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ICT portal for the development of mathematic teachers competence: The development and the feasibility

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Abstract

One of the problems in improving the competence of Information and Communication Technology (ICT) for mathematics teachers is that the teacher has to leave his / her teaching activities to participate in various improving competence events. This study aims to develop an ICT house portal that will be managed by the Mathematics Subject Teacher Forum in Indonesia or known as MGMP that allows teachers to interact with fellow teacher communities to improve ICT competence without having to leave their teaching activities at school. Furthermore, the researchers also conducted a usability test of the developed portal. The application development model used is the ADDIE model which stands for Analysis, Design, Development, Implementation, Evaluation. Meanwhile, application usability testing was carried out by distributing usability questionnaires to 30 respondents consisting of postgraduate students and lecturers of mathematics education. The results showed that the ADDIE model can be used to design and create the ICT house portal called *RumahTIK* where the procedures in the development section include making applications, testing by experts, testing content filling, testing the use of clinical features. Based on the results of the usability questionnaire processing, the percentage of usability was 81% which was classified as very feasible. Although this research was not implemented for real teacher groups, the ICT house portal is very suitable for use by the MGMP group. In the future, it is necessary to implement this portal in various MGMP groups so that recommendations can be obtained to improve teachers' ICT competence in mathematics.

Keywords: ADDIE model, ICT house portal, Competence, Usability

1. Introduction

One of the competencies that teachers need in this century is the competence of Information and Communication Technology (ICT) [1]. ICT competence is needed because the students faced by teachers today are children born in the digital age who place technology as part of their daily lives. This is in line with Tucker's opinion who said that one of the challenges of the 21st century is technology as a mainstay. The International Society for Technology in Education (ISTE) standard for students states that the components that must be mastered by students related to technology include the ability to apply digital tools to gather information and the ability to use technology to build knowledge and fluency in information [2]. For students to have these abilities, teachers need to have sufficient ICT competencies to help students become empowered learners. Currently, teacher competence in Information and Communication Technology (ICT) has been considered as part of their professional competence [3]. Thus, mathematics teachers as part of subject teachers are required to have ICT skills for learning mathematics. These skills include the ability to design ICT-based or assisted learning, create learning media, and provide ICT-based learning resources.

In general, there are three purposes for using ICTs in education: the use of ICTs as learning objects; the use of ICT as an aspect of scientific and professional disciplines; and the use of ICTs as a medium for teaching and learning [4]. The use of ICT as a medium focuses on improving student learning processes. It is often assumed that the use of ICTs will lead to changes in learning and teaching methods [5].

In developed countries, the competency of teachers in the field of ICT has been developed since 1998. For example, the UK, this country has implemented a test for teachers in the field of ICT where

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teachers must pass to be called Qualified Teacher Status (QTS). The test given includes basic skills in ICT such as the ability to master a word processor, spreadsheet, database, presentation, e-mail, and internet browser [6]. In Indonesia, the law on teachers and lecturers has promoted ICT competence as part of professionalism since 2005 [7]. Making IT lessons in one course does not seem to work effectively, since each subject may require different IT skills. To encourage the readiness of human resources in the global era through education in schools, it is necessary to integrate ICT into the learning process [8]. The ability of ICT is a requirement that must be possessed by mathematics teachers who administer the 2013 curriculum. This demand is different from the previous curriculum which places ICT as a separate subject taught to students by ICT teachers [9]. However, in the 2013 curriculum, the ability to use ICT is integrated with all existing subjects, so that every teacher needs to master ICT to teach students and for the demands of their professional duties [7].

on the other hand, there are problems and obstacles for teachers to use ICT in learning. Eleman (2016) in his research shows that teachers have several obstacles in implementing ICT in learning, including due to low ICT skills, financial support, and available time [10]. Besides, two limitations of ICT integration were also found, namely the lack of time to apply technology, and the lack of training that teachers get in the field of ICT [11]. Meanwhile, in another study, it was found that several obstacles were faced by teachers in terms of ICT accessibility, time, professional development, and technical support [12]. Recent research reports that secondary school teachers in Indonesia have insufficient knowledge of ICT to apply in teaching [13].

The Government of the Republic of Indonesia has made various efforts to improve the competence of mathematics teachers in the field of ICT, among others, by holding ICT training at the educational quality assurance institute as well as in training organized by the Provincial and District Education Offices. Also, the government increases the competence of teachers by sending them to higher education levels. However, there are drawbacks to these methods, namely the teacher has to leave school for a long time that which affects the student to teacher ratio, which is ideally 16: 1 [14]. Non-ideal ratios harm the educational process in schools, thus efforts are needed to increase teacher competence without causing new problems or other negative impacts. In a study, it was reported that teachers face major challenges such as the development of skills, knowledge in technology, and independent training in the use of ICT for teaching [15].

Mathematics is the main subject, but very few mathematics teachers use ICT in learning mathematics [16]. One of the reasons is the lack of skills in ICT. One of the efforts made is to optimally empower the Mathematics Subject Teacher Forum or in Indonesia, it is also called the MGMP, which is a non-structural teacher professional organization formed by secondary school teachers in an area as a forum for exchanging experiences to increase teacher competence [17]. MGMP can also improve teachers' professional abilities [18]. With the MGMP activities, all teachers can improve their performance in carrying out their duties as educators and can unify perceptions with teachers of similar subjects. Also, MGMP is effective in improving teacher performance [19]. By utilizing the teacher professional forum, teachers can exchange experiences and share so that they can develop teacher competence and turn them into professional teachers. Maximizing teacher performance in MGMP is an effective way to improve teacher professional and pedagogic competence [20].

Empowerment includes sharing knowledge and skills in ICT. Teachers who have ICT knowledge and skills can teach other teachers in the MGMP meeting. The problem is that there are not many teachers who master it, and there is not enough time available. Besides, face-to-face delivery has a very small reach, only teachers who have the opportunity to attend the MGMP can draw knowledge from their more skilled groupmates.

A strategy that considers the above limitations is to provide all the ICT needs of teachers online on the learning portal. The availability of portals with these characteristics is considered important because it will be able to increase the competence of teachers in the field of ICT. By developing this portal, teachers can improve their competence without having to leave learning at school, and the student-teacher ratio can be maintained to be at a normal ratio.

There are many platforms that can be used to improve teacher competence through distance learning, such as using Blackboard and Moodle learning management systems, but these platforms demand more didactics than technical skills [21]. In addition, it is also perceived as difficult to use [22]. It is necessary to create a learning management system that is technically easy to use by groups of teachers.. This study aims to determine the procedure for developing *RumahTIK* that will be managed by

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teachers in the mathematics MGMP. The portal's content consists of tutorials on ICT and Mathematics for Junior High Schools, ICT and mathematics clinics, creating media, media integration in mathematics teaching, and related news with mathematics teaching. Also, this study aims to determine the usability of *RumahTIK* by users.

2. Research Method

To create the applications, we adopt and modify the ADDIE development model. ADDIE is a design model which stands for: Analyze, Design, Develop, Implement, and Evaluate. This model is commonly used for the development of learning models and tools [19-20]. Commonly used application development models are waterfall, RAD, and prototype. One of the advantages of the ADDIE model is that there are stages of development that will accommodate user needs for various levels of conditions. Also, this model has stages of application in actual conditions before summative evaluation. *RumahTIK* is a learning-related application, and it requires validation and various trials before it is implemented.

There are five main stages in the ADDIE model. The first is the analysis stage which aims to identify possible causes of a performance gap. The second stage is the design which aims to verify the expected performance and test the appropriate method. The main procedures are to take inventory of tasks, set performance goals, and come up with a strategy. The development stage aims to produce and validate things that have been designed in the design phase. The main procedures include creating content, selecting the right media, developing system instructions, conducting formative evaluations by experts, and conducting content and clinic management testing. Content management testing aims to test whether the news presentation feature or tutorial can run well. Slightly different from non-interactive content management features, clinical management testing is needed to see the functionality of this feature in facilitating question and answer activities between teachers and experts. The fourth stage is implementation, which aims at this stage is to introduce the design to real users. The last is the evaluation stage that determines the effectiveness of the resulting product [23]. The ADDIE diagram that has been adopted can be seen in the following figure:

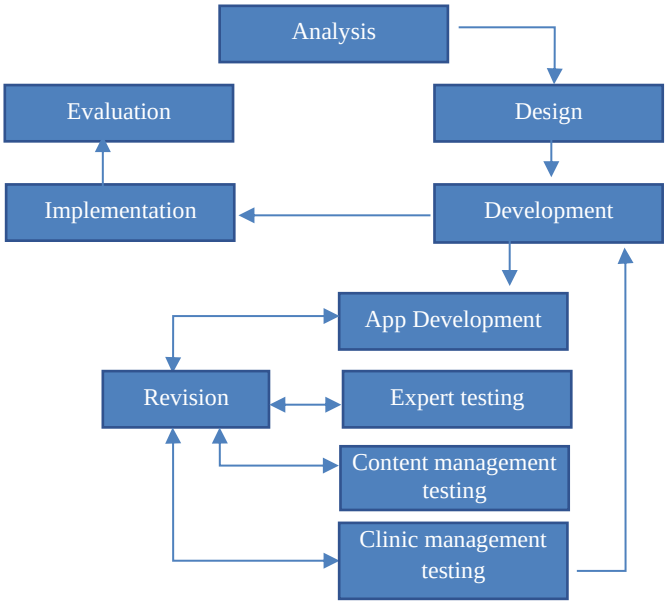

Figure 1. The modified ADDIE model

2.1 Usability Testing

Usability testing aims to get user perceptions about the usability of the application. The usability aspect in this study was tested using a questionnaire adapted from Arnold M. Lund's standard usability questionnaire [25]. There are four variables evaluated to measure the usability of the application, namely usability, ease of use, ease of learning, and satisfaction, each of which consists of 4, 7, 4, 4 items. The response scale used follows a Likert scale with five values, namely 1 = Strongly disagree, 2 = Disagree,

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3 = Neutral, 4 = Agree, and 5 = Strongly agree. Items are provided in the form of a statement, for example, "I am generally satisfied with the ease of use of this system".

Data were collected through questionnaires in December 2017. The study participants who acted as teachers consisted of 4 men and 24 women. Some of them had become real teachers, and some were fresh graduates who have had experience as teachers during their teaching practice at schools. Meanwhile, 2 expert teachers came from lecturers who taught in the mathematics education master's study program. All students and lecturers come from the mathematics education master program. Lecturers act as expert teachers, and students act as teachers in the MGMP group. To get the percentage of usability for each variable and in total, the formula is used:

$$Percentage = \frac{Onserved\ Score}{Ideal\ Score} \times 100\%.$$

The criteria for usability as shown in Table 1.

Table 1. The criteria for usability

Percentage (%)	Criteria
0 – 20	Very Unworthy (VU)
20 – 40	Unworthy (U)
40 – 60	Fair (F)
60 – 80	Feasible (Fe)
80 – 100	Very Feasible (VFe)

Source: [26]

3. Result and Discussion

3.1. Application Design and Creation Procedure

The first objective of this research is to show the procedure for designing and developing *RumahTIK*. The development stages of adapting the ADDIE development model, and the overall development procedure can be seen in Table 2 below:

Table 2. *RumahTIK* Developing Procedure

Components	Procedures
Analysis	- Identification of MGMP activities - Identification of MGMP activities in *RumahTIK* management - Identify system requirements to be built
Design	- Creating a system design in the form of a use-case diagram, activity diagram, sequence diagram. - Design the database and user interface
Development	
Create the application	- Develop the ICT House application based on the plan. - The system analyst tests all application features - Make revisions based on analyst system correction
Expert testing	- Expert tests system performance, interface eligibility, and application security. - Make revisions based on expert suggestion
Content management testing	- Test news feature - Test article feature - Test tutorial feature - Make corrections if there are errors
Clinic management testing	- Test the teacher's question and answer feature with expert - Make revision based on test finding

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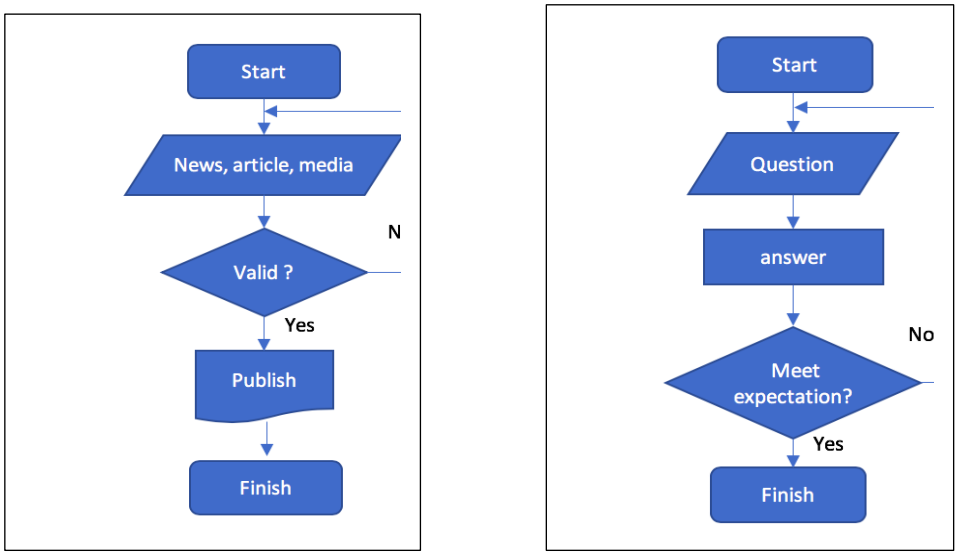
Implementation	-	Implement *RumahTIK* to an arbitrary group as representative of MGMP
Evaluation	-	Usability testing

Some important results in the application creation procedure are found at the analysis and design stages. The ICT house application is a web-based application created using the PHP programming language with the Laravel framework and the MySql database. At the design stage, to create *RumahTIK* that allows teachers to learn from each other, the following entities are required:

a. Administrators input all the teachers who will be the core team of ICT House managers.
b. The ICT House management team will input expert teachers and ordinary teachers on the list of expert teachers and ordinary teachers. Besides being able to self-publish articles, news, or media on the portal, the team is also tasked with validating each article, news, media to be published.
c. Expert teachers can answer any question directly without the need for validation from other parties.
d. Teachers can ask questions about ICT in learning mathematics, and teachers may upload an article, media, or teaching news to the portal.



(a) (b)

Figure 2. (a) Flow chart for the publication (b) Flow chart of clinical consultation

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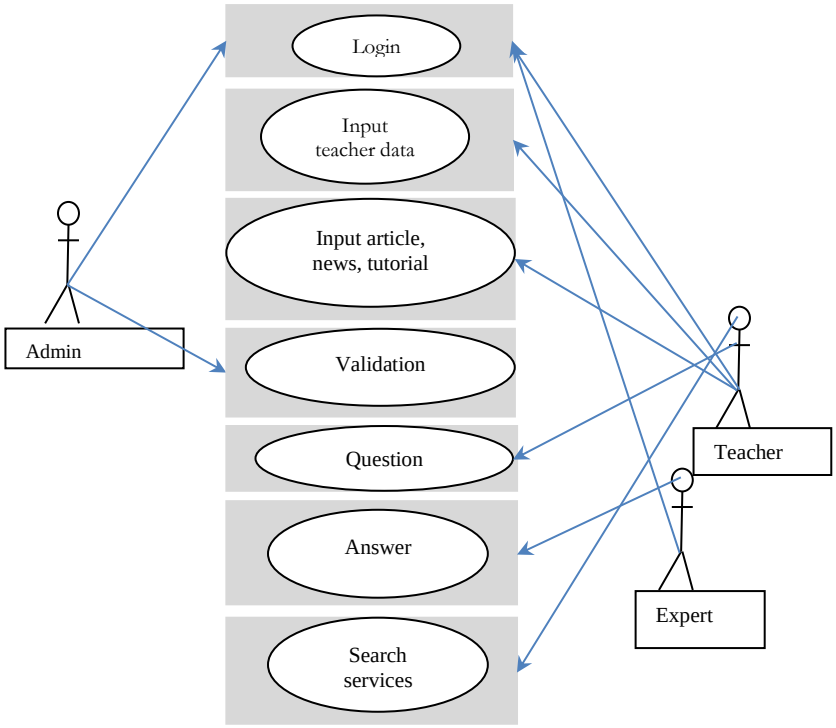

Figure 3: Use Case Diagram

The design phase produces an application flowchart that is used to describe the flow of services. In general, there are two services in this application which are publications and consulting clinics. Figure 2. (a) is a flowchart of tutorial, article, and news publication services. In this diagram teachers who are members of the MGMP will validate all types of services that will be uploaded. Meanwhile, Figure 2 (b) is a flowchart in the ICT clinic service process where every question given by a teacher will be answered by experts who can be either lecturers or senior teachers. A question is declared closed if the questioner is satisfied with the answer given by the expert.

The result of another important design activity is the Case Diagram which is used to show the interaction between all actors in the system which includes admin, teacher, and expert teacher. The main activities of each actor are shown in Figure 3. Figure 4 shows the main page of the Rumahtik web.

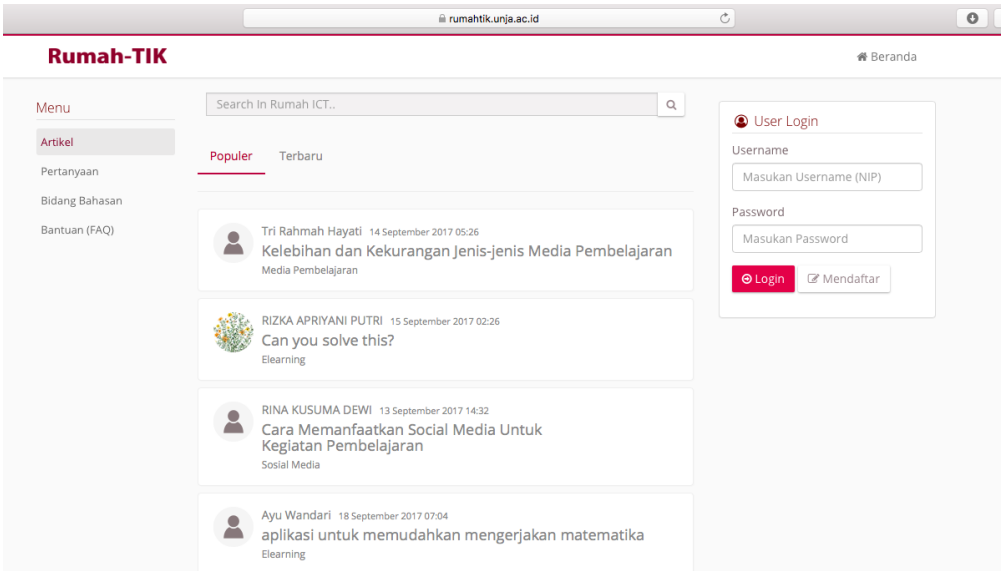

Figure 4. The web view

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3.2. Usability Aspect Testing

Table 3 shows the recapitulation of the reusability evaluation results. Satisfaction with *RumahTIK* has the highest percentage with the very feasible category. Meanwhile, the average ease of learning variable occupies the lowest position, but it is still in the feasible category.

Table 3: Recapitulation of usability evaluation results

No	Variable	Total Score	Ideal Score	Percentage	Category
	Usefulness	470	600	78.33	Fe
	Ease of Use	821	1050	78.19	Fe
	Ease of Learning	459	600	76.5	Fe
	Satisfaction	555	600	92.5	VFe

Figure 5 shows a graph comparing the percentage of usability for each variable which indicates users are very satisfied with *RumahTIK*.

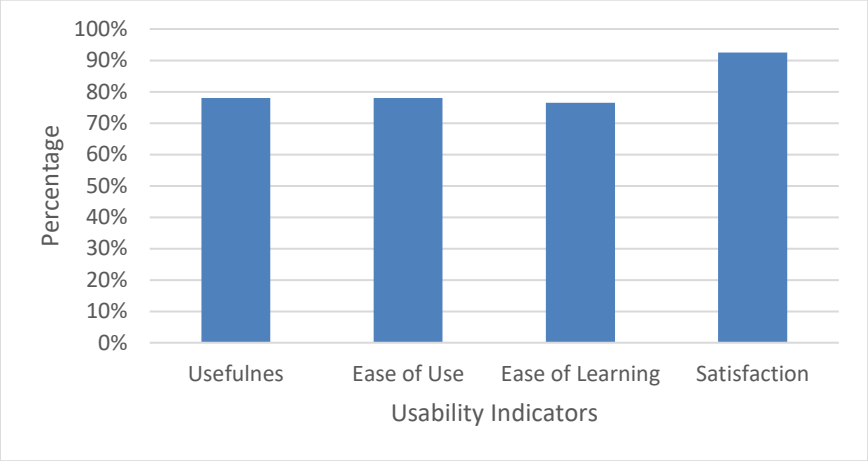

Figure 5. Graph of comparison of the percentage of usability variables

Furthermore, the observed score of 30 respondents was 2305, the expected total score was 5 x 19 x 30 = 2850. By substituting the observed score and the expected score in formula (1), it was obtained $Percentage = \frac{2305}{2850} \times 100\% = 81\%$. This percentage is interpreted that the value of 81% is considered very feasible. Thus it can be concluded that the *RumahTIK* meets the usability aspect.

3.3. Discussion

Based on the results of this study it can be seen that the ADDIE model can be used to produce *RumahTIK* that is used by groups of mathematics teachers. The successful use of this model is due to several reasons: first, all ADDEI components are found in almost all ICT application development models. One popular model in application development is Waterfall with Requirement, Design, Implementation, Verification, and Maintenance components [27], and all ADDIE components can be paired with Waterfall model components. The second reason is that the ADDIE model has components that have very flexible development procedures. Thus the implementation of the ADDIE model in this study further emphasizes that the model is very suitable to be used for the development of ICT-based tools [28]. An important procedure for producing *RumahTIK* is the existence of content management trials, expert trials, and clinical management trials. These tests are made specifically to ensure every feature that involves the user runs well. This portal can be accessed openly by the public at https://rumahtik.unja.ac.id.

From the usability aspect, it was revealed that the application was very feasible to use. This conclusion is supported by the level of feasibility of the supporting variables. The variable usability,

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ease of use, and ease of learning have a feasible level, while the satisfaction variable has a very feasible level. The high level of usability is inseparable from the ease of use and reliability of applications in meeting the basic needs of system users. It has become the intuition of the user when having difficulty in operating the system, the user will seek help on the system. This application provides FAQ facilities (frequently asked questions). With this feature, the user feels helped and comfortable when using the application. Hsu stated that when users feel the simplicity of an innovative product it will be considered to help improve performance [29]. Meanwhile, in research, it was reported that the completeness of information in an application affects user satisfaction [30]. The limitation of this research is the implementation of use of the application is still applied to a limited environment, it has not been applied to the actual MGMP environment. It remains to be seen how the usability will be for real users in the future by introducing and implementing this application to groups of math teachers.

4. Conclusion

RumahTIK has been successfully developed using the ADDIE model which consists of five main stages, namely analysis, design, development, implementation, and evaluation. There are four procedures in the development stage, namely application development, web expert testing, application management test, question and answer management test. Thus the stages of making an ICT Home are relevant to the five stages of the ADDIE model. Meanwhile, the application usability index is 81% and this is classified as very feasible so that it can be used by teachers or groups of teachers to improve ICT competence in mathematics learning. In the future, this application can be used on a larger scale and used in various groups of teachers and various subjects. This is very possible because the patterns of interaction and activities of each teacher community are the same. Future research can also be continued by looking at the effectiveness of *RumahTIK* in increasing the competence of mathematics teachers in the field of ICT as a learning aid.

Daftar pustaka

[1] K. Selvi, "Teachers' competencies," *Cult. Int. J. Philos. Cult. Axiolog.*, vol. 7, no. 1, pp. 167–175, 2010.

[2] T. Trust, "2017 ISTE Standards for Educators: From Teaching With Technology to Using Technology to Empower Learners," *J. Digit. Learn. Teach. Educ.*, vol. 34, no. 1, pp. 1–3, 2018.

[3] J. Kubrický and P. Částková, "Teachers ICT Competence and their Structure as a Means of Developing Inquiry-based Education," *Procedia - Soc. Behav. Sci.*, vol. 186, pp. 882–885, 2015.

[4] T. Plomp, A. C. A. ten Brummelhuis, and R. Rapmund, *Teaching and learning for the future*. Den Haag: SDU, 1996.

[5] H. J. Becker, "Findings from the teaching, learning, and computing survey: Is Larry Cuban right?," *Educ. Policy Anal. Arch.*, vol. 8, no. 51, pp. 1–31, 2000.

[6] M. Selinger and R. Austin, "A comparison of the influence of government policy on information and communications technology for teacher training in England and Northern Ireland," *Technol. Pedagog. Educ.*, vol. 12, no. 1, pp. 19–38, 2003.

[7] P. Pannen, "Integrating Technology in Teaching and Learning Mathematics," *19th Asian Technol. Conf. Math.*, pp. 1–15, 2014.

[8] U. A. Chaeruman, "Mengintegrasikan Teknologi Informasi dan Komunikasi (TIK) ke dalam Proses Pembelajaran: Apa, Mengapa dan Bagaimana?," *J. Teknodik*, no. April, p. 046, 2019.

[9] H. D. Hermawan, N. Deswila, and D. N. Yunita, "Implementation of ICT in Education in Indonesia during 2004-2017," *Proc. - 2018 Int. Symp. Educ. Technol. ISET 2018*, no. May, pp. 108–112, 2018.

[10] A. E. Elemam, "Barriers to Implementation of Information and Communication (ICT) in Public Sudanese Secondary Schools: Teacher's Prospective," *J. Sociol. Res.*, vol. 7, no. 1, pp. 33–43, 2016.

[11] P. S. Hsu, "Examining Current Beliefs, Practices and Barriers About Technology Integration: A Case Study," *TechTrends*, vol. 60, no. 1, pp. 30–40, 2016.

[12] S. Hadijah and S. Shalawati, "Investigating Teachers ' Barriers to ICT (Information Communication Technology Integration in Teaching English at Senior High Schools," *Proceeding Fifth Int. Semin. English Lang. Teach.*, pp. 302–310, 2017.

[13] M. Mailizar and L. Fan, "Indonesian teachers' knowledge of ICT and the use of ICT in secondary mathematics teaching," *Eurasia J. Math. Sci. Technol. Educ.*, vol. 16, no. 1, pp. 1–13, 2020.

[14] L. Sutcher, L. Darling-Hammond, and D. Carver-Thomas, "Understanding teacher shortages: An analysis of teacher supply and demand in the united states," *Educ. Policy Anal. Arch.*, vol. 27, 2019.

[15] S. Amuko, M. Miheso, and S. Ndeuthi, "Opportunities and Challenges : Integration of ICT in Teaching and Learning Mathematics in Secondary Schools , Nairobi , Kenya," *J. Educ. Pract.*, vol. 6, no. 24, pp. 1–7, 2015.

[16] A. Perienen, "Frameworks for ICT Integration in Mathematics Education - A Teacher's Perspective," *Eurasia J. Math. Sci. Technol. Educ.*, vol. 16, no. 6, 2020.

[17] R. N. Emiliasari, "an Analysis of Teachers' Pedagogical Competence in Lesson Study of Mgmp Smp Majalengka," *ELTIN JOURNAL, J. English Lang. Teach. Indones.*, vol. 6, no. 1, p. 22, 2018.

[18] A. Arifin, "The Role of MGMP Civic Education in Improving Professional Competence of Teacher," *J. Iqra' Kaji. Ilmu Pendidik.*, vol. 4, no. 2, pp. 249–264, 2019.

[19] Y. Nurlaeli and O. Saryono, "Efektivitas Musyawarah Guru Mata Pelajaran (MGMP) Dalam Meningkatkan Kinerja Mengajar Guru Bahasa Inggris," *Indones. J. Educ. Manag. Adm. Rev.*, vol. 2, no. 2, pp. 308–317, 2018.

[20] U. Sulistiyo and S. Haswindy, "Organizing Professional and Pedagogical Training to Improve English Teachers' Skills: A Literature Review," *Edukasi J. Pendidik. dan Pengajaran*, vol. 5, no. 2, pp. 167–174, 2018.

[21] V. Awouters and S. Jans, "E-learning competencies for teachers in secondary and higher education," *Int. J. Emerg. Technol. Learn.*, vol. 4, no. 2, pp. 58–60, 2009.

[22] A. Blecken, D. Brüggemann, and W. Marx, "Usability evaluation of a learning management system," *Proc. Annu. Hawaii Int. Conf. Syst. Sci.*, no. June, 2010.

[23] R. M. Branch, *Instructional Design: The ADDIE Approach*. London: Springer, 2009.

[24] M. Rusdi, *Penelitian Desain dan Pengembangan Kependidikan*. Depok: Rajawali Pers, 2018.

[25] A. M. Lund, "Measuring usability with the USE questionnaire," *Usability interface*, vol. 8, no. 2, pp. 3–6, 2001.

[26] W. A. Kusuma, V. Noviasari, and G. I. Marthasari, "Analisis Usability dalam User Experience pada Sistem KRS Online UMM menggunakan USE Questionnaire," *J. Nas. Tek. Elektro dan Teknol. Inf.*, vol. 5, no. 4, 2016.

[27] T. Vithani and A. Kumar, "Modeling the mobile application development lifecycle," *Lect. Notes Eng. Comput. Sci.*, vol. I, no. January, pp. 596–600, 2014.

[28] N. Moradmand, A. Datta, and G. Oakley, "The Design and Implementation of an Educational Multimedia Mathematics Software: Using ADDIE to Guide Instructional System Design," *J. Appl. Instr. Des.*, vol. 4, pp. 37–49, 2014.

[29] M. W. Hsu, "An analysis of intention to use in innovative product development model through TAM model," *Eurasia J. Math. Sci. Technol. Educ.*, vol. 12, no. 3, pp. 487–501, 2016.

[30] W. H. DeLone and E. R. McLean, "The DeLone and McLean model of information systems success: A ten-year update," *J. Manag. Inf. Syst.*, vol. 19, no. 4, pp. 9–30, 2003.

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