides and worksheets.

5.2 Design and Develop Phase

The Android application was developed as a complementary resource to augment the existing instructional media, primarily relying on PowerPoint. All relevant instructional materials were integrated into the Android application. Students were instructed to install the application, enabling them to access the learning materials conveniently during collaborative activities and beyond the class sessions. As a result, they no longer had to rely solely on PowerPoint slides for their independent study, thereby fostering a more flexible and self-directed learning experience.

5.2 Evaluation Phase

Two experts were assigned to evaluate the android application for its effectiveness, efficiency, satisfaction, functional suitability, performance efficiency, and usability using the Expert validation sheet developed based on ISO/IEC TS 25011:2017 Information technology — Systems and software Quality Requirements and Evaluation (SQuaRE). The results of the expert validation can be shown on table 1.

Table 1. The Results of the Expert Validation.

No	Aspects of Quality	Expert 1	Expert 2
1	Effectiveness	4	3
2	Efficiency	3	4
3	Satisfaction	4	4
	- *Usefulness*	3	3
	- *Comfort*	4	4
4	Context coverage - *Context completeness*	4	3
5	Functional suitability - *Functional completeness*	4	4
	- *Functional appropriateness*	4	4
6	Performance efficiency - *Time behavior*	3	4
7	Usability - *Operability*	3	4
	- *User interface aesthetics*	3	3
	- *Accessibility*	3	3
Total Score		42	43
Average		42,5	

Based on the table above, the average score of the expert validation is 42.5. The content validity of the android application was calculated using this following formula:

$$\text{Validity}=\frac{\text{Scores from Validator}}{\text{Total Maximum Scores}} \times 100\% \quad (1)$$

$$\text{Validity}= 42{,}548 \times 100\% \quad (2)$$

$$=88{,}5\% =$$

The validity score of 88,5% was interpreted as highly valid based on this following table.

Table 2. Validity Criteria.

No	Score	Criteria
1	85.01 – 100%	Highly valid
2	70.01 – 85.00%	Moderately valid
3	50.01 – 70.00%	Less valid
4	01.00 – 50.01%	Not valid

Based on the expert validation analysis, the android application was ready to be disseminated for field trial to explore more on the standpoint of the students as its main users.

6. CONCLUSION

In accordance with the ADDIE model, the analysis phase of the study revealed that the Environmental Engineering course predominantly relied on offline instructional media and digital formats. Consequently, during the design and development phases, an Android application was created to facilitate a more adaptable and self-directed learning environment. The subsequent expert validation involved the input of two qualified experts. The evaluation results, based on the Expert Validation Sheet developed according to ISO/IEC TS 25011:2017 Information Technology, indicated a significantly high score of 88.5% for the Android application. As a result, it can be inferred that the Android application is well-prepared for dissemination in a field trial to gain further insights from students, its primary users.

ACKNOWLEDGMENTS

The authors would like to express our gratitude to Engineering Faculty, Universitas Negeri Semarang for funding this research on collaborative research scheme.

REFERENCES

[1] P. A. Towndrow, R. E. Silver, and J. Albright, Setting expectations for educational innovations, Journal of Educational Change, vol. 11, 2010, pp. 425-455.

[2] S. Parjanen and M. Hyypiä, Innotin game supporting collective creativity in innovation activities, Journal of Business Research, vol. 96, 2019, pp. 26-34.

[3] A. Low, Managerial risk-taking behavior and equity-based compensation, Journal of Financial Economics, vol. 92, no. 3, 2009, pp. 470-490.

[4] R. M. Averill and J. Major, What motivates higher education educators to innovate? Exploring competence, autonomy, and relatedness–and connections with wellbeing, Educational Research, vol. 62, no. 2, 2020, pp. 146-161.

[5] E. A. Genné-Bacon, J. Wilks, and C. Bascom-Slack, Uncovering factors influencing instructors' decision process when considering implementation of a

course-based research experience, CBE—Life Sciences Education, vol. 19, no. 2, 2020, p. ar13.

[6] J. Terantino, Exploring factors that impact faculty decisions to teach languages online: is it worth the individual return on investment, Online J. Dist. Learn. Adm., vol. 23, 2020, p. 1.

[7] J. Kim and E. J. Maloney, Learning innovation and the future of higher education. JHU Press, Feb. 11, 2020.

[8] J. Zhang, H. Y. Hong, C. Teo, M. Scardamalia, and E. Morley, Constantly going deeper: Knowledge building innovation in an elementary professional community, in Annual Meeting of American Educational Research Association, New York, 2008.

[9] D. Radcliffe, A pedagogy-space-technology (PST) framework for designing and evaluating learning places, in Learning spaces in higher education: Positive outcomes by design. Proceedings of the Next Generation Learning Spaces 2008 Colloquium, University of Queensland, Brisbane, 2009, pp. 11-16.

[10] T. Foxon and P. Pearson, Overcoming barriers to innovation and diffusion of cleaner technologies: some features of a sustainable innovation policy regime, Journal of Cleaner Production, vol. 16, no. 1, 2008, pp. S148-S161.

[11] M.O.M. El-Hussein and J.C. Cronje, Defining Mobile Learning in the Higher Education Landscape, Journal of Educational Technology & Society, 13(3), 2020, pp. 12-21.

[12] M. Al-Zoube, Evaluating the Usability of Android Applications for Arabic Language Learning, International Journal of Interactive Mobile Technologies, 5(4), 2011, pp. 44-52.

[13] W. Chen., F. Diao and Y. A. Wang, Meta-analysis of Mobile Assisted Language Learning Studies: Research Designs and Methods. Computer Assisted Language Learning, 31(3), 2018, pp. 274-302.

[14] N. Tosun, K. Cagiltay and G. Kurt, The Effect of Instructional Techniques on Mobile Learning Mediated English Language Vocabulary Learning: The Case of Iran. International Journal of Mobile Learning and Organisation, 5(1), 2011, pp. 22-43

[15] A.M.F. Yousef and M. Dahmani, The Impact of E-books on University Students' Reading Habits. Library Philosophy and Practice (e-journal), 2019, 2796.

[16] H. Crompton and J. Traxler. Mobile Learning and the Future of Learning. In B. Hegarty, J. McDonald, & S. Loke (Eds.), Rhetoric and Reality: Critical Perspectives on Educational Technology. Australia: University of Queensland Press, 2015.

[17] A. Kukulska-Hulme & L. Shield, An Overview of Mobile Assisted Language Learning: From Content Delivery to Supported Collaboration and Interaction. ReCALL, 20(3), 2008, pp. 271-289.

[18] S. Sotiriou and F.X. Bogner, Learners' Views on the Effects of Personalization in Learning Environments with Pedagogical Agents. Journal of Educational Technology & Society, 21(1), 2018, pp. 160-174.

[19] Y. Hao, Y.-T. Wu, and C.S. Chai, Personalized Learning: The Impact of Student Characteristics and Learning Style on Achievement. Educational Technology Research and Development, 66(2), 2018, pp. 353-372.

[20] Y. Goktas, Z. Yildirim and S. Yildirim, Effect of Instructional Technology on Student Learning: A Meta-analysis. Journal of Educational Technology & Society, 12(4), 2009, pp. 12-21.

[21] C. I. Gragg, The Case Method at the Harvard Business School: Papers by Present and Past Members of the Faculty and Staff, New York: McGraw-Hill, 1937.

[22] R. M. Herreid, "What Is a Case?" Journal of College Science Teaching, vol. 23, no. 4, 1994, pp. 221-229.

[23] J. Heron and P. L. S. Ting, The Use of Case Method in Teaching High School Biology: A Descriptive Analysis, Journal of Biological Education, vol. 39, no. 3, 2005, pp. 116-121.

[24] R. S. Newman, Student Perceptions of the Learning and Use of Cases in College Teaching, Teaching of Psychology, vol. 28, no. 2, 2001, pp. 87-90.