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COMBINING GOOGLE SKETCHUP AND ISPRING SUITE 8: A BREAKTHROUGH TO DEVELOP GEOMETRY LEARNING MEDIA

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Abstract

This study aims to develop geometry learning media on curved-solid objects using Ispring Suite 8 with 3D effects supported by Google SketchUp. It also aims to find the effectiveness of the media towards the basic geometry skills and the learning result of 9th-grade students of junior high school. This study is a development study which refers to Budiyono's development model that includes four stages. These stages are the preliminary, product development, product trial on its effectiveness, dissemination and product implementation. The entire stage was imposed on three different schools in Karanganyar, one of a district in Indonesia, by using stratified cluster random sampling. Within the three schools, we took seven classes to join the effectiveness test through the assessment questionnaire and the before-after test, as well as the efficacy test after the expert's judgement using the validation sheet. The result shows that the geometry learning media is valid based on the experts' validation judgement, and also practical based on the teacher and students' judgement in the trial of the product. The students' basic geometry skills and learning result are improved after getting the treatment with the media. Finally, we can conclude that this media is effective and able to be used further in the junior high school level.

Keywords: Geometry learning media, Google SketchUp, Ispring Suite 8.

Abstrak

Penelitian ini bertujuan untuk mengembangkan dan menghasilkan media geometri bangun ruang sisi lengkung menggunakan Ispring Suite 8 dengan efek 3D berbantuan program Google SketchUp yang valid dan praktis. Penelitian ini juga bertujuan untuk mengetahui efektifitas media yang dikembangkan terhadap kemampuan dasar geometri dan hasil belajar geometri siswa SMP kelas 9. Model pengembangan yang digunakan mengacu pada model pengembangan menurut Budiyono dengan empat tahapan, yaitu studi pendahuluan, pengembangan produk, pengujian keampuhan produk, serta diseminasi dan implementasi produk. Keseluruhan tahap dikenakan pada tiga sekolah yang berbeda di Karanganyar, Indonesia, dengan pemilihan sekolah menggunakan teknik *stratified cluster random sampling*. Dari tiga sekolah tersebut, diambil tujuh kelas yang terlibat dalam uji coba keefektifan melalui angket penilaian dan tes sebelum dan sesudah perlakuan, serta uji keampuhan setelah dilakukan penilaian ahli menggunakan lembar validasi. Hasil dari penelitian pengembangan ini yaitu media pembelajaran geometri berupa Ispring Suite 8 didukung program Google SketchUp sebagai fitur visualisasi 3D yang valid berdasar penilaian validasi pakar, dan praktis berdasar penilaian guru dan siswa pada saat proses uji coba produk. Kemampuan dasar geometri dan hasil belajar geometri siswa meningkat setelah pembelajaran menggunakan media tersebut. Hal ini menunjukan bahwa media tersebut efektif untuk digunakan lebih lanjut, khususnya pada jenjang SMP.

Kata kunci: Google SketchUp, Ispring Suite 8, Media pembelajaran Geometri.

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The research and development in computer-based media become the focus of the mathematics experts and researchers to improve the teaching and learning quality. Many studies of the implementation of technology in teaching and learning emphasize the effectiveness of technology (Aliasgari, Riahinia, & Mojdehavar, 2010; Bennison & Gooos, 2010; Leung, 2017; Saadati, Tarmizi, & Ayub, 2014). Much earlier, the use of technology in mathematics teaching and learning had been recommended by the National Council of Teachers of Mathematics (NCTM, 2000). UNESCO also recommended the use of

technology in teaching and learning in 2002. The reason behind it is that since mathematics is an abstract subject which will not be easily observed by the senses. Therefore, it is understandable if most students find it difficult to understand it, and requires learning media. Moreover, the advanced technology also affects the learning.

Considering that the interactive multimedia can stimulate the students' mathematical thinking, technology has an important role in teaching and learning. Students use it to find pattern, to solve problem, to communicate the mathematics idea into a picture, and to use the connection among mathematics topics in problem-solving (Kariadinata, 2007). By using a learning media, teacher could explain the material with more proportional thinking, starting with the connection into possibilities (Borovcnik & Kapadia, 2009). Kirkwood & Price (2014) explains that the technology-enhanced learning was increasingly used in Europe as it can help the teaching and learning process. Zhang (2005) states that students joining the interactive multimedia-based learning will produce higher learning result compared to the less interactive or traditional learning. Bennison & Gooos (2010) also confirmed that the use of technology is one of the ways to improve learning.

Currently, there are a lot of media to support and improve teaching and learning quality. Ispring Suite 8 presents an application software which can help the teacher to explain the lesson material. Further, this software is changes the presentation file that is compatible with powerpoint into flash format. Ispring Suite 8 also provides the learning material in a slide containing picture, animation, video, and audio becomes more interesting, practical, and ideal. It has a positive impact in learning process (Suprapti, 2016; Wijayanto, Utaya, & Astina, 2017; Sasahan, Oktova, & Oktavia, 2017).

In mathematics, particularly in geometry, there are numerous developed media used in the class. For examples, there are Cabri 3D, Wingeom, Geogebra, and Google SketchUp. Many studies find out the effectiveness of these media towards the geometry learning and how the media improves the students' spatial and visual skills (Nurwijayanti, Budiyono, & Fitriana, 2018a; Uygan & Kurtulus, 2010; Uygan & Kurtulus, 2016; Toptas, Celik, & Karaca, 2012; Hamdunah *et al.*, 2016; Nisiyatussani *et al.*, 2018; Zengin, 2017; Chou & Wu, 2014; Turğut & Uygan, 2014). The results show that the dynamic 3D software gives more effective spatial skill compared to conventional learning (Baki, Kosa, & Guven, 2011). Another study promotes the use of technology in geometry learning (González & Herbst, 2009). The study analyzed how the students solve the geometrical problem. When the students use the dynamic geometrical software, they manage to get the mathematical ideas better compared to when they are not using it.

Google SketchUp is a software developed by Google which combines several advanced tools in 3D graphic design on the computer screen. Panorkou & Pratt (2016) explore how this software can help the students experience through dimension. Abu, Ali, & Hock (2012) claim that learning uses Google SketchUp emphasizes the importance of geometrical structure in mathematics which is related to the visualization activity using the Google SketchUp feature. This activity also represents a concept that involves various geometrical representation such as a diagram, picture, and abstract visualization.

Abu *et al.* (2012) also states that Google SketchUp helps the students to visualize, construct the geometry concept, associate, and develop their thinking process. Therefore, they can recognize the geometry from the simplest form into the complex ones. But the study only helps students to construct and visualize geometrical objects in 3 dimensions without involving the development of the students' geometric concepts as a whole.

The students' low achievement in learning mathematics becomes one of the concerns in most countries (Peker & Mirasyedioglu, 2008). It means that there are still many barriers and obstacles in the mathematics teaching and learning process, including Indonesia. Moreover, based on the national exam result on junior high school level in 2015/2016 academics year, the topic of geometry has the lowest score compared to other material. Thus, geometry is still considered a difficult topic.

Connoly (2010) reveals that the geometry lesson is one of the most difficult to understand and also the most disliked material for students. Adolphus (2011) claims that geometry is the most feared and difficult mathematics element, which the students also acknowledge this fact. Further, the result from Nurwijayanti *et al.* (2018b) proves these two opinions based on the theory stated by Hoffer (1981) about the five basic geometry skills (visual, verbal, drawing, logical, and application). The study also shows that the students are only able to reach the basic visual skill.

On the verbal skill, they still have difficulty in linking the connection between solids, so they still lack in their ability to build the geometrical concept. Meanwhile, the verbal and visual skills have to develop the basic logical reasoning (Connoly, 2010). Hoffer (1981) states that those basic skills of geometry are crucial and must be balanced with the development of proving and problem-solving. These require the integration of those five basic skills. The structured and broader geometrical knowledge has a positive correlation with better problem-solving work. However, referring to the interview result, geometry is the hardest element to understand. The reason is that it requires the students to draw and then calculate it.

According to the earlier findings for the media's importance to improve the learning result and to find the students' difficulty with geometry, some action in developing and producing a learning media is necessary. Therefore, this study will focus on the development a geometry media using the Ispring Suite 8 software combined with the 3D effects in Google SketchUp feature.

METHOD

This study used the research and development design which refers to the development model of Budiyono (2017). It consists of four stages, which are the preliminary, product development, product trial on its effectivity, dissemination and product implementation. However, the analysis of this study is only up to the product trial phase only. The four steps can be illustrated in Figure 1.

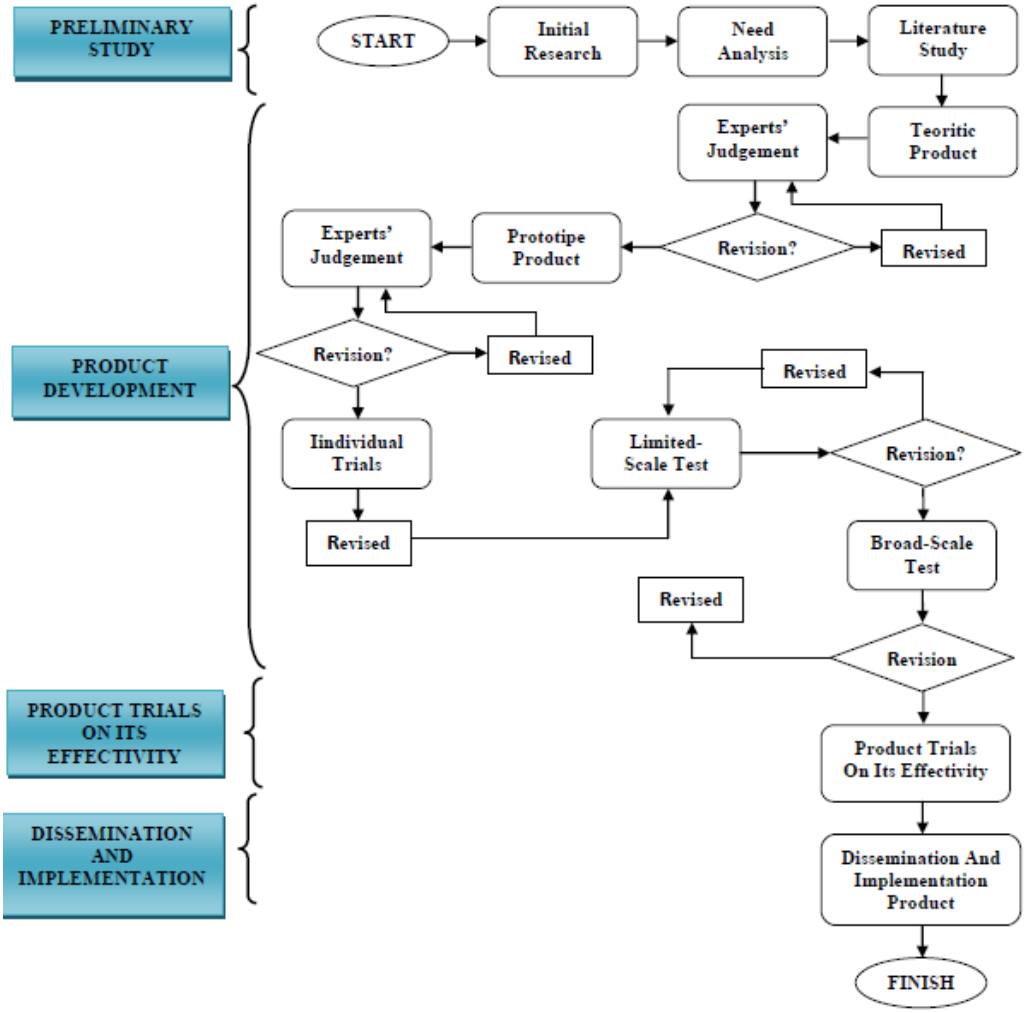


Figure 1. Research and development process according to Budiyono (2017)

The preliminary stage included the initial research, the needs analysis, and literature study. This stage was done on the target school by using the observation sheet, pre-test, the needs analysis questionnaire, and an interview with teachers and students. The product development stage included the experts' validation, individual, limited-scale, and broad-scale trials. This stage was done to the validator by using the media and material experts' validation sheet, as well as to the three classes using a media assessment questionnaire, the learning activities observation sheet, also the geometry basic skills test which is conducted on the broad-scale trial. The product trials stage used the experimental research with the static group comparison model, subjected to four classes consisting of two control and two experimental classes selected with stratified cluster random sampling. These four classes are subjected to a test of geometry after the implementation of the learning media, then analyzed following the experimental using stage using hypothesis analysis. The media itself is the Ispring Suite 8 application. On the teaching and learning activities, the uses of it combined with the 3D feature of the Google SketchUp program.

RESULT AND DISCUSSION

Preliminary Study

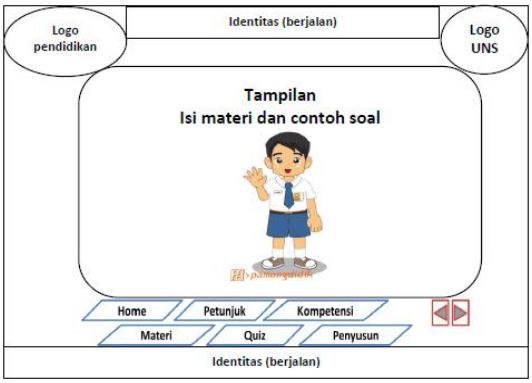
On this stage, we found that the teachers' activity only supported by text-book. They delivered the lesson without any visual model. The illustration was merely drawn on the whiteboard. Also, the interview result with several students showed that they tended to memorize the formula, but not to understand it. Moreover, the teachers rarely gave the varied teaching method. The use of learning media was also limited. It used models for some subjects only. Whereas, according to students the use of media on the learning activity could help them to understand the subject better. The pre-test result for the basic geometry skills to some students revealed that their ability was limited to visual skill only. On the verbal skill, they still struggled to link the connection between geometry which obstructed them to build the geometry concept. It caused their lack of logical process and geometry concept implementation for daily matters.

The next step was filling the needs analysis questionnaire by the teachers and students also interview. The results from this phase are as follows: (1) In the process of mathematics learning, teachers only used a textbook as the main source of learning. To get a wider range of material, the students demanded a learning source that was not only from the textbook, for instance, from the internet; (2) The students still struggled to visualize the geometry shapes. It was particularly the curved-face-three-dimensional objects. It led to their lack of ability to link the connection between it and troubled them to build the geometrical concept; (3) The media that often used in learning geometry was the geometrical framework. It showed through the demonstration method. To get a deeper understanding, the students wanted an alternative media as the additional source, such as using computer-based learning media. The use of interactive media as a supporting source of learning has not been implemented to the fullest by the teachers. Also, it was necessarily needed for the students and teachers as the alternative learning method. Moreover, it could help the students to have a broader knowledge of the related subject.

Then, we also conducted a literature study to find the syllabus information for the material referred to the basic competence. It was to find the surface geometry area and curved-solid objects (cylinder, cone, and sphere) volume formulas as well as to solve the related contextual problem. Then, these materials were implemented in the learning media. Further, the media also contained the materials from various sources, and one of them was the teacher book in the 2013 curriculum.

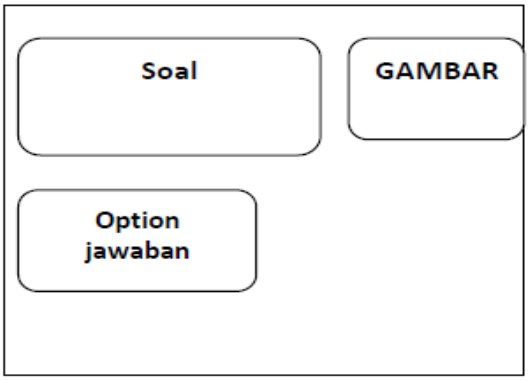
Product Development

The development stage started with composing the media draft. It included the homepage, the sub-materials page of curved-solid objects, and the quiz page that made by Ispring quiz maker. Then, we developed this draft into an intact media. Figure 2 were the result of the developed media draft.

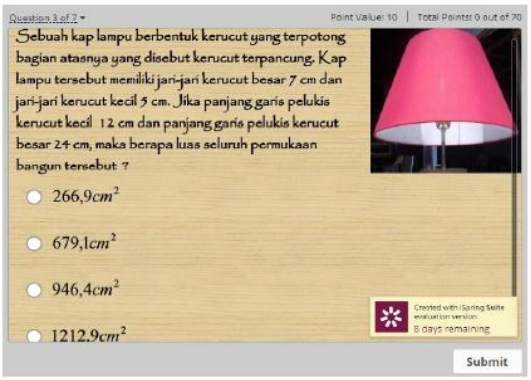


(a) Content page storyboard

(b) Content page preview



(c) Quiz page storyboard



(d) Quiz page preview

Figure 2. The design and the realization of the learning media

Figure 2a is the storyboard of the media design on the content page, while Figure 2b is the development result. Figure 2c is the storyboard for quiz design and then developed using Ispring quiz maker shown in Figure 2d.

After the development of the media draft, the next step was media and material experts' validation. The first and second media validation results showed in Figure 3.

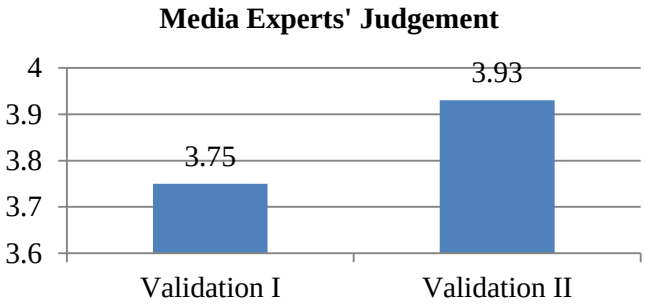


Figure 3. Media experts' judgement results

The media first validation average score was 3.75, which is in the good category. However, there were suggestions and feedbacks from the validators. They suggested fixing the system in the Ispring Suite 8 media to link with Google SketchUp. It was to make the quiz link and system directly

connected to the media. Based on that, we made the improvements and refined the lack of the media. Further, the polished media was validated again. The score for the second validation was 3.93 with the good category. Thus, the geometry media of Ispring Suite 8 supported by Google SketchUp could be used in the learning activities. The second validation result was presented in Figure 4.

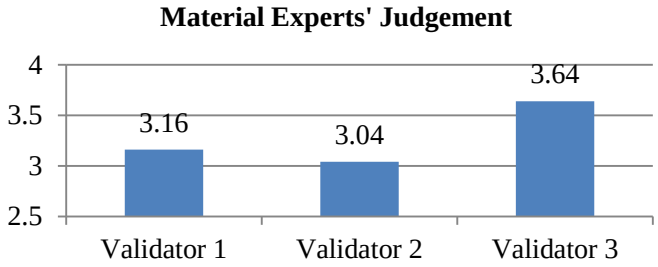


Figure 4. Material Experts' Judgement Results

The average score from the first validator was 3.16 and the second validator was 3.04 both were in fair category, and the third validator was 3.64 in a good category. However, there were several suggestions and feedbacks from the validators. First, to add geometry illustration is on the quiz and test. It was to make the students able to observe visually. Then, made the test questions are closer to students' daily life. After making the media text more colourful and adjusted with its background, we served the images accordingly to avoid the ambiguous material concepts. Based on the validators' suggestions and feedbacks, the researchers made the improvements and refined the lacking materials in the media then validated it again. According to the second validation, the score was 3.80 which is in a good category. Therefore, the geometry media Ispring Suite 8 supported by Google SketchUp generally could be used in the learning activity.

After the product was said to be valid, then it was ready to be tested. The first trial was the individual test. This test was performed to seven students who randomly chosen from one of the schools. It used a questionnaire as the instrument of the test. The total scoring score for this test was 894 with its average 3.55. This score was in the strongly agree category if the media used further. Moreover, there was a suggestion and feedback as well from the students. It was to make the material deeper so they could understand it in more details. Then, we also observed the run of the program. The result of it revealed several barriers. These were the incompatibility of the media with the computer's capacity, due to some laptop or computer encountered an error when used it. These input suggestions and the barrier were used as the reference for the researchers to make the improvements. Also, the detailed result of the individual trial presented in Figure 5.

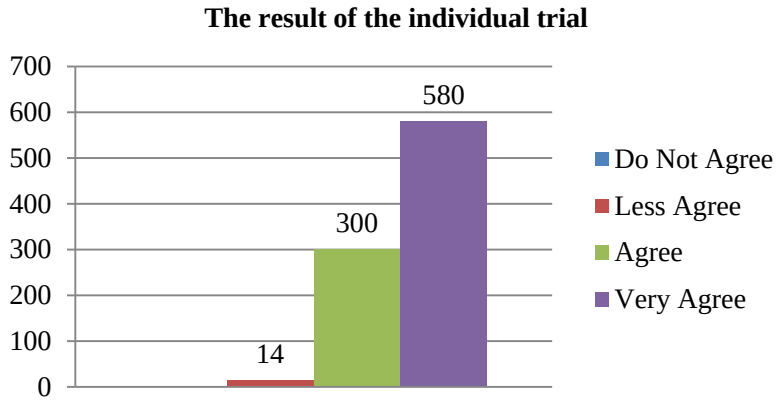
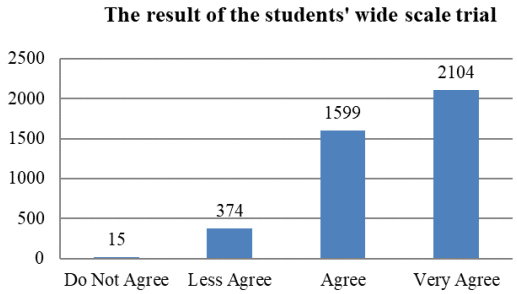
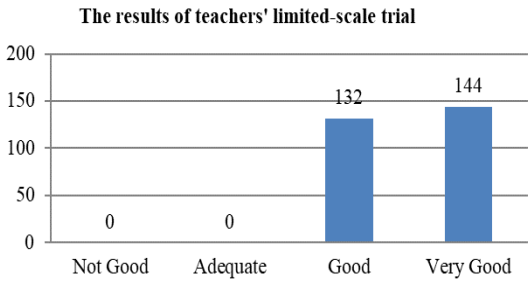


Figure 5. The appraisal question of media on individual trial

The second trial was the limited-scale test. It was conducted to one class consisted of 35 students and teachers by using questionnaire. The result from the students indicated a total score of 4122 with an average of 3.27. This score was –along with the individual test—included in the strongly agree category if the media used further. Further, the scoring on this test was included the teachers as the users. The result of their valuation was 141 with the average score of 3.52 in the good category. Aside from the questionnaire, the scoring is also performed by observation. The observation results presented the conclusion that from the media or the learning activities aspects were already run well and appropriate. As for the obstacle happened when used the media was: the video on the media could not be displayed, so it had to be shown separately. We used this constraint as the basis to refine the media. The students and teachers scoring results displayed in Figure 6.



(a) The media scoring result from students



(b) The media scoring result from teachers

Figure 6. The results of the trial

The third trial was the broad-scale test. It was performed by using the stratified cluster random sampling to two classes from two different schools. These two classes were from SMP 1 Karanganyar (9J) and SMP 1 Jaten (9A). The before-after experimental design used in this test. Later, it used the t-test to analyze the data. Then, the data collection technique also used before and after the media used in the class tests, for the students' result of the basic geometry skills on the curved-solid objects. Table 1 presents the result of the basic geometry skills test.

Table 1. The before-after geometry basic skills test results

Group	The Number of Students	Highest Score	Lowest Score	Mean
Before	85	8	1	4.48
*Aft*er	82	10	1.25	6.66

Before running the t-test, it has to fulfil the normality and the homogeneity tests first, as presented in in Table 2.

Table 2. The normality test result of the before-after tests

Group	The Number of Students	L_{obs}	L_{tabel}	Hypothesis Result	Description
Before	85	0.0507	0.0961	H_0 accepted	The sample was from the normal distribution population
*Aft*er	82	0.0608	0.0978	H_0 accepted	The sample was from the normal distribution population

The average score from the group before treatment was 4.48 and the after treatment was 6.66. In Table 2, the normality test showed decent results from both before and after groups which means that both samples were from the normal distribution population. Based on the homogeneity test calculation, the variance result was $\chi^2_{obs} = 0.0001$ with $\chi^2_{0,05;1} = 3.841$. According to the critical region criterion $CR = \left\{\chi^2 \middle| \chi^2 . > \chi^2_{\alpha,k-1}\right\}$ then $\chi^2_{obs} = 0.0001 \notin CR$. Thus, the null hypothesis was accepted since it signified that both population variances were homogeneous or equal.

After meeting both requirements (normal and homogeneous), we could conduct the *t*-test. From the *t*-test, the calculation result revealed that $t_{obs} = 7.364$ with the critical region for $\alpha = 0.05$ was $CR = \{t | t > 1.65\}$, so $t_{obs} = 7.364 \in CR$. Therefore, the test decision for the null hypothesis was rejected. Both groups (before and after) average scores were different. On the other words, the result from the after group was better compared to the before group. It established that the learning used the geometry media Ispring Suite 8 supported by Google SketchUp on the curved-solid objects was effective to use.

To find the effect (before and after) in applying media for the students' basic geometry skills, we took some students' answers as the samples for deeper analysis. It covered the visual, verbal, drawing, logical, and application which referred to Hoffer (1981). From the analysis results, it showed these skills improved after the implementation of the media in the class. According to those average scores explanation and the basic skills analysis above, we could conclude that geometry media Ispring Suite 8 supported by Google SketchUp was effective to use especially in junior high school level.

Product Trials on Its Effectiveness

The product trials on its effectiveness performed in four classes from two different schools as the stratified random sampling. From the first school, there were class 9E as the control class and 9I as the experiment class in SMP 1 Karanganyar. Another school was SMP 1 Jaten with class 9B as the control class and 9C as the experiment class. The trials itself had done by using the Static Group Comparison experiment draft then analyzed by the *t*-test. The data is presented in Table 3.

Table 3. Test result data

Group	The Number of Students	Highest Score	Lowest Score	Mean
Experiment	57	90	45	67.63
Control	59	85	35	63.22

Before using the *t*-test, it required fulfilling the normality and homogeneity tests first, as presented in Table 4.

Table 4. Normality test result of the test result data

Group	The Number of Students	L_{obs}	L_{table}	Hypothesis Result	Description
Experiment	57	0.0781	0.1174	H_0 accepted	The sample was from the normal distribution population
Control	59	0.0865	0.1153	H_0 accepted	The sample was from the normal distribution population

The average score of experiment class was 67.63 and control class was 63.22. In Table 4, the normality test showed for both classes, these samples came from the normally distributed population. Then, the variance according to the homogeneity test acquired the result $\chi^2_{obs} = 0.1872$ with $\chi^2_{0,05;1} = 3.841.$ Since the critical region criterion was $CR = \left\{\chi^2 \middle| \chi^2 . > \chi^2_{\alpha,k-1}\right\}$ then $\chi^2_{obs} = 0.1872 \notin CR$. Therefore, the null hypothesis was accepted since it signified that both population variances were homogeneous or equal.

The hypothesis test used the *t*-test was performed after passed the requirement for both normality and homogeneity. From the *t*-test result, the $t_{obs} = 2.037$ with the critical region criterion for $\alpha = 0.05$ was $= \{t|t > 1.65\}$, so $t_{obs} = 2.037 \in CR$. Then, the null hypothesis was rejected. In addition, for both experiment and control groups had a different mean score. On the other hands, the learning used the geometry media Ispring Suite 8 supported by Google SketchUp had a better achievement compared to the one without it.

CONCLUSION

Geometry learning media using Ispring Suite 8 combined with the 3D effect of Google SketchUp program was valid according to the experts. It was also practical to use as the students and teachers' response on the product trials process. Further, the students' geometry basic skills was improved after the implementation of the media. It showed that it was effective to use the media. Moreover, from the development series, we also concluded that this media was valid, practical, and effective to be used in the geometry teaching and learning process.

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REFERENCES

Abu, M. S., Ali, M. B., & Hock, T. T. (2012). Assisting primary school children to progress through their Van Hiele's levels of geometry thinking using Google Sketchup. *Procedia-Social and Behavioral Sciences*, *64*, 75-84.

Adolphus, T. (2011). Problems of teaching and learning of geometry in secondary schools in Rivers State Nigeria. *International Journal of Emerging Sciences*, *1*(2), 143-152.

Aliasgari, M., Riahinia, N., & Mojdehavar, F. (2010). Computer-assisted instruction and student attitudes towards learning mathematics. *Education, Business, and Society: Contemporary Middle Eastern Issues*, *3*(1), 6-14.

Baki, A., Kosa, T., & Guven, B. (2011). A comparative study of the effects of using dynamic geometry software and physical manipulatives on the spatial visualisation skills of pre- service mathematics teachers. *British Journal of Educational Technology*, *42*(2), 291-310.

Bennison, A., & Goos, M. (2010). Learning to teach mathematics with technology: A survey of professional development needs, experiences, and impacts. *Mathematics Education Research Journal*, *22*(1), 31-56.

Borovcnik, M., & Kapadia, R. (2009). Research and developments in probability education. *IEJME-Mathematics Education*, *4*(3), 111-130.

Budiyono. (2017). *Pengantar Metodologi Penelitian Pendidikan*. Surakarta: UNS Press.

Chou, P. N., & Wu, C. Y. (2014). Integrating 3D visualization tools into teaching surface area in elementary school classrooms: An example of Google Sketchup. *Taiwan Journal of Mathematics Education*, *1*(1), 1-18.

Connoly, S. (2010). The impact of Van Hiele-based geometry instruction on student understanding. *Thesis*. Pittsford: St. John Fisher College.

González, G., & Herbst, P. G. (2009). Students' conceptions of congruency through the use of dynamic geometry software. *International Journal of Computers for Mathematical Learning*, *14*(2), 153-182.

Hamdunah, H., Yunita, A., Zulkardi, Z., & Muhafzan, M. (2016). Development a constructivist module and web on circle and sphere material with Wingeom Software. *Journal on Mathematics Education*, *7*(2), 109-116.

Hoffer, A. (1981). Geometry is more than proof. *Mathematics Teacher*, *74*(1), 11-18.

Kariadinata, R. (2007). Desain dan pengembangan perangkat lunak (software) pembelajaran matematika berbasis multimedia. *Jurnal Pendidikan dan Kebudayaan*, *69*(13), 1055-1080.

Kirkwood, A., & Price, L. (2014). Technology-enhanced learning and teaching in higher education: What is 'enhanced' and how do we know? A critical literature review. *Learning, Media, and Technology*, *39*(1), 6-36.

Uygan, C., & Kurtuluş, A. (2010). The effects of Google Sketchup-based geometry activities and projects on spatial visualization ability of student mathematics teachers. *Procedia-Social and Behavioral Sciences*, *9*, 384-389.

Uygan, C., & Kurtuluş, A. (2016). Effects of teaching activities via Google Sketchup and concrete models on spatial skills of preservice mathematics teachers 1. *Turkish Journal of Computer and Mathematics Education*, *7*(3), 510-535.

Leung, A. (2017). Exploring techno-pedagogic task design in the mathematics classroom. *Digital Technologies in Designing Mathematics Education Tasks*, *8*, 3-16.

NCTM. (2000). *Principles and Standards for School Mathematics*. Reston, VA: National Council of Teachers of Mathematics.

Nisiyatussani, N., Ayuningtyas, V., Fathurrohman, M., & Anriani, N. (2018). GeoGebra applets design and development for junior high school students to learn quadrilateral mathematics concepts. *Journal on Mathematics Education*, *9*(1), 27-40.

Nurwijayanti, A., Budiyono & Fitriana, L. (2018a). The geometry ability of junior high school students in Karanganyar based on the Hoffer's theory. *Journal of Physics: Conference Series*, *983*(1), 012085.

Nurwijayanti, A., Budiyono & Fitriana, L. (2018b). The use of interactive media ispring suite 8 supported by Google SketchUp to improve students' geometry skills based on Hoffer's Theory. *Journal of Physics: Conference Series, 1008*(1), 012075.

Panorkou, N., & Pratt, D. (2016). Using Google SketchUp to develop students' experiences of dimension in geometry. *Digital Experiences in Mathematics Education*, *2*(3), 199-227.

Peker, M., & Mirasyedioğlu, Ş. (2008). Pre-service elementary school teachers' learning styles and attitudes towards mathematics. *Eurasia Journal of Mathematics, Science & Technology Education*, *4*(1), 21-26.

Saadati, F., Tarmizi, R. A., & Ayub, A. F. M. (2014). Utilization of Information and communication technologies in mathematics learning. *Journal on Mathematics Education*, *5*(2), 138-147.

Sasahan, E. Y., Oktova, R., & Oktavia, O. O. (2017). Pengembangan media pembelajaran interaktif tentang optika berbasis android menggunakan perangkat lunak Ispring Suite 7.0 untuk mahasiswa S-1 Pendidikan Fisika pada pokok bahasan interferensi cahaya. *Prosiding SNFA (Seminar Nasional Fisika dan Aplikasinya)*, *2*, 52-61.

Suprapti, E. (2016). Pengembangan perangkat pembelajaran matematika model kooperatif tipe STAD dengan media powerpoint Ispring pada materi jajargenjang, layang-layang dan trapesium di kelas VII SMP. *Journal of Mathematics Education, Science and Technology*, *1*(1), 57-68.

Toptas, V., Celik, S., & Karaca, E. T. (2012). Improving 8th grades spatial thinking abilities through a 3D modeling program. *TOJET: The Turkish Online Journal of Educational Technology, 11*(2), 128-134.

Turğut, M. & Uygan, C. (2014). Spatial ability training for undergraduate mathematics education students: Designing tasks with Sketchup. *Electronic Journal of Mathematics and Technology*, *8*(1), 53–65.

Wijayanto, P. A., Utaya, S. & Astina I. K. (2017). Increasing student's motivation and geography learning outcome using active debate method assisted by Ispring Suite. *International Journal of Social Sciences and Management*, *4*(4), 240-247.

Zengin, Y. (2017). The effects of Geogebra software on pre-service mathematics teachersí attitudes and views toward proof and proving. *International Journal of Mathematical Education in Science and Technology*, *48*(7), 1-21.

Zhang, D. (2005). Interactive multimedia-based e-learning: A study of effectiveness. *The American Journal of Distance Education*, *19*(3), 149-162.