Measuring Student Learning Activities Through Articulate Storyline 3-Based Mobile Learning

Yessi Prihartina[1*], Das Salirawati[1], Antuni Wiyarsi[1]

[1] Department of Chemistry Education, Faculty of Mathematics and Natural Sciences, Yogyakarta State University, Yogyakarta, Indonesia.

Abstract: This study aims to measure students' learning activities through the use of articulate storyline 3-based mobile learning with the Project Based Learning learning model on colloidal material. The type of research used is experimental research. The subjects of this study were 17 students of class XI MIPA Negeri 1 Seyegan. The instruments used were question sheets and questionnaire sheets. The indicator of success in this study is the results of student learning activities in general reaching the Active criteria. In research learning activities are carried out with 5 assessments including student worksheet assessment, quiz assessment, poster assessment, presentation assessment, and student activity questionnaire assessment. The results showed that the average student worksheet score was 73.50, the quiz score was 76.46, the poster score was 87.05 the presentation score was 80.60, and the questionnaire score was 76.52. The average value of students from all assessments gets a value of 78.83 and is included in the active category. The recommendation in this study is that the learning activities of students must be further enhanced so that they can provide knowledge to students through direct experiences in learning.

Keywords: Articulate storyline; Colloid; Learning activities; Mobile learning.

Introduction

Currently, we are facing the rapid development of information and communication technology which is characteristic of the 21st century (Hidayat et al, 2019). This condition has an impact on several fields, one of which is education (Ichsan et al., 2020; Mustika et al., 2019). The change from a teaching paradigm to a learning paradigm changes not only the role of teachers and students, but also the role of technology and the role of those who shape and support the integration of technology into education (Barr & Tagg, 2012). The use of technology in learning activities can facilitate opportunities for teachers to convey learning material through various platforms as a learning environment (Salsabila et al., 2020). It is necessary to pay attention to the selection of the learning environment so that the teaching and learning process can be effective (Tafonao, 2018; Wati and Widiansyah, 2020). Through the development of instructional media, teachers can guide learning concepts and improve students' learning abilities (Kalatting et al., 2015). Selection of the right media for the learning process has a significant impact on learning outcomes to achieve learning objectives (Sudarmin, 2016).

Therefore, m-learning is very important in the technological era because it is an interesting research trend (Al-Emran et al., 2016). ICT tools and skills provide students with an autonomous, adaptive, and engaging learning environment with few constraints to remain competitive in this technological era (Mouza & Barret, 2015). This clearly shows that the rapid development and application of technology has positively changed the way of teaching and learning in education (Al-Khowarizmi et al., 2020). Mobile learning-based learning has not been widely used for science learning, especially chemistry for high school students (Clapson et al., 2020). Many studies have revealed that multimedia learning develops a mobile learning environment with Articulate Storyline (Fardila and Arief, 2021; Sindu, et al. 2020).

This software is suitable as a learning tool that can compete with Adobe Flash media (Setyaningsih,

Rusijono and Wahyudi, 2020). Articulate Storyline 3 has several advantages such as: ease of use and the resulting output can be published in various formats including HTML5 to create attractive educational presentations. Articulate works across a wide range of devices, including software for tablets, laptops, and applications for smartphones (Arwanda, Irianto and Andriani, 2020; Purnama and Retnowati, 2020). Articulate Storyline has an interesting character, presenting quizzes, buttons, URL links and trigger links that direct sections or pages to the desired destination (Sari and Harjono, 2021).

According to Susanto (2016), there is a positive relationship between student learning activities and mobile learning. The importance of student learning activities is confirmed by Rahmat's research (2016) which shows that student activity in learning activities contributes to student learning outcomes. According to Diedrich (2015), the types of student activities can be classified as follows, namely, (1) visual activities, (2) oral activities, (3) listening activities, (4) writing activities, (5) drawing activities, (6) motor activities, (7) mental activities, (8) emotional activities. In this study, the activities observed included visual activities, oral activities, listening activities, writing activities, and mental activities.

Method

In this study researchers used the experimental method. The design used was pre-experimental, involving one experimental class without using a control class. The research sample used a stratified random sampling technique and the determination of the experimental class used a random sampling technique. The research subjects were Class XI MIPA SMA Negeri 1 Seyegan with a total of 17 students with 3 boys and 14 girls. In research learning activities are carried out with 5 assessments including student worksheet assessment, quiz assessment, poster assessment, presentation assessment, and student activity questionnaire assessment. The assessment techniques used in this study are tests and non-tests. Test techniques are applied to student worksheet assessment and quiz assessment, while non-test techniques are applied to poster assessment, presentation assessment, and activity questionnaire assessment. The instruments used in the test assessment are in the form of essay-type questions found in Articulate Storyline 3 and the non-test assessment instruments use questionnaires, presentation sheets, and product assignment sheets. The data analysis in this research is qualitative and quantitative data. The student activity questionnaire grid can be seen in Table 1.

Table 1. Activity Questionnaire Grid

Activity Type	Rated aspect	Item Number Positive	Item Number Negative
Visual	Pay attention to the teacher's explanation of the learning material	1	9
	Pay attention to the teacher's explanation regarding the use of E-LKPD features	3	14
Oral	Ask about things that are not clear	5	15
	Students ask about the use of things that are not yet clear related to the E-LKPD	10	2
Write	Summarize the material	13	6
	Answer the questions available in the E-LKPD	12	20
Listen	Listen to the teacher's explanation	8	18
Mental	Express opinions and conclude about the material that has been studied	16	7
	Presenting project results	17	11
	Do activities relevant to learning	19	4

Determining the value of each student's questionnaire answer to the media developed refers to the assessment guidelines according to Sugiyono (2013) can be seen in Table 2.

Table 2. Guidelines for Student Questionnaire Assessment

Category	Positive Statement	Statement Negative
Strongly agree	5	1
Agree	4	2
Doubtful	3	3
Don't agree	2	4
Strongly Disagree	1	5

After the student scores were obtained, the value interpretation of the activity questionnaire was then carried out as shown in Table 3.

Table 3. Activity Questionnaire Interpretation

Category (%)	Information
$80 < \% R \leq 100$	Very active
$60 < \% R \leq 80$	Active
$40 < \% R \leq 60$	Moderately Active
$20 < \% R \leq 40$	Less Active
$R \leq 20$	Not active

Result and Discussion

This study uses articulate storyline 3-based learning cars with the application of the Project Based Learning (PJBL) model to measure student learning activities carried out in 3 meetings. The first meeting, providing an overview of material related to project assignments carried out online. The second meeting, independent assignment using student worksheets and quizzes as well as project monitoring. The third meeting, project presentations and filling out student activity questionnaires. The initial page of learning media using articulate storyline 3 can be seen in Figure 1. This media consists of core competency & basic competencies instructions for use, colloidal material, quizz, and examples of poster assignments, and references as shown in Figure 1.

Figure 1. The Initial Appearance of the Media Articulate Storyline

This media consists of KI & KD, instructions for use, colloidal material, quizz, and examples of poster assignments, and references. The assessment of student learning activities consists of 5 assessments including:

Assessment of Student Worksheets

In this assessment there are 2 types, namely, student worksheet 1 and student worksheet 2. The difference between the two lies in the questions that must be answered by students. Student worksheets are done after students have studied colloid material. After students read colloidal material in the first stage, student worksheet 1 must be done first before studying the next material, otherwise they cannot move on to the next stage. So with this, the activities of students can be controlled.

Quiz Assessment

In this assessment there are 2 different types of quizzes, namely the cafe quiz and the park quiz. The two quizzes are designed like a cafe illustration as shown in Figure 2 and a garden illustration as shown in Figure 3.

Quiz illustrations are designed to be as attractive as possible, which allows students to be enthusiastic about working on quizzes, taking into account the appropriate color choices. This is in accordance with Tumewan et al. (2021), that choosing the right color can set a mood and make text on media more attractive. Interesting visuals can increase enthusiasm for learning (McCrudden and Rapp, 2017). In this quiz students are asked to look for colloidal items in the illustration. After students find colloidal items, students are asked to answer questions related to colloidal items in the cafe and garden illustrations. Each quiz has 3 questions to answer. The form of the question is essay.
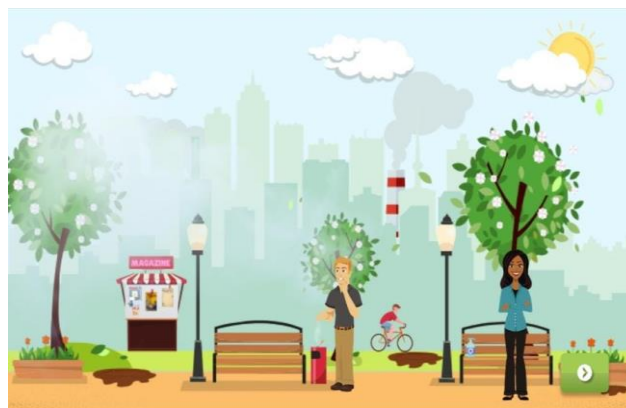

Figure 2. Cafe Quiz View

Figure 3. Garden Quiz View

Poster Assessment

Poster assessment is a project from students who are assessed at the third meeting offline. An explanation of this project is contained in the articulate storyline media which was developed in detail so that students understand clearly. The project is done in groups with a total of 4 groups. Each group makes posters related to examples of colloids that exist in everyday life, especially types of food. This project has the theme of the month of Ramadan, because students are asked to look for types of food that are available in the month of Ramadan which are often eaten as takjil. As for product evaluation in the form of posters, there are several

components that are assessed including: concept correctness, completeness of ideas, grammar and creativity. One of the student project results can be seen in Figure 4.

Figure 4. Student Project Results

Presentation Assessment

Presentation assessment is carried out after students work on a project in the form of a poster. Each group explained the posters that had been made, such as the applications used in making the posters, the types of food they chose, and the reasons for choosing foods related to the colloid system. There are several components that are assessed in the assessment of presentations including: how to open the presentation, presentation of presentation material, presentation time, cooperation, material conclusions, and how to close the presentation.

Student Activity Assessment Questionnaire Assessment

Student questionnaires use self-assessment techniques, in which students assess themselves. Self-assessment is the essence of assessment as learning (Dann, 2014). According to Arikunto (2013), self-assessment is a form of assessment carried out by the learner himself, which is based on criteria or references that have been prepared regarding the status, process, and level of achievement of the competencies he has learned in certain subjects. There are 5 types of activities assessed, namely visual, verbal, listening, writing, and mental activities with a total of 20 statement items. Statements are developed in the form of positive and negative statements. Completion of student activity questionnaires via gform. The link for completing the activity questionnaire via the gform was shared after the students made their presentations. Activity questionnaires are used as information used to determine student attitudes regarding learning that has been carried out with various types of assessments.

Based on the assessment that has been carried out, the results obtained by students in each assessment. The calculation results can be seen in Table 4.

Table 4. The Results of The Calculation of All Student Assessment Activities

Activity assessment	Value Range (%)				
	0-20	21-40	41-60	61-80	81-100
Student worksheet	0.0-	0.0-	5,88	64,71	29,41
Quiz	0.0-	0.0-	29.41	29.41	41,18
Poster	0.0-	0.0-	0.0-	17.65	82,35
Presentation	0.0-	0.0-	0.0-	23.53	76,47
Activity questionnaire	0.0-	0.0-	5.88	70,58	23.54

From the five activity assessments that have been obtained, then the average score of students is calculated in each activity assessment. Detailed calculation results can be seen in Figure 5.
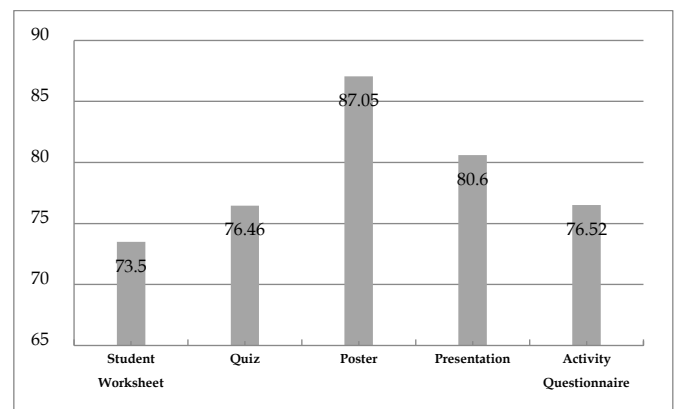

Figure 5. The Average Value of All Students In Each Assessment

Based on Figure 5, it shows that the lowest average score of students comes from the student worksheet assessment. This is because there are some students who do not fill in all the questions, so the average value produced is still low. Therefore it is necessary to appeal to students to answer all questions and be serious when working on them. From the calculation results, the average value of students is 17 from all assessments as shown in Table 5.

Based on Table 5 it can be seen that 10 students are included in the "active" category and 7 students are included in the "very active" category. This shows that the articulate storyline is able to measure student activity. In general, the use of an articulate storyline makes students happy because learning is packaged using technology, but this cannot be separated from the learning objectives in such a way as to make students feel motivated (Indriani et al., 2021; Pratama, 2018).

Table 5. The Average Value of Students From All Assessments

Name	Value	Information
Student 1	70.62	Active
Student 2	83,67	Very active
Student 3	69,87	Active
Student 4	75,83	Active
Student 5	85,25	Very active
Student 6	80,62	Very active
Student 7	78,00	Active
Student 8	77,25	Active
Student 9	71,75	Active
Student 10	80,37	Very active
Student 11	76,25	Active
Student 12	67,25	Active
Student 13	86,25	Very active
Student 14	79,12	Active
Student 15	79,00	Active
Student 16	88,62	Very active
Student 17	84,50	Very active

This is the result of previous research which found that the visualization of interesting animations and games in multimedia independently influences mastery of concepts (Mashami & Gunawan, 2018), learning motivation (Koo & Hew, 2020; Thongmak, 2018), and student learning to become independent (Hoch, Scheiter and Schüler, 2020; Nietfeld, 2019). This is because the articulate storyline is complemented by an interesting audio visual. Based on the results of a student survey, learning materials with images (visual), sound and video (auditory) are easier to understand and more interesting. Visual learning from the media is very important in learning activities. This was confirmed by Ernanida & Yusra (2019) and Nurfajriyah (2016) that the benefits of a visual learning environment can improve students' memory and facilitate understanding of material. The visual learning environment can also increase student interest so that they can connect the material content with the real world. Meanwhile, auditory learning media has the ability to stimulate auditory stimulation. Therefore, the combination of audio and visual media makes the learning material presented more effective and interesting. This shows that the use of interactive media such as articulate storylines can foster student enthusiasm for learning and allows students to have more flexible learning because it can be used anywhere and anytime.

In addition, media such as the articulate storyline, student activities can be monitored, so that student performance can be measured correctly. Articulate Storyline 3 has user-friendly features (84.4%) so that the role of the teacher can be minimized (Heliawati, Lidiawati, and Pursitasari, 2022). According to Tarigan & Siagian (2015), the focus of interactive learning media is not only on conveying messages, but also on how students interact with the media. Istiqlal (2017) added that the interactive learning environment as a learning resource has several advantages, one of which is the atmosphere of students' affection and attention to learning. Learning that can create a new and interesting learning atmosphere and can help teachers deliver material that is difficult to teach. Using the Articulate Storyline learning environment makes it easier for teachers to share material and students to engage with and understand what they are learning. In addition, it motivates students and can make students focus on learning, thus facilitating the delivery of subjects (Nugroho and Arrosyad, 2020; Sadikin and Hardianti, 2022).

Conclusion

Measurement of student learning activities using mobile learning based on Articulate Storyline 3 includes 5 assessments, namely student worksheet assessment, quiz assessment, poster assessment, presentation assessment, and questionnaire activity assessment. The results of the calculation obtained an average student assessment on the student worksheet obtaining a value of 73.50, quiz scoring obtaining a value of 76.46, poster scoring obtaining a value of 87.05, presentation rating obtaining 80.60, and questionnaire scoring obtaining a value of 76.52. The average value students from all assessments get a score of 78.83 and are included in the active category. With this, the use of articulate storyline-based mobile learning can measure student activity and can control student activity well.

Acknowledgments

References

Al-Emran, M., Elsherif, H. M., & Shaalan, K. (2016). Investigating attitudes towards the use of mobile learning in higher education. *Computers in Human Behavior*, 56, 93–102. https://doi.org/10.1016/j.chb.2015.11.033

Al-Khowarizmi, A. K., Fauzi, F., Sari, I. P., & Sembiring, A. P. (2020). The effect of indonesian and hokkien mobile learning application models. *Journal of Computer Science, Information Technology and Telecommunication Engineering*, 1(1), 1–7. http://dx.doi.org/10.30596%2Fjcositte.v1i1.4360

Arikunto, S. (2013). *Dasar-Dasar Evaluasi Pendidikan* . Jakarta: Bumi Aksara.

Arwanda P., Irianto, S., & Andriani, A. (2020). The development of the Articulate Storyline K13 learning media based on the competence of 21st century learners. *Jurnal Ilmiah Pendidikan Madrasah Ibtidaiyah*, 4(2), 194-204. http://dx.doi.org/10.35931/am.v4i2.331

Barr, R. B., & Tagg, J. (2012). From teaching to learning: A new paradigm for undergraduate education. *Change*, 27(6), 13–25. https://doi.org/10.1080/00091383.1995.10544672

Chsan, Ilmi Zajuli., Hasanah, Risky., Ristanto, Rizhal, Hendi., Rusdi., Cahapay, Michael Bobias., Widiyawati, Yeni., Rahman, Md. Mehadi. Designing an innovative assessment of hots in the science learning for the 21st century. *Jurnal Penelitian dan Pembelajaran IPA*, 6(2), 211-224. http://dx.doi.org/10.30870/jppi.v6i2.4765

Clapson, M. L., Gilbert, B. C. T., & Musgrove, A. (2020). Race to the Reactor and Other Chemistry Games: Game-Based and Experiential Learning Experiences in Materials and Polymer Chemistry. *Journal of Chemical Education*, 97(12), 4391–4399. https://doi.org/10.1021/acs.jchemed.0c01135

Dann, R. (2014). Assessment as learning: blurring the boundaries of assessment and learning for theory, policy, and practice. *Assessment in Education: Principles, Policy, and Practice*, 21(2), 149-166. https://doi.org/10.1080/0969594X.2014.898128

Diedrich, B.P. (2015). Aktivitas Belajar Siswa. Retrieved from http://hamiddarmadi. blogspot.com/2015/04/aktivitas-belajar-siswa-ala-paul-b.html

Ernanida & Yusra, R. (2019). Media audio visual dalam pembelajaran PAI. *Jurnal Pendidikan Islam,* 2(1). 1-8. https://doi.org/10.15548/mrb.v2i1.333

Fardila, S., & Arief, M. (2021). Pengembangan mobile learning berbasis articulate storyline 3 pada mata pelajaran kearsipan untuk meningkatkan self regulated learning dan hasil belajar siswa (studi pada kelas x OTKP di SMK Cendika Bangsa Kepanjen). *Jurnal Ekonomi, Bisnis dan Pendidikan,* 1(4), 344–356. https://doi.org/10.17977/um066v1i42021p344-356

Heliawati, Leny., Lidiawati, Linda., & Pursitasari, Indarini Dwi. (2022). Articulate Storyline 3 multimedia based on gamification to improve critical thinking skills and self-regulated learning. *International Journal of Evaluation and Research in Education (IJERE),* 11(3), 1435-1444. http://doi.org/10.11591/ijere.v11i3.22168

Hidayat, Rais., M, Dyah Vicihayu., & Ulya, Himmatul. (2019). Competence of 21st century school principles: a theoretical review in Indonesian. *Jurnal Kepemimpinan dan Pengurusan Sekolah*, 4(1), 61-68. https://dx.doi.org/10.34125/kp.v4i1.394

Hoch, E., Scheiter, K., & Schüler, A. (2020). Implementation intentions for improving Self-regulation in multimedia learning: Why don't they work?. *Journal of Experimental Education*, 88(4), 536–558. https://doi.org/10.15294/jese.v1i2.49841

Ichsan, I. Z., Rahmayanti, H., Purwanto, A., Sigit, D. V., Kurniawan, E., Dewi, A. K., Wirdianti, N., Hermawati, F. M., & Marhento, G. (2020). Covid dan E-Learning: Perubahan Strategi Pembelajaran Sains dan Lingkungan di SMP. *Jurnal Inovasi Pembelajaran*, 6(1), 50–61. https://doi.org/https://doi.org/10.22219/jinop.v6i1.1 1791

Indriani, M. S., Artika, I. W., & Ningtias, D. R. W. (2021). Penggunaan aplikasi articulate storyline dalam pembelajaran mandiri teks negosiasi. Jurnal Pendidikan Bahasa dan Sastra Indonesia, 1(11), 25-26. https://doi.org/10.23887/jjpbs.v11i1.29316

Istiqlal, M. (2017). Pengembangan Multimedia Interaktif dalam Pembelajaran Matematika. JIPMat, 2(1). https://doi.org/10.26877/jipmat.v2i1.1480

Kalatting, S., Serevina, V., dan Astra, I. (2015). Pengembangan Media Pembelajaran Fisika Berbasis Web Menggunakan Pendekatan Guided Discovery Learning. *Jurnal Penelitian & Pengembangan Pendidikan Fisika,* 1(1), 1-8. https://doi.org/10.21009/1.01101

Koo, L. Anthonysamy, A. C & Hew, S. H. (2020). Self-regulated learning strategies in higher education: Fostering digital literacy for sustainable lifelong learning. *Education and Information Technologies*, 25(4), 2393–2414. https://doi.org/10.1007/s10639-020-10201-8

Mashami, R. A. & Gunawan, G. (2018). The influence of sub-microscopic media animation on students' critical thinking skills based on gender. *Journal of Physics*: *Conference Series,* 1108(1), 1–7. doi: 10.1088/1742-6596/1108/1/012106

McCrudden, M. T & Rapp, D. N. (2017). How visual displays affect cognitive processing. Educational Psychology Review, 29(3), 623–639. https://doi.org/10.1007/s10648-015-9342-2

Mouza, C., & Barrett-Greenly, T. (2015). Bridging the app gap: An examination of a professional development initiative on mobile learning in urban schools. *Computers & Education*, 88(10), 1–14. https://doi.org/ 10.1016/j.compedu.2015.04.009

Mustika, M., Maknun, J., & Feranie, S. (2019). *Case study : analysis of senior high school students scientific creative, critical thinking and its correlation with their scientific reasoning skills on the sound concept*. Paper presented at Journal of Physics: Conference Series.

Nietfeld, J. L. (2019). *The role of self-regulated learning in digital games*. Handbook of Self-Regulation of Learning and Performance, Routledge, 271–284. doi: 10.4324/9781315697048-18.

Nugroho, F & Arrosyad, M. I. (2020). Learning multimedia development using articulate storyline for students. *International Journal of Elementary Education*, 4(4), 575–579. https://doi.org/10.23887/ijee.v4i4.27763

Nurfajriyah, D. A. (2016). Pengaruh model problem based learning terhadap kemampuan berpikir kreatif siswa pada materi pesawat sederhana. *Jurnal Pena Ilmiah*, 1(1), 251-260. https://doi.org/10.23819/pi.v1i1.3016

Pratama, R. A. (2018). Media pembelajaran berbasis articulate storyline 2 pada materi menggambar grafik fungsi di SMP Patra Dharma 2 Balikpapan. Jurnal Dimensi, 7(1), 19-35. https://doi.org/10.33373/dms.v7i1.1631

Purnama, P. W & Retnowati, E. (2020). The effectiveness of goal-free problems for studying triangle similarity in collaborative groups. *Journal of Research and Advances in Mathematics Education*, 6(1), 32–45.
https://doi.org/10.23917/jramathedu.v6i1.11198

Rahmat, L. O. M. (2016). Hubungan antara aktivitas siswa dalam merespon metode pembelajaran guru dengan hasil belajar pada mata pelajaran bahasa Indonesia siswa kelas XIII madrasah aliyah swasta wadiabero buton tengah. *Jurnal Bahasa dan Sastra*, 2(1), 1-9. http://dx.doi.org/10.36709/jb.v2i1.1516

Setyaningsih, S., Rusijono, R., & Wahyudi, A. (2020). The influence of the use of Articulate Storyline-based interactive learning media on learning motivation and student learning outcomes on the materials of the Hindu-Buddhist Kingdom in Indonesia (in Indonesian). *Didaktis: Jurnal Pendidikan dan Ilmu Pengetahuan*, 20(2), 144–156. http://dx.doi.org/10.30651/didaktis.v20i2.4772

Sadikin, A & Hardianti, R. D. (2021). Development of emulsi (electronic module practicum articulate storyline 3) to support self-regulated learning of students. Journal of Environmental and Science Education, 1(2), 25-31. doi: https://doi.org/10.15294/jese.v1i2.49841

Salsabila, H., Sari, I., Lathif, H., Lestari, P., & Ayuning, A. (2020). Peran teknologi dalam pembelajaran di masa pandemi covid-19. al-mutharahah. *Jurnal Penelitian dan Kajian Sosial Keagamaan*, 17(2), 188–198. https://doi.org/10.46781/al-mutharahah.v17i2.138

Sari, R. kurnia, & Harjono, N. (2021). Pengembangan media pembelajaran interaktif berbasis articulate storyline tematik terhadap minat belajar siswa kelas 4 SD. *Jurnal Pedagogi dan Pembelajaran*, 4(1), 122–130. https://doi.org/10.23887/jp2.v4i1.33356

Sindu, I. G. P., Santyadiputra, G. S., & Permana, A. A. J. (2020). The effectiveness of the application of Articulate Storyline 3 learning object on student cognitive on Basic Computer System courses. *Jurnal Pendidikan Vokasi*, 10(3), 290-299. http://dx.doi.org/10.21831/jpv.v10i3.36094

Sudarmin, Muhamad, T., Parmin, & Regilita, A. (2016). Pembuatan Media Study Card dan Lembar Kerja Siswa yang Mengintegrasikan Soft Skills Konservasi Bagi Guru IPA melalui Kegiatan Lesson Study. *Jurnal Scientia Indonesia*, 1(1), 74-81. https://doi.org/10.15294/jsi.v1i1.7944

Sugiyono. (2013). *Metode Penelitian Pendidikan Pendekatan Kuantitatif, Kualitatif, dan R&D*. Bandung: Alfabeta.

Susanto, H. P. (2016). Analisis hubungan kecemasan, aktivitas, dan motivasi berprestasi dengan hasil belajar matematika siswa. *Jurnal Beta*. Volume 9 (2). 134-147. https://dx.doi.org/10.20414/betajtm.v9i2.10

Tafonao, T. (2018). Peranan media pembelajaran dalam meningkatkan minat belajar mahasiswa. *Jurnal Komunikasi Pendidikan*, 2(2), 103. https://doi.org/10.32585/jkp.v2i2.113

Tarigan, D & Siagian, S. (2015). Pengembangan media pembelajaran interaktif pada pembelajaran ekonomi. 2(2), 187–200. https://doi.org/10.24114/jtikp.v2i2.3295

Thongmak, M. (2018). Creating gameful experience in the object-oriented programming classroom: A case study. *Journal of Applied Knowledge Management*, 6(1), 30–53. https://doi.org/10.36965/OJAKM.2018.6(1)30-53

Tumewan, P., Sojow, L., & Kaparang, D. (2021). Pengembangan media pembelajaran tutorial desain komunikasi visual di SMK Negeri 3 Tondano. EduTIK: Jurnal Pendidikan Teknologi Informasi dan Komunikasi, 1(1), 39–52. https://doi.org/10.53682/edutik.v1i1.996

Wati, E. K and Widiansyah, N. (2020). Design of learning media: Modeling & simulation of building thermal comfort optimization system in building physics course. *Jurnal Pendidikan IPA Indonesia*, 9(2), 257-266. https://doi.org/10.15294/jpii.v9i2.23504