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Developing Digital Game Based Learning to Support Numeracy of Elementary School Teacher Education Students

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Abstract—**Digital Game-Based Learning (DGBL) is a form of learning** innovation that facilitates students to learn game-based. This study aims to produce digital game-based learning products that can improve the numeracy skills of elementary school teacher education students. The game will be tested for validity and practicality before being applied in learning. This study indicates that the resulting product, "CAKAP NUMERASI" game, is suitable for use in learning and is practically used in learning. The validation test results from learning experts in the field of elementary school teacher education showed a percentage of 95.9%, which was in the very valid criteria. The results of the practicality test are in the practical criteria with a percentage of 80.4%. Based on the notes on the validity and practicality of the media, several ways can be done to improve the quality of the media before being tested on a wider range of students.

Keywords—DGBL, numeracy, mathematics game, elementary school teacher

I. INTRODUCTION

Research related to numeracy has continued to increase over the last ten years. These studies show the relationship of numeracy to various areas of life. In addition to mathematics, numeracy is also related to language skills to health [1]–[5]. Numeration becomes an inseparable part as the basis for developing logic and mathematical reasoning, especially related to problem-solving in everyday life [6].

The importance of numeracy is, in fact, not in line with the current mastery of numeracy skills in Indonesia. The results of the 2018 PISA (Program for International Student Assessment) show that the ability of Indonesian students in mathematics is far below the world average, which is 379, with a world average of 489 [7]. The average mathematical ability of Indonesian students in 2018 even experienced a downward trend from previous years. The AAC (Program for the International Assessment of Adult) survey conducted by the OECD in 2016 also showed that the numeracy skills of adults in Indonesia were low [8]. These results underscore the

need to inculcate numeracy skills from an early age to increase mastery of these competencies into adulthood.

In 2020 the Ministry of Education and Culture issued a policy to change the National Examination into a National Assessment 2021. Numeration is one of the Minimum Competency Assessment (AKM) focuses. AKM will be given at the elementary, middle, and high school levels. This policy is also accompanied by supporting facilities developed by the Assessment and Learning Center of the Ministry of Education and Culture, namely the website https://pusmenjar.kemdikbud.go.id/akm/ as student learning materials [9]. In developing numeracy skills in students, of course, it cannot be separated from the role of the teacher in the process. Teachers who have good numeracy skills are expected to positively influence the development of students' numeracy skills [1].

As agents who play a role in instilling the concept of numeracy in elementary school students, prospective elementary school teachers should master numeracy skills well. The numeracy skills of prospective elementary school teachers have not fully met the expected criteria. The results of research related to the numeracy ability of prospective elementary school teacher students at the Universitas Negeri Malang on an online assessment showed that the average numeracy ability of students was in a low category [10]. Another study showed that most elementary school teacher professional education students had problems related to numeracy skills [11]. It encourages the need to provide learning resources and special programs to improve numeracy skills.

Digital Game-Based Learning (DGBL) is a learning innovation that facilitates students to learn game-based. In this case, DGBL or learning-based digital games are part of applying information technology to learning. The results of previous studies showed that games could improve numeracy skills quickly in elementary school students [12]. DGBL is also an effective educational method in improving students' motivation and skills in mathematics education [13]. In

several studies, DGBL has been proven to improve student achievement [14]-[18].

The advantages of DGBL in improving students' abilities in mathematics are an alternative to developing numeracy skills for prospective elementary school teachers. This research is important to prepare prospective elementary school teachers who will later prepare elementary school students for AKM. It can be done by developing DGBL to improve the numeracy skills of prospective primary school teachers.

This research is an alternative to develop numeracy skills in prospective elementary school teachers. This is done by developing DGBL to improve the numeracy skills of prospective elementary school teachers. The urgency of this research as part of innovation in learning for prospective elementary school teachers. The development of DGBL is important to improve the numeracy skills of prospective elementary school teachers to prepare learning that supports the success of AKM for elementary school students. The results of this study will provide insight regarding strategies that can be used to maximize AKM Numeration in subsequent learning, both at the higher education level and in elementary school.

This study aims to produce digital game-based learning products that can improve the numeracy skills of elementary school teacher education students. The resulting product will be tested for validity and practicality before being applied in learning. The benefits of this research as part of innovation in learning for prospective elementary school teachers. The development of DGBL is important to be able to improve the numeracy skills of prospective elementary school teachers prepare learning that supports the success of AKM for elementary school students. The results of this study will provide insight regarding strategies that can be used to maximize AKM Numeration in subsequent learning, both at the higher education level and in elementary school.

A. Elementary School Teacher's Numeracy

In general, numeracy skills can be used as a reference in predicting the skills of working with numbers in the future [20]. The ability to compare, interpret numbers, calculate, understand the place value of numbers, read data, and knowledge of logically related to numeracy is proven to be relevant to the needs of all aspects of the world of work. To develop numeracy skills in students, of course, will depend on the role of the teacher in the learning process. Teachers who have good numeracy skills are expected to positively influence the development of students' numeracy skills [21], [22].

The development of numeracy competencies for teachers certainly needs to be carried out periodically to update and maintain their competencies. Based on a survey conducted by Audrey Cooke (2014), teachers' numeracy skills fluctuated [23]. Along with these fluctuations, there is anxiety in the community, which begins to doubt the ability of teachers in a particular field, especially numeracy [24]. So that effort is needed to continue to upgrade the numeracy skills of teachers. Such is the case with the development of the framework that has been carried out by Peter Sellings, et al. In his research showed an effect of 0.99 in the numeracy ability of prospective teachers after being given treatment [25]. These results indicate that the numeracy skills of prospective

teachers need to be honed and developed through innovations in learning.

B. Minimum Competency Assessment

The importance of assessment in learning cannot be separated from its role as a key component that helps students see their learning process [26]. Assessment is an inseparable part of the learning process. By knowing the extent of student achievement, students can find out what they need to improve in learning. In addition, through the assessment, the teacher can determine the achievement of learning objectives and follow up on these results.

AKM is a step by the Ministry of Education and Culture to assess the quality of learners on a basic basis [9]. The two competencies used as references in the AKM are reading literacy and numeracy literacy. Information related to AKM can be accessed on the https://pusmenjar.kemdikbud.go.id/akm/ page. Specifically related to numeration, AKM focuses on four main categories: numbers, geometry & measurement, algebra, and data & uncertainty. On the AKM website, it is stated that the Learning Level for elementary school students is divided into three levels, namely Level 1 (Grades 1 & 2), Level 2 (Grades 3 & 4), and Level 3 (Grades 5 & 6). The distribution of material at each level is adjusted to the learning achievement of the highest class with relevant competencies accompanied by practice questions and discussions on each indicator.

C. Digital Game-Based Learning (DGBL) in Mathematics Learning

DGBL is a term used to describe digital games as a medium in learning. DGBL refers to utilizing the entertainment value of digital games for educational purposes [27], [28]. The use of digital technology in education is a development demand. It has even become more rapid after the emergence of the COVID-19 pandemic, which requires most students to study from home by utilizing digital-based electronic devices such as mobile phones, smartphones, laptops, and/or computers to access various learning applications. Learning must be reformed and use contemporary methods to meet the new needs and requirements of the 21st century [29].

The recent development of distance learning demands innovation in learning, including the use of DGBL to address the challenges and trends in the development of mathematics learning, both in learning design, learning materials, learning media, and learning assessments. The development of DGBL in mathematics learning can help educators instill concepts, including numeracy concepts. Previously, the use of digital games was considered effective in increasing learning motivation, mathematics attitudes and mathematics learning achievement [29]–[31].

II. METHOD

The trial subjects in this study were selected during small group trials. Small group trials were carried out to identify the shortcomings of the initial product based on students' views to re-examine the revised results of the instrument validation results. The subjects of the small group trial in this study were ten students in the year 2019 and 2018 of elementary school teacher education study program undergraduate study programs who had taken a series of courses in Mathematics. This research data collection uses validity and practicality

tests, each of which has a data collection instrument. The following are some data collection instruments.

TABLE I.   THE GRID OF VALIDATION INSTRUMENTS

Aspect	Indicators	Items
Content	Media compatibility with numerical indicators	2
	Media compatibility with numeric content	1
	Ease of media content to understand	1
Construct	Suitability of media presentation	1
	Ease of use of media	1
	The accuracy of the selection and placement of supporting images on the media	1
Language	Appropriateness of language used in media	1
	The media use communicative language	1
	Understanding sentences on media	1
	The readability of sentences on the media	1

The validity test instrument in this research and development is a validation sheet. The sheet is given to the validator, which is used to validate the media and materials in the learning media developed by the researcher. Table 1 shows the grid of validation instruments. The practicality test instrument in this development research is in the form of a student response questionnaire. The questionnaire will be given to students who have taken a series of courses in Mathematics. The grid of practicality test instruments is shown in Table 2.

TABLE II.   THE GRID OF PRACTICALLY TEST INSTRUMENTS

Aspect	Indicators	Items
Use of Media	Ease of access	1
	Instructions for using media are easy to understand	1
Design and Appearance	Media attraction	1
	The attractiveness of media theme colors	1
	Easy-to-use media buttons	1
	Readability of writing on media	1
User Response	Positive impact on students	1
	Encouraging students to learn	1
	Increase student knowledge	1
	Helping students to learn	1

This research is a type of research and development using the ADDIE development model. This development model has five main stages: Analysis, Design, Development, Implementation, and Evaluating. The presentation of each stage is explained as follows.

1) Stage of Analysis (Analysis). At this stage, an initial analysis of the numeracy skills of prospective elementary school teachers is carried out based on an online assessment that has been carried out on elementary school teacher education study program students at the Universitas Negeri Malang [10]. In addition, the learning strategies carried out related to numeracy for elementary school teacher education study program students were analyzed, as well as analysis related to the schedule of research implementation.

2) Design Phase (Design). This stage is related to the determination of learning strategies in DGBL aimed at improving the numeracy skills of prospective elementary school teachers, including initial displays, storyboards, and prototypes of digital games related to numeracy skills for elementary school teacher education study program students.

3) Development Phase (Development). This stage includes the development of digital games that have been adapted to the design stage, followed by compiling expert test instruments, validation by experts, and continued revisions based on results and suggestions from experts.

4) Implementation phase (Implementation). The implementation phase was carried out through small group trials through experiments to determine the practicality of digital games with student responses to small group trials.

5) Stage of Evaluating (Evaluation). This stage consists of a formative evaluation stage which is carried out at each previous stage as a process of improving product quality.

Games are given to students of elementary school teacher education study program Universitas Negeri Malang. The data of this study consisted of data from the practicality test after students tried to use DGBL, "CAKAP NUMERASI", which contained four materials focused on numeration according to the AKM, namely numbers; geometry & measurement; algebra; and data & uncertainty. In addition, product development process data was obtained in the form of expert validity test results were analyzed descriptively by presenting percentages and qualitative data in the form of suggestions.

This research data analysis aims to determine the validity and practicality of the product developed. The data analysis techniques used in this research and development are qualitative descriptive analysis and quantitative descriptive analysis. The following is an explanation of the data analysis techniques in this study.

Quantitative descriptive analysis technique was used to analyze the data obtained from student responses in descriptive form. Validity analysis converted in percentage. Qualitative descriptive analysis technique is used to analyze data by describing or describing qualitative data. Qualitative data analysis techniques are used to process the data from the review in the form of comments, input, suggestions for improvement from experts and users (students). The results of this analysis are used as a reference for improving the learning media so that the resulting learning media is of high quality

Conclusions on the practicality of the media based on the criteria. The media is declared eligible for testing if it reaches the minimum score of percentage. If there are still improvements, the interactive media can be revised according to comments or suggestions that the validator has given. Revisions should be made if the criteria are under "Sufficiently Valid." Media is declared suitable for use if it reaches " Practical " minimum criteria. If there are still improvements, the interactive media can be revised according to comments or suggestions that the validator has given. Revisions should be made if the criteria are under "Practical".

III. RESULT AND DISCUSSION

The development of "CAKAP NUMERASI" has been developed in the form of an assessment that aims to support students' numeracy skills. Figure 1 shows the appearance of the initial page on this medium. Initial page has function to describe the application generally. Figure 1 use landscape user interactive (UI) mode to make student easily to use.

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Fig. 1. The Initial Page of "CAKAP NUMERASI" Game

Fig. 3. The Level of "CAKAP NUMERASI" Game

This media also displays the *Main Menu* (Figure 2), which consists of initial information related to numeracy which can be accessed on the *Did You Know* menu. Furthermore, the *Socialization Video* contains videos related to the introduction of numeracy as available on the Ministry of Education and Culture's AKM page. Numerical assessment is available on the Let's Play menu, and the name of this media developer is written on the *Developer Profile* menu.

Fig. 2. The Display of "CAKAP NUMERASI" Game Main Menu

On the Let's Play menu, you can see the level of play available in this Numerical CAKAP game (Figure 3). There are three levels of play in the game: Level 1, Level 2, and Level 3. At each level, there are ten questions that must be solved. The level of difficulty contained in each level is adjusted to Levels 1-3 on the numeration questions at the AKM.

Participants who get a score of 80 (getting eight correct answers) can immediately move to the next level. An example of a question display can be seen in Figure 4. The games that have been developed have been validated by three learning experts in the field of elementary school education. The validation results of the three validators can be seen in Table 3.
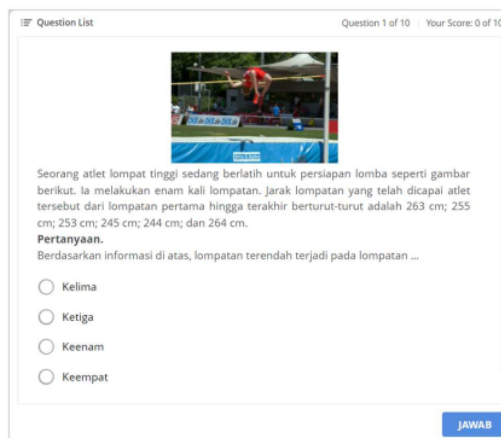

Fig. 4. Example of a Question Display on "CAKAP NUMERASI" Game

Subsequent questions were revised, and the revised media were tested for practicality in small group trial. The results of small group trials on ten students (subject) can be seen in Table 4.

TABLE III. THE EXPERT VALIDATION RESULT

Validity	Expert 1	Expert 2	Expert 3
Content	100%	100%	100%
Construct	100%	83.3%	100%
Language	100%	90%	90%
Average		95.9%	

In addition to quantitative data related to the results of the practicality test, there are also suggestions from users regarding this media revision. The suggestion such as the questions are quite challenging; it is better to explain the function of the home button, books, and arrows at the first page; the memory should not be too large because not all smartphone can accommodate large enough applications. Another suggestion is about the web response is quite slow when accessed.

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TABLE IV.   THE PRACTICAL TEST RESULT

Subject	Practically Test (%)	Note
1	90	
2	90	
3	80	
4	90	
5	84	
6	74	
7	68	
8	72	
9	84	
10	72	
Average	80.4	Practical

Creativity and technology are the determinants in optimizing the use of technology as an option during online learning activities. Along with the development of technology, as an educator, you must be able to quickly adapt and be able to use technology for the development of learning, especially during the current pandemic [27]. Online technology allows interaction during online learning to occur. In delivering learning materials, teachers must be creative so that students do not feel bored while carrying out learning at home. Variations in the use of learning media adapted to students' conditions are needed to keep students learning well [26]. Giving an interlude in the form of games in the middle of learning can also be a solution to keep the learning atmosphere fun.

Generation Z is a generation that is already familiar with gadgets and games. Children generally like games, so the use of game-based learning is suitable to be applied to the conditions of the digital generation as it is today. Game-based learning is a learning method that uses game/game applications that have been specifically designed to assist in the learning process [28]. Using game-based learning,, we can provide stimulus to three important parts of learning: emotional, intellectual, and psychomotor.

Learning evaluation in the form of quizzes does not doubt that students need to be treated with interesting learning models to not experience boredom in learning. This creation is still casuistic but can be cloned in another school to ensure its effectiveness. Educators need to always innovate and be creative in learning so that students remain enthusiastic about learning and can easily understand the material we provide [22], [23]. The philosophy of learning is to transfer material, character, and inspire. The thing that is no less important is to make the learning atmosphere fun and make a deep impression so that the material is always imprinted in the minds of students. Creating a learning environment that is always fun is closely related to creativity, and this is where technology plays a big role.

Digital game-based learning (DGBL) has attracted the interest of various parties in using games as a learning tool. Continuous research that has been carried out in every decade has led to various books as well as research articles that have increasingly popularized the existence of DGBL as an alternative in learning [17], [18]. This is inseparable from technological developments and students who are increasingly adapting to technology. The era of the industrial revolution 5.0 led to the development of an increasingly massive and unstoppable digital world. There is a lot of information flow, from the emergence of various interesting digital applications and content to the emergence of a digital generation that is accustomed to interacting through cyberspace and can't even

be separated from all the interesting things in it [27]. This generational character supports the existence of DGBL as a tool that is easier to use in learning.

Differences of opinion often arise regarding the perception that games are always something that is relaxed, not serious in nature, and different from learning. It seems that it can slowly be eliminated. Today, the majority of people believe that games are interesting, and when used effectively, games can play a role in learning [30]. The question that arises then is why DGBL is interesting and effective and how games can be integrated into the learning process to maximize students' learning potential. Educational games are often designed by academics so that they have a less attractive impression in game design. Sometimes games are fun to play but don't play a role in learning, nor are we expecting them to be. Ultimately, DGBL creates a space for collaboration between pedagogy and game design to maximize their function in learning [29].

This study indicates that the game is suitable for use in learning and is practically used in learning. According to expert validation results, games on numeration are considered effective in learning according to learning outcomes and changes in student behavior after they learn with the help of games. Games have been proven to teach intellectual skills as well as motor skills [26]. In learning, games are also able to realize established learning principles and models. Games effectively support learning because they take place in a meaningful context [13]. Games in learning are also associated with the learning environment and can demonstrate students' skills in their learning situations. Learning that occurs in a meaningful context is what causes games to positively influence learning.

Based on the strengths and weaknesses of the DGBL, especially from the notes on the validity and practicality of the media, there are several ways that can be done to minimize these weaknesses—giving audio needs to be done to support the game's attractiveness. This can add a fun aspect to the game. The ease and speed of access on the website need to be considered in order to make the game easier to access. In the next stage, it is necessary to analyze the effectiveness of DGBL on the numeracy abilities of students and elementary school students.

IV. CONCLUSION

This study indicates that the DGBL, "CAKAP NUMERASI", is suitable for use in learning and is practically used in learning. The validation test results from learning experts in the field of elementary school teacher education showed the percentage of 95.9%, which was in the very valid criteria. The results of the practicality test are in the practical criteria with a percentage of 80.4%. Based on the notes on the validity and practicality of the media, several ways can be done to improve the quality of the media before being tested on a wider range of students. Giving audio needs to be done to support the game's attractiveness. The audio can add a fun aspect to the game. The ease and speed of access on the website need to be considered in order to make the game easier to access. In the next stage, it is necessary to analyze the effectiveness of DGBL on the numeracy abilities of students and elementary school students. The DGBL is ready for use, but it needs to be revised again to improve the media's quality. Furthermore, the media can be tested on elementary school teacher education study program students to see the readiness of students in teaching numeracy in elementary schools.

Media can also be disseminated to teachers or schools who need media as an introduction to numeracy material. Further researchers can carry out further product development to develop supporting media products for numeracy learning using other software.

REFERENCES

[1] S. McLeod, L. J. Harrison, and C. Wang, "A longitudinal population study of literacy and numeracy outcomes for children identified with speech, language, and communication needs in early childhood," Early Child. Res. Q., vol. 47, pp. 507–517, Apr. 2019, doi: 10.1016/j.ecresq.2018.07.004.

[2] F. Niklas and C. Tayler, "Room quality and composition matters: Children's verbal and numeracy abilities in Australian early childhood settings," Learn. Instr., vol. 54, pp. 114–124, Apr. 2018, doi: 10.1016/j.learninstruc.2017.08.006.

[3] S.-L. Skwarchuk, C. Sowinski, and J.-A. LeFevre, "Formal and informal home learning activities in relation to children's early numeracy and literacy skills: The development of a home numeracy model," J. Exp. Child Psychol., vol. 121, pp. 63–84, May 2014, doi: 10.1016/j.jecp.2013.11.006.

[4] H. S. Yin et al., "Assessment of Health Literacy and Numeracy Among Spanish-Speaking Parents of Young Children: Validation of the Spanish Parental Health Literacy Activities Test (PHLAT Spanish)," Acad. Pediatr., vol. 12, no. 1, pp. 68–74, Jan. 2012, doi: 10.1016/j.acap.2011.08.008.

[5] T. Kleemans, E. Segers, and L. Verhoeven, "Relations between home numeracy experiences and basic calculation skills of children with and without specific language impairment," Early Child. Res. Q., vol. 28, no. 2, pp. 415–423, Apr. 2013, doi: 10.1016/j.ecresq.2012.10.004.

[6] J. Hong, P. (Vonu) Thakuriah, P. Mason, and C. Lido, "The role of numeracy and financial literacy skills in the relationship between information and communication technology use and travel behaviour," Travel Behav. Soc., vol. 21, pp. 257–264, Oct. 2020, doi: 10.1016/j.tbs.2020.07.007.

[7] K. C. Media, "Skor PISA Terbaru Indonesia, Ini 5 PR Besar Pendidikan pada Era Nadiem Makarim Halaman all," KOMPAS.com. https://edukasi.kompas.com/read/2019/12/04/13002801/skor-pisa-terbaru-indonesia-ini-5-pr-besar-pendidikan-pada-era-nadiem-makarim (accessed Jan. 17, 2021).

[8] "Survey of Adult Skills (PIAAC) - PIAAC, the OECD's programme of assessment and analysis of adult skills." https://www.oecd.org/skills/piaac/ (accessed Aug. 31, 2020).

[9] "AKM | Kementerian Pendidikan dan Kebudayaan." https://pusmenjar.kemdikbud.go.id/akm/ (accessed Jan. 17, 2021).

[10] N. L. S. Nuraini and Humaidi, "Online Assessment Application in Measuring the Numeracy Level of Prospective Elementary School Teachers," IEEE, 2020.

[11] S. Hartatik and N. Nafiah, "Kemampuan Numerasi Mahasiswa Pendidikan Profesi Guru Sekolah Dasar dalam Menyelesaikan Masalah Matematika", EHDJ, vol. 5, no. 1, pp. 32–42, Apr. 2020.

[12] D. Rohendi, "Game-Based Multimedia for Horizontal Numeracy Learning," iJet. Res., vol. 14, no. 15, 2019, Accessed: March. 8, 2021, https://doi.org/10.3991/ijet.v14i15.10679.

[13] JH. Byun and E. Joung, "Digital game‐based learning for K‐12 mathematics education: A meta‐analysis," School Science and Math. Res., vol. 118, no. 3-4, pp. 113‐126, Mar. 2018, https://doi.org/10.1111/ssm.12271.

[14] Y. Resti, Zulkarnain, Astuti, and E. S. Kresnawati, "Peningkatan Kemampuan Numerasi Melalui Pelatihan Dalam Bentuk Tes Untuk Asesmen Kompetensi Minimum Bagi Guru SDIT Auladi Sebrang Ulu II Palembang," AVOER 12. Res., vol. 2020, pp. 670-673, 2021.

[15] S. Y. S. Hussain, W. H. Tan, and M. Z. Idris, "Digital Game-Based Learning for Remedial Mathematics Students: A New Teaching and Learning Approach in Malaysia," International Journal of Multimedia and Ubiquitous Engineering, vol. 9, no. 11, pp. 325-338, 2014, http://dx.doi.org/10.14257/ijmue.2014.9.11.32.

[16] J. O'Rourke, S. Main, and S. M. Hill, "Commercially Available Digital Game Technology in the Classroom: Improving Automaticity in Mental-Maths in Primary-Aged Students," Australian Journal of Teacher Education, vol. 42, no. 10, pp. 50-70, Oct, 2017.

[17] A. N. Aziz, S. Subiyanto, and M. Harlanu, "Effects of the Digital Game-Based Learning (DGBL) on Students Academic Performance in Arabic Learning at Sambas Purbalingga," KARSA, Res., vol. 26, no. 1, 2018.

[18] N. A. M. Zin and W. S. Yue, "Design and Evaluation of History Digital Game Based Learning (DGBL) Software," JNIT. Res. Q., vol. 4, no. 4, pp. 9-24, June. 2013, doi:10.4156/jnit.vol4.issue4.2.

[19] M. Salaschek and E. Souvignier, "Web-Based Progress Monitoring in First Grade Mathematics," Frontline Learn. Res., vol. 1, no. 2, pp. 53–69, 2013.

[20] J. Zhu and M. M. Chiu, "Early Home Numeracy Activities and Later Mathematics Achievement: Early Numeracy, Interest, and Self-Efficacy as Mediators," Educ. Stud. Math., vol. 102, no. 2, pp. 173–191, Oct. 2019, doi: 10.1007/s10649-019-09906-6.

[21] V. Geiger, Teachers as Designers of Effective Numeracy Tasks. Mathematics Education Research Group of Australasia, 2016.

[22] N. M. Mackenzie, L. Danaia, A. MacDonald, and D. A. Metcalf, "Working above Standard in Literacy and Numeracy in Primary School," Issues Educ. Res., vol. 29, no. 2, pp. 485–501, 2019.

[23] A. Cookey, "Preliminary Investigations of Pre-Service Teacher Numeracy," Mathematics Education Research Group of Australasia, pp. 151-158, 2014.

[24] A. Wilson and W. Goff, ""Hopefully, I Will Gain Confidence": Hope in Pre-Service Teachers' Mathematics and Numeracy Testing" Australian Journal of Teacher Education, vol. 44, no. 10, pp. 52-65, Oct, 2019.

[25] P. Sellings, K. Felstead, and A. Goriss-Hunter, "Developing Pre-Service Teachers: The Impact of an Embedded Framework in Literacy and Numeracy," Australian Journal of Teacher Education, vol. 43, no. 4, 2018, http://dx.doi.org/10.14221/ajte.2018v43n4.1.

[26] H. Karakis, A. Karamete, and A. Okçu, "The Effects of a Computer-Assisted Teaching Material, Designed According to the ASSURE Instructional Design and the ARCS Model of Motivation, on Students' Achievement Levels in a Mathematics Lesson and Their Resulting Attitudes," Eur. J. Contemp. Educ., vol. 15, no. 1, pp. 105–113, 2016.

[27] C. Hebert, J. Jensen, and T. Terzopoulos, " "Access to technology is the major challenge": Teacher perspectives on barriers to DGBL in K-12 classrooms," SAGE Journal, pp. 1-18, 2015, http://dx.doi.org/10.1177/2042753021995315.

[28] Y.M. Cheng, S.J. Lou, S.H. Kuo, and R.C. Shih, "Investigating elementary school students' technology acceptance by applying digital game-based learning to environmental education," Australasian Journal of Educational Technology, vol. 29, no. 1, 2013, https://doi.org/10.14742/ajet.65.

[29] T. Anastasiadis, G. Lampropoulos, and K. Siakas, "Digital Game-based Learning and Serious Games in Education," IJASRE, vol. 44, no. 12, pp. 139–144, 2018, http://doi.org/10.31695/IJASRE.2018.33016.

[30] K. M. Al-Akl, "The effect of digital games-based learning on middle school students' math achievement and attitude: a case study," Thesis at Notre Dame University-Louaize, 2019.

[31] L. R. Cooper, "Digital Game-Based Learning and The Mathematics Achievement of Gifted Students," Dissertation at Liberty University, 2018.

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