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DEVELOPMENT OF INTERACTIVE MATHEMATICS LEARNING MEDIA ON GEOMETRY MATERIAL

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Abstract

The purpose of this study was to describe the development of valid, practical, and effective learning media on Geometry materials with worksheets equipment. This research type was development research using the modified Borg & Gall procedures by several main steps, namely product analysis developed, initial product development, and product trials. The product trials carried out consisted of two stages, namely expert validation was carried out to know whether the created learning media was suitable for use or not, from the validation results it was concluded that learning media could be used with slight revisions, then small-scale trials were carried out to find out college student responses to learning media by using college student response questionnaires and conducting tests (evaluations) to obtain media effectiveness data, while the results of the development of interactive mathematics learning media are valid with scores of 3.64 and 3.36, practical with a score of 3.83 and very effective with 90% complete mastery of the material.

Keywords: Development, Geometry, Mathematics learning media.

Abstrak

Tujuan dari penelitian ini adalah untuk medeskripsikan pengembangan media pembelajaran materi Geometri yang valid, praktis dan efektif serta dilengkapi dengan lembar kerja. Jenis penelitian ini adalah penelitian pengembangan dengan prosedur Borg & Gall yang telah dimodifikasi dengan beberapa langkah utama yaitu analisis produk yang dikembangkan, mengembangkan produk awal, dan uji coba produk. Uji coba produk yang dilakukan terdiri dari dua tahap yaitu validasi ahli dilakukan untuk mengetahui apakah media pembelajaran yang dibuat sudah layak digunakan atau tidak, dari hasil validasi diperoleh kesimpulan bahwa media pembelajaran dapat digunakan dengan sedikit revisi, selanjutnya dilakukan uji coba skala kecil untuk mengetahui respon mahasiswa terhadap media pembelajaran dengan meggunakan angket respon mahasiswa serta melakukan tes (evaluasi) guna mendapatkan data keefektifan media, adapun hasil pengembangan media pembelajaran matematika interaktif ini adalah valid dengan perolehan skor 3,64 dan 3,36, praktis dengan perolehan skor 3,83 dan sangat efektif dengan 90% ketuntasan penguasan materi.

Kata kunci: *Geometri, Media pembelajaran matematika, Pengembangan.*

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INTRODUCTION

Mathematics was an important role in the development of science and also a universal science that underlies the development of modern technology, has an important role in various scientific disciplines, develops human thinking power, plays a role in the process of human life and as the language of science. In daily life, we cannot be separated from

mathematics, both from small things to sophisticated technological developments and the National Council of Teachers Mathematics (NCTM, 2000) stated that technology is essential in teaching and learning mathematics, it influences the mathematics that is taught and enhances college students' learning.

Since the role of mathematics is important, every college student should be interested and interested in learning mathematics. However, in reality college students' interest in learning mathematics is still low and the learning process is still less effective. Based on the results of observations on March 9, 2022 and March 16, 2022, class II semester college students of the Mathematics Education Study Program, Faculty of Science, Technology and Education, Universitas Tamansiswa, Padang, with the Field and Spatial Geometry course, it can be seen that college student learning interest is still low.

This is caused by several factors, one of which is the learning media used. Existing learning so far is still dominated by lecturers, while college students only come, sit, listen, take notes, and memorize, this situation has a bad impact on college students, one of which is that college students only master the material provided without knowing the benefits and how to apply knowledge or these lessons in daily life and college students become less active in learning.

To overcome this problem, researchers plan to design and develop an interactive mathematics learning media. Afriansyah and Arwadi (2021) stated that what can be done to increase college students' interest in learning is to use interesting learning media. According to Iswara, Darhim, and Juandi (2021) by using technology teachers are required to be creative and innovative in conducting learning and one of them is by changing methods, methods and media so that learning is no longer monotonous and conservative. The use of media in the learning process can generate new interests, desires and stimulate learning activities as well as bring positive influences on college students. In connection with these conditions, it can be said that college student learning motivation is something that is important to improve the desired learning outcomes (Rachmavita, 2020). In addition, this media can also be used by college students to study independently at home (independently) to repeat parts of material that they do not understand or to better understand the material that has been presented.

According to Kartini and Putra (2020), the current trend that is developing very rapidly is technology, so the development of learning media using this technology is quite

promising and according to Sakat et al. (2012), learning using technological media has a significant influence on learning. College students who are accustomed to using IT-based media indirectly develop their abilities in the field (Hendri & Anugrah, 2019). The developed interactive learning media can be used by college students for independent learning (Puspa, Hidayat, & Supriatno, 2021; Kamaruddin et al., 2021), and the interactive learning media developed allows college students to discover concepts independently (Has, 2021; Subekti & Prahmana, 2021), so that college students are actively involved in learning and college students feel challenged in finding (Simamora, 2020; Khusna et al., 2019).

Recognizing the many benefits of using technology and computer programs to develop interactive mathematics media as a tool in the learning process and the shortcomings of learning media in geometry material, the researchers tried to conduct research related to developing mathematics learning media in this case aimed at describing the media development process. interactive mathematics learning on geometry material and the results of its development.

RESEARCH METHODS

The model in this study refers to the procedural development model, which is a descriptive model and the development model used is the modified Borg and Gall (1989) model, which involves several main steps including 1) analysis of the product being developed, 2) developing the initial product, 3) product trials consisting of expert validations and revisions, small-scale field trials and product revisions, large-scale field trials and the final product.

This research was conducted at Universitas Tamansiswa, Padang. This research was conducted in the odd semester of the 2022/2023 academic year. The instruments used in this study were 1) Instructional media validation sheets filled in by design experts, multimedia, field of study, evaluation experts, and so on which are useful for reviewing the initial product. This validation sheet is given to the validator along with the learning media that will be validated to obtain input or data about the expert's assessment of the learning media. 2) College student assessment sheets for learning media, data collection with this sheet is useful for obtaining information about college student responses to interactive mathematics learning media. College students give a checklist (✓) in the

column provided for each question asked. The questionnaire was given to college students at the end of the learning activities carried out in class.

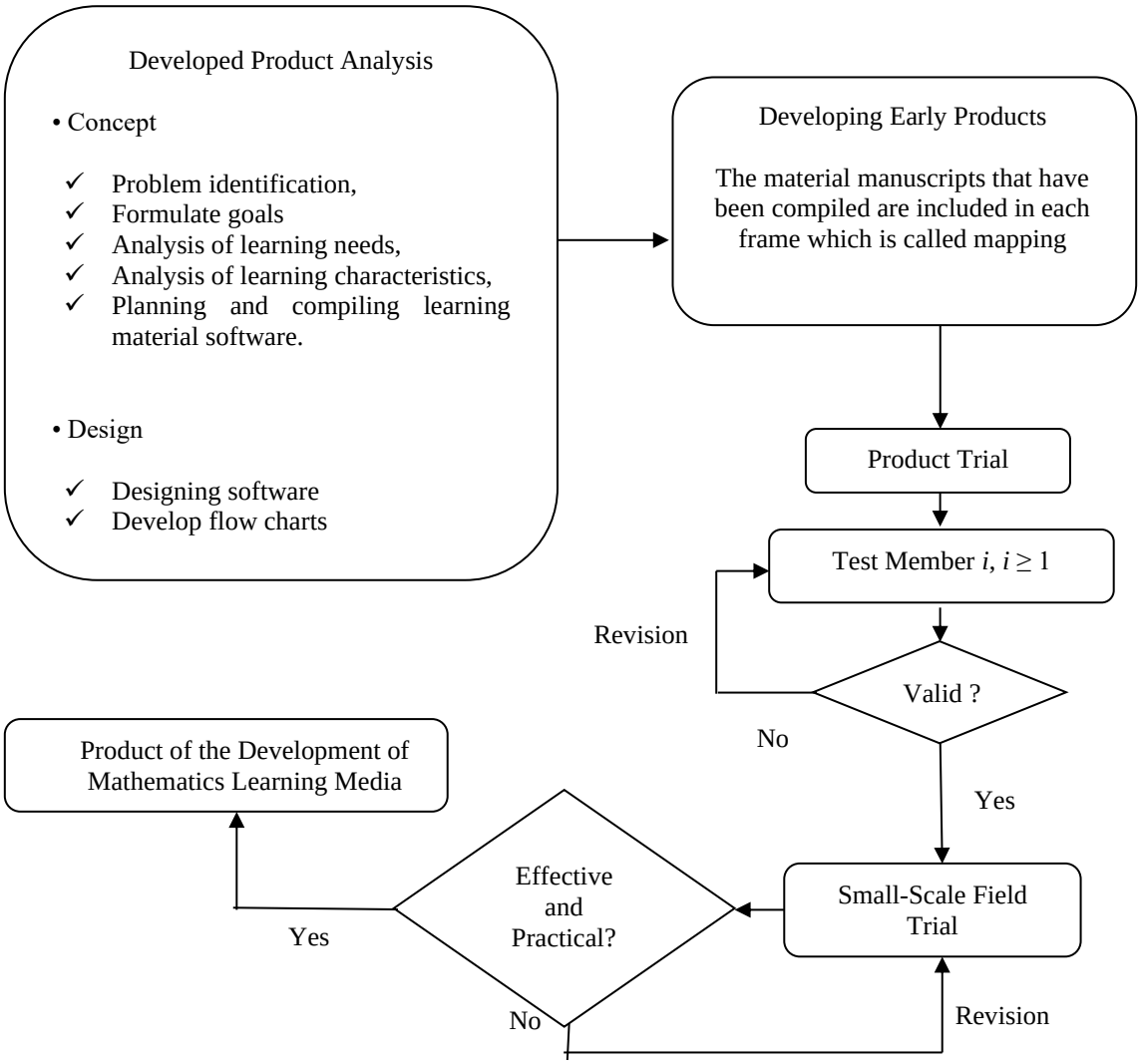


Figure 1. Research Implementation Procedure

Quantitative data validation results were analyzed using the average analysis technique based on the following steps: (a) determine the average of all validators for each indicator, (b) determine the validity score.

Table 1. Validity Criteria

Validity Score (V_a)	Validity Criteria	Description
$V_a = 4$	Very valid	No need for revision
$3{,}25 \leq V_a < 4$	Valid	No need for revision
$2{,}50 \leq V_a < 3{,}25$	Valid Enough	Partial revision
$1{,}75 \leq V_a < 2{,}50$	Less valid	Partial revision
$1 \leq V_a < 1{,}75$	Invalid	Total Revision

To test the validity of the media, the validity criteria are presented in the following Table 1.

Quantitative data from practicality trials were analyzed using the average analysis technique based on the following steps: (a) determine the average of all respondents for each indicator, and (b) determine practicality score. To test the practicality level of the media, the criteria for the practicality level are presented in Table 2.

Table 2. Practicality Criteria

Practicality Score (P)	Practicality Criteria	Description
$P = 4$	Very practical	No need for revision
$3{,}25 \leq P < 4$	Practical	No need for revision
$2{,}50 \leq P < 3{,}25$	Practical enough	Partial revision
$1{,}75 \leq P < 2{,}50$	Less practical	Partial revision
$1 \leq P < 1{,}75$	Not practical	Total Revision

Quantitative data from the results of the effectiveness trials were analyzed using the average analysis technique based on the following steps: (a) data on the results of the material mastery test (evaluation), that is: 1) determine the average value of the test subjects for each question, and 2) determine the value of effectiveness, and (b) determine the percentage value (%).

To test the level of effectiveness of the media, the criteria for the level of effectiveness are presented in Table 3.

Table 3. Effectiveness Criteria

Percentage of Value (%)	Level of Effectiveness	Description
$85 \leq E < 100$	Very effective	No need for revision
$70 \leq E < 85$	Effective	No need for revision
$55 \leq E < 70$	Effective Enough	No need for revision
$50 \leq E < 55$	Less effective	Revision
$0 \leq E < 50$	Not effective	Revision

RESULTS AND DISCUSSION

Expert test or validation is carried out with the help of two validators, namely the mathematics lecturer and the teacher. Each validator provides assessments, corrections, comments and suggestions on learning media and research instruments. From the results of this validation the researcher can determine whether the learning media and research

instruments still need to be revised before small-scale field trials or are ready to be tested in the field.

Analysis of the developed product

At this stage an analysis of the various things needed in product development is carried out, both in designing learning devices and in making learning devices.

Analysis of the needs required in the design of learning devices

The three to develop a product is concept, design, and collecting materials. At the stage to develop the concept, an analysis of the needs needed in the design of learning devices is carried out, starting with studying the material to be made. This is done by selecting material in the curriculum and also the results of observations that have been made. Based on the existing problems, geometry material was chosen with the sub-topic of distance in geometric shapes to be developed in interactive mathematics learning media.

Product design is carried out in two stages, in the first stage the general structure of the software to be developed is carried out, in this case in the form of a tutorial (presentation of subject matter in stages). The general structural form presented in the device is like the scheme in Figure 2.

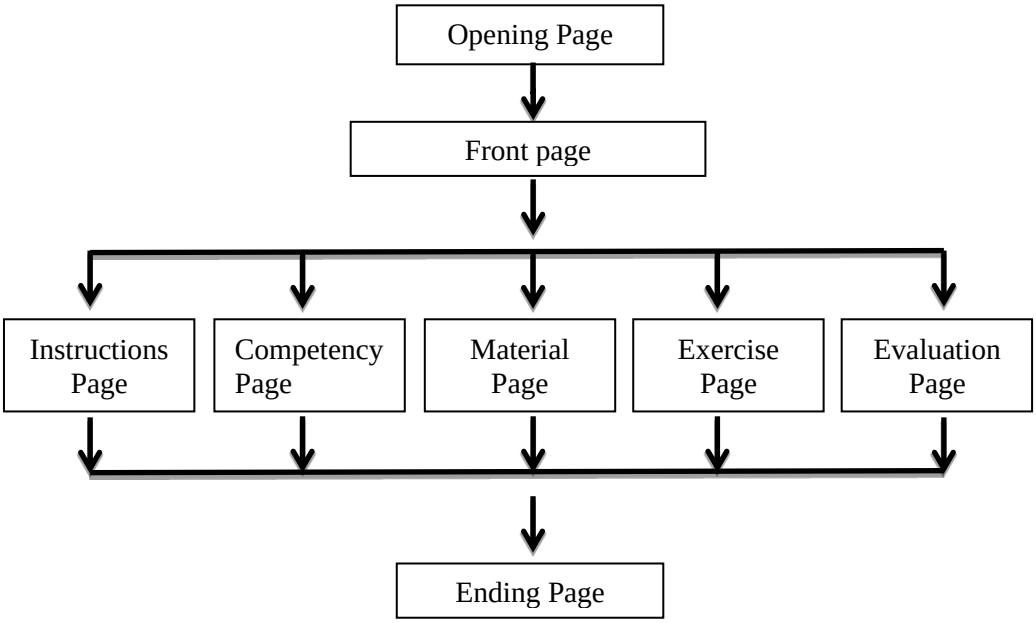


Figure 2. General Structure of Media

At this stage, the materials needed to make the product are collected, such as the main material that will be made, namely material about geometry, besides collecting the

basic material, other aspects needed in making the product are also collected, such as video, audio and images related to the product being made.

Analysis of the needs required in making mathematics learning media

In addition, a need-analysis of the requirements design in terms of materials, it is also necessary to analyze the needs for the manufacture of products in the form of software and hardware. The hardware used in the development of learning media is in the form of a laptop unit and the software used in making mathematics learning media is Macromedia Flash MX 8, 3D Animation, and Microsoft Office Word 2019.

Developing the initial product

The next process after analyzing the product to be developed is developing the initial product, at this stage the material that has been prepared is included in each frame in the Macromedia Flash MX 8 software. After developing the product Initial editing process is carried out on the product being developed.

Trials of the product

After the initial product was finished, a product trial was carried out which consisted of two stages, namely expert testing and small-scale field trials.

Media Expert Validation Results

The results of the validator's assessment of the developed media have been recapitulated in Table 4.

Table 4. Media validation results and recapitulation

Aspects Assessed	I_i
Instructions for using learning media are clear.	4
Media can be operated easily.	4
The text on learning media is easy to read.	3
The display of images on learning media is of high quality.	4
The use of animated images is already interesting	3
Color composition is good.	4
The typeface used is consistent.	4
The font size used is good.	3
The program display on each page is good.	4
The language used is according to the ability of students.	4
Sound on learning media is good.	3
Validity Score (V_a)	3,64

I_i is the Average score of each aspect

Based on the results of media expert validation, the validity score (V_a) was 3.64. According to the established validity criteria, the learning media can be said to be valid. This score indicates that the media is feasible to be tested and carried out several product revisions.

Learning Expert Validation Results

The results of the validator's assessment of the material in the developed media have been recapitulated in Table 5.

Table 5. Results and recapitulation of material validation on media

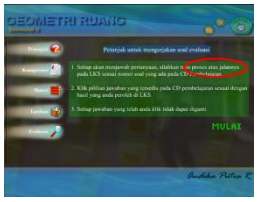
Aspects Assessed	Validator 1	Validator 2	I_i
Quality of content and purpose			
a) The material is in accordance with competency standards, basic competencies, and learning objectives.	4	4	4
b) Learning media according to the concept.	3	4	3.5
c) Animation and pictures according to the material.	3	3	3
d) Examples of questions and exercises according to the material.	3	4	3.5
e) Sample questions are arranged from easy to difficult.	3	3	3
f) The media can increase students' learning motivation on distance material in geometric shapes.	4	3	3.5
Technical quality			
a) The simulation presented in this media can help students understand the concept of distance.	4	4	4
b) Sentences on learning media are clear.	4	3	3.5
c) The placement of the buttons in the media does not confuse students.	3	3	3
Quality of learning			
a) Media can facilitate understanding of distance material in geometric shapes.	3	3	3
b) Media can provide opportunities to learn according to ability.	3	4	3.5
c) The media has facilitated students' independent learning.	3	3	3
d) Media can involve students actively.	4	3	3.5
e) Media can construct students' understanding.	3	3	3
Validity Score (V_a)			3.36

Based on the results of the validation of learning experts, the validity score (V_a) was 3.36. According to the established validity criteria, the learning media can be said to be valid. This score indicates that the media is feasible to be tested.

According to Nieveen and Folmer (2013) media includes content validity (relevance) and consistency validity (consistency). A product is said to be valid if the formulation and

preparation of the developed media product are based on scientific knowledge and are designed logically, and there is a relationship between the components in the developed media product. From the explanation above, interactive mathematics learning media on geometry material can be said to be valid. The media revision process before the media is developed is said to be valid as follows.

Table 6. Revision

Before Revision	After Revision	Before Revision	After Revision
			
Before Revision	After Revision	Before Revision	After Revision
			
Before Revision	After Revision	Before Revision	After Revision
			
Before Revision	After Revision		
			

After making improvements to the validation results of media experts as well as material experts, this interactive mathematics learning media was tested in small groups. This trial was conducted in three meetings for learning and one meeting for a material mastery test (evaluation) and students filled out student assessment sheets for interactive mathematics learning media. The trial implementation schedule was carried out 4 times in April and May.

Based on the practicality criteria that have been determined by the researcher,

learning media is said to be practical if the practicality score data at least 3.25. The results of observing the implementation of learning media are presented in Table 7.

Table 7. Observations on the effectiveness of learning media

Aspects Assessed	I_i
Media can be operated easily.	4
The use of learning media by students according to the time allocation.	4
The implementation instructions in the learning media have been carried out by students.	4
The material in the learning media has been understood by students.	3
The evaluation questions are in accordance with the material.	4
The use of this learning media can be used as a learning resource.	4
Practicality Score (*P*)	3,83

Based on the results of observations of the implementation of learning media, the practicality score (*P*) was 3.83. According to the established practicality criteria, learning media can be said to be practical and do not need to be revised. According to Nieveen and Folmer (2013) a product is said to be practical if the developed media can be used in real situations where the media is created and developed. Internally the developed media can be applied in class and operationally the developed media can be applied properly by the teacher. From the explanation above, the developed media can be said to be practical.

One of the criteria for the effectiveness of learning media is the completeness of learning outcomes and the recapitulation of the results of the material mastery test (evaluation) for all college students is presented in Table 8.

Table 8. Material Mastery Test Recapitulation (Evaluation)

Name	Score	Description
FSM	100	Achieved
RDA	65	Not Achieved
AK	90	Achieved
FKM	80	Achieved
NP	75	Achieved
TKT	75	Achieved
MJK	75	Achieved
MFC	80	Achieved
ZA	80	Achieved
I	90	Achieved
Completeness Percentage	90%	Very effective

Based on Table 8, the percentage of completeness in mastering the material is 90%, but there is still one college student who has not mastered and understood the material in interactive media learning media. According to the established effectiveness criteria, learning media can be said to be very effective and do not need to be revised.

A product resulting from the development is said to be effective if it can achieve the expected learning objectives. Media as a development product is said to be effective if students' activities in participating in the learning process use development products with a high category (Nieveen & Folmer, 2013). From the explanation above, the media researchers have developed can be said to be effective.

CONCLUSION

Based on the research results obtained, it can be concluded that the results of developing interactive learning media on the resulting geometry material are valid with scores of 3.64 and 3.36, practical with scores of 3.83 and very effective with 90% mastery of the material. Suggestions for this interactive mathematics learning media are that evaluation questions are still in the form of objective questions and questions need to be developed in the form of descriptions and field trials only up to small-scale tests, namely one class only and further research needs to be continued for large-scale trials.

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REFERENCES

Afriansyah, E. A., & Arwadi, F. (2021). Learning Trajectory of Quadrilateral Applying Realistic Mathematics Education: Origami-Based Tasks. *Mathematics Teaching Research Journal*, *13*(4), 42-78.

Borg, W. R., & Gall, M. D. (1989). *Educational Research: An Introduction*. Longman

Has, Z. (2021). The Implementation of Improve Method Using LCD Media and Its Effect on Student's Learning Outcome. In *Journal of Physics: Conference Series*, *1752*(1), 012065. https://doi.org/10.1088/1742-6596/1752/1/012065

Hendri, N., & Anugrah, S. (2019). Development of Web-Based Materials Using Moodle Applications in E-Learning System. In *International Conference on Education Technology (ICoET 2019)* (pp. 272-275). Atlantis Press.

Iswara, E., Darhim, D., & Juandi, D. (2021). College students' Critical Thinking Skills in Solving on The Topic of Sequences and Series. *Plusminus: Jurnal Pendidikan Matematika*, *1*(3), 385-394. https://doi.org/10.31980/plusminus.v1i3.1317

Kamaruddin, E., Wijaya, Y. S., Avianti, R. A., Rahardjo, I. A., & Sunawar, A. (2021). Development of prototype e-learning mathematics learning tools using Moodle. *IOP Conference Series: Materials Science and Engineering*, *1098*(2), 022095. https://doi.org/10.1088/1757-899X/1098/2/022095

Kartini, K. S., & Putra, I. N. T. A. (2020). Respon Siswa terhadap Pengembangan Media Pembelajaran Interaktif Berbasis Android [Student Responses to the Development of Android-Based Interactive Learning Media]. *JurnalPendidikan Kimia Indonesia*, *4*(1), 12-19. https://doi.org/10.23887/jpk.v4i1.24981

Khusna, A. A., Hayati, R. M., Sari, Y. A., & Tohir, M. (2019). Developing E–Learning Worksheet Based Information Technology for English Learning. *Attractive: Innovative Education Journal*, *1*(1), 14-39.

NCTM. (2000). *Principles and Standart for School Mathematics.* NCTM.

Nieveen, N., & Folmer, E. (2013). Formative Evaluation in Educational Design Research. In Plomp, T., & Nievven, N. (Eds) *Educational Design Research.* Netherlands Instute for Curriculum Development.

Puspa, V. R., Hidayat, T., & Supriatno, B. (2021). Development of android-based digital determination key application (e-KeyPlant) as learning media for plant identification. *Journal of Physics: Conference Series*, *1806*(1), 012145. https://doi.org/10.1088/1742-6596/1806/1/012145

Rachmavita, F. P. (2020). Interactive media-based video animation and student learning motivation in mathematics. *Journal of Physics: Conference Series*, *1663*(1), 012040. https://doi.org/10.1088/1742-6596/1663/1/012040

Sakat, A. A., Zin, M. Z. M., Muhamad, R., Anzaruddin, A., Ahmad, N. A., & Kasmo, M. A. (2012). Educational Technology Media Method in Teaching and Learning Progress. *Advances in Natural and Applied Sciences*, *6*(3), 484-490.

Simamora, R. M. (2020). The Challenges of online learning during the COVID-19 pandemic: An essay analysis of performing arts education students. *Studies in Learning and Teaching*, *1*(2), 86-103. https://doi.org/10.46627/silet.v1i2.38

Subekti, M. A. S., & Prahmana, R. C. I. (2021). Developing interactive electronic student worksheets through discovery learning and critical thinking skills during pandemic era. *Mathematics Teaching-Research Journal*, *13*(2), 137-176.