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# MACROMEDIA FLASH: DIGITIZATION OF MATHEMATICS LEARNING MEDIA TECHNOLOGY

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## Abstract

One of the factors that influence the learning process is the learning media. Learning media is a tool used by educators so that the concept or material to be delivered is right on target and meaningful for students. This study aims to develop a feasible and practical macromedia Flash mathematics learning medium when used on materials of two-variable linear equation systems. The method used in this study is Research and Development (R&D) using 4D development models (Four-D Models). The procedure in this study was carried out in 3 stages, namely Define, Design, and Development. The instrument used in this study was in the form of a questionnaire. There were 20 participants in this study from SMK Avicena. The data analysis technique in this study uses quantitative data and qualitative data. Based on the validation results of material experts, an average value of 69% was obtained with a decent category and the validation results of media experts obtained an average value of 82% with a very decent category. The results on the user trial obtained an average value of 78.5% with the category of practical and attractive when used. The results of this study provide recommendations for teachers to use macromedia flash media as an alternative in mathematics learning in the era of technology digitization.

**Keywords**: Digitization; macromedia flash; media technology

## *Abstrak*

*Salah satu faktor yang mempengaruhi proses pembelajaran adalah media pembelajaran. Media pembelajaran merupakan alat yang digunakan oleh pendidik agar konsep atau materi yang akan disampaikan tepat sasaran dan bermakna bagi peserta didik. Penelitian ini bertujuan untuk mengembangkan media pembelajaran matematika macromedia Flash yang layak dan praktis ketika digunakan pada materi sistem persamaan linier dua variabel. Metode yang digunakan dalam penelitian ini adalah Research and Development (R&D) dengan menggunakan model pengembangan 4D (Four-D Models). Prosedur pada penelitian ini dilakukan dengan 3 tahap, yaitu Define (Pendefinisian), Design (Perancangan), dan Development (Pengembangan). Instrumen yang digunakan dalam penelitian ini berupa angket. Partisipan dalam penelitian ini berasal dari SMK Avicena berjumlah 20. Teknik analisis data pada penelitian ini menggunakan data kuantitatif dan data kualitatif. Berdasarkan hasil validasi ahli materi diperoleh nilai rata-rata 69% dengan kategori layak dan hasil validasi ahli media diperoleh nilai rata-rata 82% dengan kategori sangat layak. Hasil pada uji coba pengguna diperoleh nilai rata-rata 78,5% dengan kategori praktis dan menarik ketika digunakan. Hasil penelitian ini memberikan rekomendasi kepada para guru untuk menggunakan media macromedia flash sebagai salah satu alternatif dalam pembelajaran matematika di era digitalisasi teknologi.*

***Kata kunci**: Digitilaisasi; macromedia flash; teknologi media*

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## INTRODUCTION

The development of computer device technology as well as applications in all fields requires many parties to pay special attention to it. Mastery of this technology is one thing that the younger generation needs to have now (Dwiana et al., 2022). The demands of the globalization era with the development of information technology can be utilized for the development of learning (Akhmadan 2017; Sutriyono et al., 2020). One way to use technology in learning is the use of technological resources as a medium in the learning process (Akhmadan, 2017). The educational process is inseparable from the learning process (Harta, 2017; Margareta & Wahyuno, 2014; Rusnilawati, 2016). Through education man can broaden his horizons and acquire knowledge (Lanani, 2015; Mikrayanti, 2016). Mathematics learning is an effort to help students construct knowledge through the process (Aljundi & Altakhayneh, 2020). Mathematics is a science that is taught at every level of education (Zhu et al., 2021). Abstract characteristics of mathematics, to understand it requires high concentration and seriousness even requires a long time full of symbols that are sometimes difficult to understand (Çakici Eser, 2021; Kusuma et al., 2022). Students' understanding of the subject matter is the main goal of the learning process (Ivars et al., 2020). The use of learning media by utilizing technology can improve mathematics learning outcomes. This is in line with the opinion Sumarmi et al., (2021) that the use of learning media can generate new desires and interests, generate motivation and stimulation of learning activities, and bring psychological influence on students.

The use and application of digital technology is expected to be one of the appropriate and efficient solutions and alternatives by providing all the ease of information and delivery of materials and messages in the teaching and learning process. Naufal, (2021) Various efforts and solutions continue to be developed to improve the quality of education in Indonesia. The progress of education that still does not show encouraging enthusiasm encourages experts to be urunrembug in providing solutions, both in the short, medium, and long term. Mathis (2022) Digital technologies serve those who use the devices and whose behavior is consequently changed. Prior et al., (2016) Advances in technology are changing the way faculty teach and students learn. Selwyn & Facer (2014) Technology affects leadership and faculty learning technology (LT) interpretation, altering the type and degree of adoption used during instruction. Michael & Ambotang (2020) asserts that digital technology is the thing that most affects the education system in the world today. This is due to the aspects of effectiveness, efficiency and attractiveness offered by digital technology-based learning. Benson & Kolsaker (2015) Digital technology has become an integral part of education.

Macromedia Flash is a multimedia platform and software used for animation, games and internet enrichment applications that can be viewed, played, and run in adobe flash player (Khairani, 2016). The use of macromedia flash as a learning medium is useful for teachers as a tool in preparing teaching materials and organizing learning (Nugroho, 2018). Learning media is a factor that supports the success of the learning process in

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schools (Umam, 2016). Through digital media and various types of educational technology can support students with various learning abilities, providing more educational opportunities (Kingry et al., 2015; Molnár, 2014; Russell & Hannon, 2012). The absence of learning media can hinder the learning process (Rasman, 2021).

Several studies that have been published in international journals show that the use of technology-based learning media in mathematics learning has a positive impact on learning outcomes and increases student enthusiasm for learning (Bernard & Senjayawati, 2019; Mulenga & Marbàn, 2020; Yaniawati et al., 2021). With learning media, the information you want to convey to is more easily understood by students (Fadillah et al., 2021; Handayani, 2021; Syah et al., 2019).

Based on the assumptions, it is necessary to develop a learning media that can support the learning process and improve the quality of learning without being hindered by distance and time so as to improve students' digital literacy skills. Therefore, the study of the development of macromedia flash learning media in mathematics learning is important to be carried out, especially in the post-Covid-19 pandemic period and in the era of disruption 4.0 as it is today. This research aims to develop macromedia Flash mathematics learning media that is feasible and practical when used on two-variable linear equation system material.

## METHOD

This study aims to produce macromedia flash mathematics learning media products that are feasible and practical to use in mathematics learning by using the Research and Development (R&D) model adopting a development model with stages of problem identification, data collection, learning device design. The second goal is achieved by conducting a survey that adopts a development model Sugiyono (2018) with the stages of design validation, design revision, usage trials, product revisions, small-scale trials of users to find out the response of trials using macromedia flash-based learning media devices to 20 students of SMK Avicena Tangerang Regency by providing questionnaires adapted from Fadillah & Bilda (2019).

Data collection instruments using eligibility questionnaire sheets and the attractiveness of student responses to the development of mathematics learning media using the macromedia flash application program. Data analysis techniques used in research and development are descriptive quantitative for processing data in the form of scores from assessments by validators and student responses, while descriptive qualitative to describe data in the form of comments on improvement suggestions from validators. The feasibility and attractiveness assessment techniques for data analysis using a likert scale with a rating scale of 1-4.

## RESULTS AND DISCUSSION

Research by developing macromedia flash applications has previously been also carried out, the research and development carried out only moved the material into the media accompanied by buttons that function to connect The slides desired by the user are visible in the display of learning media results. At This development is given several animations as a reference as a stimulus for student motivation to study the material and be given simulations related to life daily that is

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expected to stimulate students' way of thinking. Research can depart from potential or problems. From potency and problems in the field can be used as a reference for product development research.

The results of this study produced a product in the form of macromedia flash learning media that is feasible and practical when used in mathematics learning. The model used in this study is a 4D model (Four-D Models) which includes 4 stages of development. However, this study only uses 3D, namely needs analysis, design, and development.

The first stage is a needs analysis which includes: 1) preliminary analysis, In the early stages, observation activities are carried out in class when the teacher is teaching in order to find out what needs to be added to learning in order to create a pleasant and comfortable atmosphere for students and not make students bored when learning in the classroom. From the observations made by researchers obtained, it was found that the use of macromedia flash-based learning media in mathematics learning has never been done. The media used so far when the learning process uses media such as books, student worksheets (SW) with a still unattractive appearance that makes it easy for students to get bored and less interested in learning mathematics, 2) student analysis, at this stage analysis on students is carried out to find out the characteristics of each student. This analysis is carried out by considering the abilities in students, the motivation to learn in students and the background of experiences in students, both individually and in groups. There are 60% of students who already learned about the material of a system of two-variable linear equations at home or in tutoring places, and 40% of students who have not studied a system of two-variable linear equations. Meanwhile, based on the results of interviews regarding learning motivation in students, there are some students who are still not familiar with learning, but after that the teacher explains again what the students do not understand. and 3) concept analysis, at this stage the concepts taught by the teacher to students are obtained in accordance with basic competencies, and the preparation of this material is based on an independent curriculum. The teacher chooses the concept to be taught. At this stage the teacher has chosen concepts related to the subjects delivered when in the classroom and according to the abilities and level of development in students. Teachers Select, develop, and use the right strategies according to the material to be taught by the teacher. At this stage, the teacher explains the material that has been prepared before learning starts and the teacher has also prepared the material to be taught in front of the class so that indicators are formed in accordance with the material that has been prepared by the teacher before learning begins. The teacher determines an assessment as an evaluation of the results of student achievement. At this stage the teacher gives 1 different question to the students and when they finish doing it, the teacher tells the students to do it in front of the class. This is to determine an assessment as material for evaluating student achievement results.

The second stage is the design which includes: 1) test preparation, at this stage In the preparation of this test students are given questions or quizzes that are in macromedia flash products that have been made and then tested to students as users totaling 20 participants

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and when testing students are asked to create 6 groups containing about 4.5 to 6 people / group. 2) media selection, at this stage The selection of media selected in the development of this learning media is macromedia flash which is considered the most appropriate for use of learning media on the material of a system of two-variable linear equations. In addition, there are computers that support learning with macromedia flash learning media. 3) format selection, at this stage Selection of media formats used in the macromedia flash application that have been created that contain images, writings, and also animations added in the media so that the media display is attractive and not boring for students when displayed. And 4) the initial design, at this stage In this section there are 2 very important steps to proceed to the next stage. The first step the creates a flowchart in the macromedia flash application. The second step is for to make a backdrop as well as images of supporting images and materials that will be included in the developed media. At this stage, the makes a backdrop and supporting images that are in accordance with the material in this thesis, namely flat building material, besides that the makes a board that reads the understanding of flat building and the formulas of a system of linear equations of two variables.

The third stage is development. At this stage. The media that has been created is then validated by experts, namely material experts and media experts. The results of the assessment of material and media experts can be seen in Table 1 and Table 2.

Table 1. The results of material expert validation.

| No | Assessment Aspects | Score | % | Category |
|---|---|---|---|---|
| 1 | Learning | 30 | 70% | Worth |
| 2 | Content of the material | 28 | 68% | Worth |
| **Score total** | | **58** | **69%** | **Worth** |

Based on the table 1, it shows that the validation results from material experts get an average score of 58 with a percentage of 69% in the decent category. This shows that the material of the system of linear equations of two varibaels has been declared feasible and ready to be tested with revisions according to the suggestions given.

Table 2. Media expert validation results.

| No | Assessment Aspects | Score | % | Category |
|---|---|---|---|---|
| 1 | Display | 35 | 80% | Worth |
| 2 | Content | 15 | 87% | Very worth |
| **Score total** | | **50** | **82%** | **Very worth** |

Based on the table 2, it shows that the average result of the assessment from media expert validators on mathematics learning media with scratch applications obtained a percentage of 82% of the 100% percentage with qualitative data conversion with the eligibility criteria of "Very Feasible". The criteria show the results of the validation of media experts, for the assessment of these two aspects have been declared Very Kite and ready to be tested without revision.

Figure 1 shows the display that has been done on the product developed based on input input and suggestions obtained from validation experts. But the resulting product it is feasible to be able to proceed to the next stage.

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Figure 1. Flash macromedia media after validation

Product validation data on the aspect of media display received an assessment score of 80% with the category suitable for use for learning activities in classrooms. After the media is declared valid and feasible by experts, the next step is to conduct a practicality test by users. The participants at the time of the practicality test were 20 students and students of SMK Avicena by giving questionnaires. The results of the practicality test by the user can be seen in Table 3.

Table 3. Media practicality test results by users.

| No | Assessment Aspects | Score | % | Category |
|---|---|---|---|---|
| 1 | Linguistics | 75 | 75% | Exciting |
| 2 | Material | 71 | 71% | Exciting |
| 3 | Animation | 82 | 82% | Very Exciting |
| 4 | Display | 86 | 86% | Very Exciting |
| **Score total** | | **78,5** | **78,5%** | **Exciting** |

Based on the table 3, it was concluded that the results of the practicality analysis and attractiveness of the media in the trial by users were obtained on average reaching a percentage of 78.5% with practical and interesting categories when used. Based on the results of user responses, it was obtained that the learning media developed with qualitative data conversion of interesting aspects, namely "Interesting", so that the media can be used for learning resources for students and can help teachers in delivering material to make it more interesting and arouse student enthusiasm in learning. If the product is not perfect then the results of the test try this as material for repairing and perfecting the products made, so that can produce a final product in the form of mathematics learning by using the resulting Macromedia Flash application program is feasible and very interesting. Additionally the media displayed during the learning process also makes students are interested so that the process Learning went very well and fun for students. This is in line with the opinion that the use of learning media can clarify the presentation of messages and information so as to facilitate and improve the learning process and results (Samura, 2015).

The results showed that there was an improvement in students' spatial ability after having geometry material learning by using Macromedia Flash at MTsN Model Banda Aceh. Besides, the improvement of students' spatial ability based on indicator of perception spatial was 61.1%, mental rotation indicator was 55.6%, and indicator of visualization spatial was 66.7% (Yani & Rosma, 2020); The results showed that students who used macromedia flash based inquiry learning in the assessment

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process have increased concept understanding better than those used conventional learning (Prapti Utami & Rohaeti, 2019).

## CONCLUSION AND SUGGESTION

Based on the validation results of the development of mathematics learning media using the macromedia flash application program, it is feasible and practical to use. Material experts gave an average score of 69% with decent categories, media experts gave an average score of 82% with very decent categories, and practicality tests by users got an average score of 78.5% with practical categories. Macromedia Flash is expected to be able to become a solution and alternative learning media in the midst of the current era of technological digitalization. The suggestions for research and development still require follow-up to the effectiveness of obtaining more quality learning media products that can be used in learning. Hopefully this research can be useful and become a reference source or reference for future research.

## REFERENCES

Akhmadan, W. (2017). Pengembangan Bahan Ajar Materi Garis dan Sudut Menggunakan Macromedia Flash dan Moodle Kelas VII Sekolah Menengah Pertama. *Jurnal Gantang*, *2*(1), 27–40. https://doi.org/10.31629/jg.v2i1.62

Aljundi, K., & Altakhayneh, B. (2020). Obstacles to Blind Students' Learning Maths in Jordan from Students' and Teachers' Perspectives. *International Education Studies*, *13*(8), 1–5. https://doi.org/10.5539/ies.v13n8p1

Benson, V., & Kolsaker, A. (2015). Instructor Approaches to Blended Learning: A Tale of Two Business Schools. *International Journal of Management Education*. https://doi.org/10.1016/j.ijme.2015.10.001

Bernard, M., & Senjayawati, E. (2019). Developing the Students' Ability in Understanding Mathematics and Self-confidence with VBA for Excel. *JRAMathEdu (Journal of Research and Advances in Mathematics Education)*, *4*(1), 45–56. https://doi.org/10.23917/jramathedu.v4i1.6349

Çakici Eser, D. (2021). Investigation of Measurement Invariance According to Home Resources: TIMSS 2015 Mathematical Affective Characteristics Questionnaire. *International Journal of Assessment Tools in Education*, *8*(3), 633–648. https://doi.org/10.21449/ijate.817168

Dwiana, A. A., Samosir, A., Sari, N. T., Awalia, N., Budiyono, A., Wahyuni, M., & Masrul, M. (2022). Penerapan Media Pembelajaran Berbasis Macromedia Flash dalam Meningkatkan Kreativitas Siswa pada Mata Pelajaran Matematika di Sekolah Dasar. *Jurnal Basicedu*, *6*(1), 499–505. https://doi.org/10.31004/basicedu.v6i1.1669

Fadillah, A., & Bilda, W. (2019). Pengembangan Video Pembelajaran Berbantuan Aplikasi Sparkoll Videoscribe. *Jurnal Gantang*, *4*(2), 177–182. https://doi.org/10.31629/jg.v4i2.1369

Fadillah, A., Sukmawati, R., & Rahardjo, S. (2021). Analysis Of

ISSN 2089-8703 (Print)
ISSN 2442-5419 (Online)

DOI: https://doi.org/10.24127/ajpm.v12i2.7261

Student Digital Literacy In Linear Algebra Courses During The Covid-19 Pandemic. *Aksioma: Jurnal Program Studi Pendidikan Matematika*, *10*(2), 1206. https://doi.org/10.24127/ajpm.v10i2.3704

Handayani, T. (2021). Pengembangan Media Komik Digital Berbasis STEM untuk Meningkatkan Literasi Sains Siswa Sekolah Dasar. *Jurnal Didaktika Pendidikan Dasar*, *5*(3), 737–756. https://doi.org/10.26811/didaktika.v5i3.343

Harta, I. K. (2017). Pengembangan Prototipe Egg Boiler Sebagai Media Pembelajaran Prakarya Dan Kewirausahaan Untuk Materi Teknologi Tepat Guna Kelas Xi Mia SMA Negeri 4 Singaraja Tahun Ajaran 2016/2017. *Jurnal Pendidikan Teknologi Dan Kejuruan*, *14*(2), 178–187. https://doi.org/10.23887/jptk-undiksha.v14i2.11104

Ivars, P., Fernández, C., & Llinares, S. (2020). A Learning Trajectory as a Scaffold for Pre-service Teachers' Noticing of Students' Mathematical Understanding. *International Journal of Science and Mathematics Education*, *18*(3), 529–548. https://doi.org/10.1007/s10763-019-09973-4

Khairani, majidah. (2016). Pengembangan Media Pembelajaran Dalam Bentuk Macromedia Flash Materi Tabung Untuk SMP Kelas Ix. *Jurnal Iptek Terapan*, *10*(2), 95–102. https://doi.org/10.22216/jit.2016.v10i2.422

Kingry, M. A., Havard, B., Robinson, R., & Islam, M. (2015). Instructional Fading and Student Performance in Principles of Accounting Instruction. *Journal of Educational Technology Systems*, *44*(1), 53–68. https://doi.org/10.1177/0047239515598519

Kusuma, D., Sukestiyarno, Y. L., Wardono, & Cahyono, A. N. (2022). The characteristics of mathematical literacy based on Students' executive function. *European Journal of Educational Research*, *11*(1), 193–206. https://doi.org/10.12973/eu-jer.11.1.193

Lanani, K. (2015). Efektivitas Pembelajaran Kooperatif Ditinjau Dari Peningkatan Kemampuan Penalaran Logis Matematis Siswa. *Infinity Journal*, *4*(2), 140–151. https://doi.org/10.22460/infinity.v4i2.78

Margareta, L., & Wahyuno, E. (2014). Penggunaan Media Animasi Macromedia Flash Untuk Meningkatkan Kualitas Pembelajaran Ipa Siswa Tunarungu Kelas Ii Sdlb. *Jurnal P3Lb*, *1*(2), 137–139. https://doi.org/http://dx.doi.org/10.17977/um029v1i22014p137-139

Mathis, W. (2022). Review of "Vibrant Matter: A Political Ecology of Things by Jane Bennett," Bennett, J. (2010). Vibrant Matter: A Political Ecology of Things. Duke University Press. *Communication Design Quarterly*, *10*(4), 42–43. https://doi.org/10.1145/3531210.3531216

Michael, S., & Ambotang, A. S. (2020). Pengaruh Teknologi Digital Terhadap Penglibatan Pelajar dalam Aktiviti Kokurikulum Sekolah Menengah. *Malaysian Journal of Social Sciences and Humanities (MJSSH)*, *5*(6), 25–

ISSN 2089-8703 (Print)
ISSN 2442-5419 (Online)

DOI: https://doi.org/10.24127/ajpm.v12i2.7261

32. https://doi.org/10.47405/mjssh.v5i6.417

Mikrayanti, M. (2016). Meningkatkan Kemampuan Penalaran Matematis Melalui Pembelajaran Berbasis Masalah. *Suska Journal of Mathematics Education*, *2*(2), 97–102. https://doi.org/10.24014/sjme.v2i2.1547

Molnár, V. (2014). Reframing public space through digital mobilization: Flash mobs and contemporary urban youth culture. In *Space and Culture* (Vol. 17, Issue 1, pp. 43–58). https://doi.org/10.1177/1206331212452368

Mulenga, E. M., & Marbàn, J. M. (2020). Social media usage among pre-service secondary mathematics teachers in Zambia. *JRAMathEdu (Journal of Research and Advances in Mathematics Education)*, *5*(2), 130–147. https://doi.org/10.23917/jramathedu.v5i2.9920

Naufal, H. A. (2021). LITERASI DIGITAL. *Perspektif*, *1*(2), 195–202. https://doi.org/10.53947/perspekt.v1i2.32

Nugroho, A. G. (2018). Pengaruh Penggunaan Media Komputer dengan Memanfaatkan Sofware Presentasi Terhadap Hasil Belajar Matematika Siswa Ditinjau dari Aktivitas Belajar Siswa. *Jurnal Pendidikan Matematika*, *5*(2), 46–61. https://doi.org/10.18592/jpm.v5i2.1773

Prapti Utami, R., & Rohaeti, E. (2019). Students' Concept Understanding in Chemistry Learning Using Macromedia Flash Based Inquiry Learning. *International Journal on New Trends in Education and Their Implications*, *10*(3).

Prior, D. D., Mazanov, J., Meacheam, D., Heaslip, G., & Hanson, J. (2016). Attitude, digital literacy and self efficacy: Flow-on effects for online learning behavior. *Internet and Higher Education*, *29*, 91–97. https://doi.org/10.1016/j.iheduc.2016.01.001

Rasman, R. (2021). Penggunaan Youtube Sebagai Media Pembelajaran Bahasa Inggris Pada Masa Pandemi Covid 19. *Edutech : Jurnal Inovasi Pendidikan Berbantuan Teknologi*, *1*(2), 118–126. https://doi.org/10.51878/edutech.v1i2.442

Rusnilawati, R. (2016). Pengembangan perangkat pembelajaran matematika bercirikan active knowledge sharing dengan pendekatan saintifik kelas VIII. *Jurnal Riset Pendidikan Matematika*, *3*(2), 245–258. https://doi.org/10.21831/jrpm.v3i2.10633

Russell, A., & Hannon, D. (2012). A cognitive load approach to learner-centered design of digital instructional media and supporting accessibility tools. *Proceedings of the Human Factors and Ergonomics Society*, 56(1) 556-560. https://doi.org/10.1177/1071181312561116

Samura, A. O. (2015). Penggunaan media dalam pembelajaran matematika dan manfaatnya. *Delta-Pi: Jurnal Matematika Dan Pendidikan Matematika*, *4*(1), 69–79.

ISSN 2089-8703 (Print)
ISSN 2442-5419 (Online)

DOI: https://doi.org/10.24127/ajpm.v12i2.7261

Selwyn, N., & Facer, K. (2014). The sociology of education and digital technology: Past, present and future. *Oxford Review of Education*, *40*(4), 482–496. https://doi.org/10.1080/03054985.2014.933005

Sugiyono, D. (2018). Metode penelitian kuatintatif , kualitatif dan R & D / Sugiyono. In *Bandung: Alfabeta*.

Sumarmi, Bachri, S., Irawan, L. Y., & Aliman, M. (2021). E-module in blended learning: Its impact on students' disaster preparedness and innovation in developing learning media. *International Journal of Instruction*, *14*(4), 187–208. https://doi.org/10.29333/iji.2021.14412a

Sutriyono, Fitriyana, N., & Adha, I. (2020). Pengembangan Media Pembelajaran Matematika Macromedia Flash Berbasis Pendekatan Kontekstual. *Jurnal Pendidikan Matematika Undiksha*, *11*(1), 2599–2600. https://doi.org/https://doi.org/10.23887/jjpm.v11i1.21232

Syah, R., Darmawan, D., & Purnawan, A. (2019). Analisis Faktor yang Mempengaruhi Kemampuan Literasi Digital. *Jurnal Akrab*, *10*(2), 60–69. https://doi.org/https://doi.org/10.51495/jurnalakrab.v10i2.290

Umam, K. (2016). Pengaruh Menggunakan Software Macromedia Flash 8 Terhadap Hasil Belajar Matematika Siswa Kelas VIII. *Kalamatika Jurnal Pendidikan Matematika*, *1*(1), 84–92. https://doi.org/10.22236/kalamatika.vol1no1.2016pp84-92

Yani, M., & Rosma, F. (2020). Improving Students' Spatial Ability by Using Macromedia Flash on Geometry Materials. *Malikussaleh Journal of Mathematics Learning (MJML)*, *3*(1), 18–22. https://doi.org/10.29103/mjml.v3i1.2401

Yaniawati, P., Maat, S. M., Supianti, I. I., & Fisher, D. (2021). Mathematics mobile blended learning development: Student-oriented high order thinking skill learning. *European Journal of Educational Research*, *10*(1), 69–81. https://doi.org/10.12973/EU-JER.11.1.69

Zhu, J., Yeung, P. sze, & Hsieh, W. Y. (2021). Mathematical beliefs and self-reported practices of Chinese early childhood teachers in the context of teaching mathematics during block play. *European Early Childhood Education Research Journal*, *29*(5), 747–763. https://doi.org/10.1080/1350293X.2021.1933118