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Statistical Skills Analysis of Students Using Online-Learning Platforms such as Whatsapp, Youtube, and Zoom Meetings during Covid-19 Pandemic

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ABSTRACT

Education as a result of the Covid-19 pandemic has undergone transformation related to the learning process from face-to-face learning process to online-based learning process that utilizes various online platforms, such as WhatsApp, YouTube, and Zoom Meetings. The use of online platforms helps students to improve their cognitive skills, one of which is statistical skills. This study aims to determine whether there is a significant statistical difference between learning using WhatsApp, YouTube, and Zoom Meetings during online learning and to find out which online platforms are effective and interactive. The research sample consisted of 69 students taking statistics courses. The research method is mix-method or mix of quantitative and qualitative. The data collection techniques are online-based test instruments, questionnaires and interviews. The data analysis used Kruskal Wallis test and descriptive analysis test. The results showed that there were differences in students' statistical skills between the three classes, where the best came from learning using YouTube platform. The findings also show that students give higher positive responses to the use of YouTube as platform in online learning. The interview results show that the use of YouTube is more effective and interactive for students while participating in online-based learning. By that means, YouTube platform is effective in improving statistical skills in online learning.

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A. INTRODUCTION

Coronavirus 2019 (COVID-19) is a pandemic disease caused by severe acute respiratory syndrome, coronavirus 2 (SARS-CoV-2) spreading globally rapidly (Dashraath et al., 2020). The whole world, including Indonesia, is experiencing a serious public health emergency, it is so deadly and prone to spread in crowds that health care providers were not sufficiently prepared to deal with infections. In Indonesia as of February 10, 2021, based on data from the Covid-19 Task Force through the website https://covid19.go.id, data were obtained as many as 1,183,555 people who were confirmed positive for COVID-19, 982,972 people who recovered, and 32,167 people who were diagnosed with COVID-19 died. Anticipating the spread of the virus that causes the Covid-19 disease, the government has made a policy of implementing social distancing and physical distancing. Educational institutions, both schools, and universities are closed, shopping places are quiet, the use of public transportation is

limited and so on (Masrul et al., 2020). This condition causes education to be affected. The learning process also experienced disruption and transformation from face-to-face learning to online-based learning process. This aims to support government programs in suppressing the growth of COVID-19 cases, especially for education actors (students, teachers, and education staff). After almost a year, Indonesia has entered New Normal period, yet online learning is still being implemented. The new normal period made ICT-based education the spearhead of learning implementation (Pertiwi et al., 2020). The integration of ICT in the learning process is not new in education. Technology integration provides assistance not only for students in understanding learning materials but also for teachers where they are able to create more interesting and innovative development of learning materials (Navarro-Ibarra et al., 2017; Trouche & Drijvers, 2010; Zhang & Liu, 2016). Various integrations of technology in learning have a positive impact on improving the quality of learning, including students who are skilled in using technology in the learning process both inside and outside the classroom (Mulyana et al., 2021; Ramadhani & Fitri, 2020; Suryati & Gede Adnyana, 2020). Long before the outbreak of the Covid-19 pandemic, the application of ICT in the learning process, especially mathematics learning, had been implemented, such as the use of several mathematics learning software, e.g., Autograph, GeoGebra, Desmos, Cabri-3D, and other mathematics learning software; and the use of Learning Management Systems (LMS), e.g., Google Classroom, Edmodo, Schoology, and other LMS (Fadillah et al., 2020; Ramadhani et al., 2020).

The usage of online learning platforms altered the development of students' mathematical abilities, particularly those linked to statistical learning, as a result of changes in learning implementation during the Covid-19 epidemic. Before the Covid-19 epidemic, statistical learning was done using the SPSS program and was taught face-to-face. Statistical learning has evolved since the Covid-19 epidemic. It can now rely on the usage of the SPSS application. Still, it also requires the assistance of an online learning infrastructure that can handle online statistical courses (technology-based distance learning). The selection of the right online learning platform will impact the development of students' statistical abilities. According to delMas (2002), Lawson et al. (2003), Conway et al. (2019), and Aridor & Ben-Zvi (2018), developing statistical abilities with the use of technology has a favorable and substantial impact on student statistical learning outcomes. Negara et al. (2019) claim that applying a technology-integrated learning paradigm will help statistical abilities grow optimally.

The development of statistical abilities in kids is critical because statistical abilities assist other mathematical talents. Statistics and mathematics are inextricably linked. When students are given a challenge explaining a graph or statistical data table, this capacity will emerge. The significance of statistical abilities may also be observed in the research findings of Lepak et al. (2018), where students with poor mathematical communication skills will struggle to articulate mathematical issues based on mathematical literacy and execute mathematical reasoning in the context. Statistical ability refers to students' capacity to convey statistical data as well as how they model data, analyze data, and draw conclusions from the outcomes of their study. According to Ramadhani & Narpila (2018), statistical skills are critical in the development of students' social skills, particularly in making judgments about their difficulties.

According to the definition above, students ' statistical abilities must be strengthened even though learning has shifted from face-to-face to online platform-based learning. The use of online learning platforms has grown ever since the outbreak of the Covid-19 pandemic. Several online platforms are available to support the teaching and learning process from home, e.g., WhatsApp, YouTube, and Zoom Meetings. WhatsApp is a smartphone application owned by Facebook Inc., Menlo Park, CA (Trujillo Loli et al., 2021). WhatsApp is one of the platforms based on Mobile Instant Messaging (MIM) which is used as a communication tool. Social media-based learning technologies such as WhatsApp offer modern and creative ways

to build engaging, effective, and interactive social learning environments. Social media platforms can also trigger and increase interaction between teachers and students (Al-Rahmi et al., 2015; Alabdulkareem, 2015; Yousif Abdelraheem & Mohammed Ahmed, 2018). Social media-based learning is one of the learning platforms that has great potential in supporting the online learning process during the Covid-19 pandemic (Suana et al., 2019).

Learning via WhatsApp is carried out through WhatsApp Groups which can accommodate many users (students) making it easier for teachers to provide learning and conduct discussions. WhatsApp has several advantages including being able to send texts, photos, videos, and video calls with multiple people. Teachers can share various modules with .pdf or .docs file types, and images that support the presentation of learning materials through the WhatsApp platform. Teachers can also send video materials through this platform and can make video calls while carrying out the learning process that features students' faces as proof of attendance (Hertzog & Swart, 2018). In addition, WhatsApp can also be used anywhere and anytime, expanding the learning environment and having lower costs compared to computer-based learning platforms (Crescente & Lee, 2011). However, the use of the WhatsApp platform also has weaknesses, as users' cell phone may have excess memories in storing files namely photos, documents, and videos as learning materials. This is quite inconvenient for students let alone when the cell phone can no longer accommodate future files (Cetinkaya, 2017; Rosenberg & Asterhan, 2018).

Another prominent social media-based learning platform is YouTube. YouTube is an easy-to-use and valuable platform for hosting video content (Kauffman et al., 2021). This platform can reach global audience through sharing videos uploaded online. Videos uploaded on YouTube can be watched over and over again, anytime and anywhere. Video content on YouTube also has advantages including not reducing RAM or micro-SD storage capacity on smartphones, which is different from WhatsApp. The drawback of WhatsApp is that when one's RAM is full and once the contents are deleted, they are no longer can be viewed or watched. Institutions or educators can take advantage of YouTube's broad access by posting high-quality educational content. YouTube is an effective alternative to achieve learning objectives (Mayo et al., 2021). Several previous studies that explained the effect of using the YouTube platform as one of the social media-based learning platforms showed a positive and significant effect in increasing student learning activities. Szeto & Cheng (2014) obtained results showing that YouTube helps school students in Hong Kong understanding practical material well. Albahlal (2019) also conducted research on the effects of using YouTube as a learning platform for high school students and obtained the results that students were motivated to participate in learning. June, Yaacob & Kheng (2014), Duncan, Yarwood-Ross & Haigh (2013), Rizkan, Mukhaiyar & Refnaldi (2018), Safar & Alkhezzi (2016) also give the results that the use of YouTube not only helps students in understanding the teaching materials but also helps teachers in providing more interesting teaching materials, easy to use anytime and anywhere and does not require the help of complicated tools in accessing videos that have been developed by teachers. Learning mathematics through YouTube also provides preoccupation for students, where students can learn material presented in 3-dimensional form in a more comprehensible way, compared to through writing or pictures presented in two dimensions (Hidayatullah & Suprapti, 2020; Sari et al., 2020).

Zoom Meetings is another prominent social media-based learning platform. Zoom Meetings is a platform that provides video-conferencing facilities (Mahr et al., 2021). Through Zoom Meetings, several people can interact with each other at the same time even in various locations. Like never before, now the global COVID-19 pandemic has turned the spotlight on video conferencing apps. In these critical times, apps like this have seen a surge in their user base. Kustiyani, et al (2021) conducted learning through Zoom Meetings and obtained the

results that students were enthusiastic and motivated in participating in the learning process carried out through video conferencing. Interaction between students and teachers as well as discussion process can be carried out easier and smoother.

Based on the description of online-platforms above, it can be concluded that the three platforms are good for learning. However, there hasn't been found any research that discusses each difference, which one is more effective and preferred by students in online learning, as well as how students respond to the use of online-learning platforms simultaneously. Because the exploratory research only utilized one of the online learning platforms in this study, the results cannot evaluate whether or not using the online learning platform positively impacted students' mathematical skills. Therefore, here are formulations of the problems of the study that are used as research gap in this study:

1. Are there differences in the use of the three online learning platforms (WhatsApp, YouTube, and Zoom Meetings) in improving students' statistical skills in online-based mathematics learning during the Covid-19 pandemic?
2. Which online learning platform is effective and efficient to use in online-based mathematics learning during the Covid-19 pandemic?
3. How is the student response regarding the use of online learning platforms in online-based mathematics learning during the Covid-19 pandemic?

B. METHODS

The research method used is mix-method, which is a mix of quantitative and qualitative. The sample in this study was 69 students who were divided into three learning classes. Class A used YouTube, contained 11 students, Class B used WhatsApp, contained 34 students, and Class C used Zoom Meetings which contained 24 students. The test instrument that was developed previously has been tested for validity and reliability and obtained the results that the test instrument is valid and reliable. Research data were collected through the technique of giving test instruments (pre-test and post-test) and questionnaires. The collected data were analyzed both quantitatively (using descriptive statistical tests and inferential statistical tests), and qualitatively (through questionnaires). Descriptive statistical analysis techniques and inferential statistics used the Kruskal-Wallis test with SPSS to see the difference in students' statistical skills during online learning in using the three platforms. The Kruskal-Wallis test is used to compare more than two populations when the data are ordinal or interval, but not normal, and the sample is independent (Mbuli et al., 2020). The Kruskal-Wallis test can also be used for data that is not normally distributed (Rady et al., 2018). The Kruskal-Wallis test can be used instead of ANOVA for data from non-normal populations (Elliott & Hynan, 2011).

C. RESULT AND DISCUSSION

1. Result

a. Data Analysis

The data analysis process begins with conducting normality test on the pre-test data that has been obtained through the provision of test instruments before and after the treatment (learning process using three types of online platforms in three different classes). The normality test is one of the pre-requisites for the research data before proceeding to the research hypothesis test. The normality test of the data was carried out using the Shapiro-Wilk test because the consistency level of this test was high when used in large samples (Oktaviani & Notobroto, 2014). The Saphiro-Wilk test can be used to test for normality (García-Cuenllas Álvarez et al., 2020). Saphiro-Wilk test criteria are normal data if $p > 0.05$ (Hassannejad et al., 2020). The results of the analysis of the normality test on the pre-test and post-test data can be seen in Table 1 below:

Table 1. Results of Pre-Test and Post-Test Data Normality Test

Class	*Pre-Test*			*Post-Test*		
	Shapiro-Wilk			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Class A	0.711	11	0.001	0.666	11	0.000
Class B	0.675	34	0.000	0.925	34	0.023
Class C	0.835	24	0.001	0.919	24	0.056

*Class A = Learning used YouTube
Class B = Learning used WhatsApp
Class C = Learning used Zoom Meetings

Based on Table 1, it can be seen that the Sig. value in the Shapiro-Wilk test obtained from the pre-test data for class A is 0.001, class B is 0.000 and C is 0.001. The three Sig. values obtained are smaller than 0.005, then based on the criteria of the Shapiro-Wilk test, the pre-test data of the three groups can be said as not normally distributed (Kitta et al., 2020). Likewise, with the results of the normality test on the post-test data, the results for class A are 0.000 and for class, B is 0.023. The Sig. value of these two groups is less than 0.05, which means that the data is not normally distributed. While class C, the Sig. value is 0.056 > 0.05 which means the data is normally distributed. The next test is the data homogeneity test which is also a pre-requisite test for pre-test data and post-test data. The homogeneity test was carried out using the Levene Test and the results obtained can be seen in Table 2 below:

Table 2. Results of Homogeneity Test of Pre-Test and Post-Test Data

Data	Levene Statistic	df1	df2	Sig.
Pre-Test	0.769	2	66	0.468
Post-Test	0.525	2	66	0.594

Based on Table 2 above, the Sig. value obtained is 0.468 > 0.05, then based on the criteria for testing the variance of the data is the same or homogeneous. As the three independent data groups were not normally distributed, the Kruskal-Wallis test (K-Sample Independent Test) was used to test the statistical skills differences in the pre-test data between the three groups. Meanwhile, in the post-test data homogeneity test, it was found that the Sig. value is 0.594 > 0.05 which means the data variance is homogeneous. As there is one out of the three groups that have not normally distributed data namely class C, the Kruskal-Wallis test is also carried out to see the difference in the final statistical skills (post-test) of the three groups. The results of the Kruskal-Wallis test for both pre-test and post-test data can be seen in Table 3 below:

Table 3. Data of Kruskal-Wallis Test Pre-Test Data and Post-Test

	Data *Pre-Test*	Data *Post-Test*
Chi-Square	1.423	39.564
Df	2	2
Asymp. Sig.	0.491	0.000

Based on Table 3 above, the Asymp.Sig value is 0.491 > 0.05, which based on the test criteria, can be concluded that there is no significant difference in the initial statistical

skills (pre-test data) of the students between the three groups. Meanwhile, in the post-test data test using the Kruskal-Wallis test, the Asymp.Sig test was 0.000 < 0.05 which indicated that there was a significant difference between the three groups. These findings address the study's first concern: that there are disparities in how students improve their statistical abilities when taught through the YouTube, WhatsApp, and Zoom Meetings platforms.

b. Descriptive Statistical Analysis Results

The average value for statistical skills using WhatsApp platform is 39.6. The average statistical skills using YouTube is 90. The average statistical skills using Zoom Meetings platform is 62.7. These three averages are illustrated in the Figure 1 below:

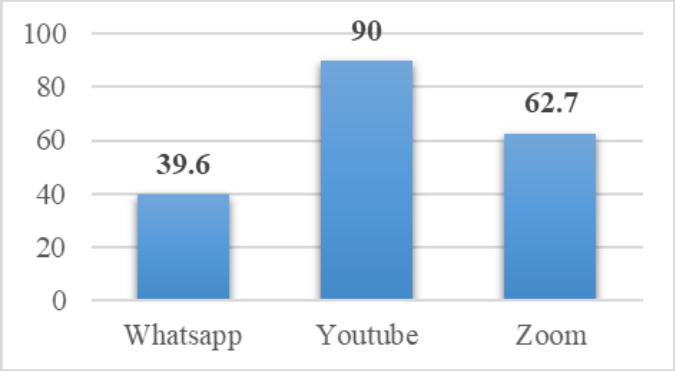

Figure 1. Average Statistical Skills of Students Taught Using Three Online Learning Platforms

Based on Figure 1 above, it can be seen that the highest average statistical skill is those who use YouTube in online learning for Statistics courses during COVID-19 pandemic. The lowest average statistical skill is using WhatsApp. Meanwhile, the survey data related to student responses after being taught using the three online-learning platforms can be seen in the Figure 2 below:

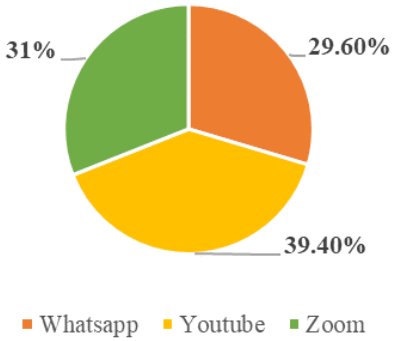

Figure 2. Student Responses after Being Taught Using WhatsApp, YouTube, and Zoom Meetings as Online-Learning Platforms

Based on Figure 2 above, it was found that out of the 69 students who were taught using the three online learning platforms (WhatsApp, YouTube, and Zoom Meetings) as many as 39.4% said they liked YouTube in online learning for Statistics courses, 29.6% liked WhatsApp, and 31% liked Zoom Meetings.

2. Discussion

This research process uses three types of online platforms, namely WhatsApp, YouTube, and Zoom Meetings and each has its own relative merits. There are disparities in the progress of students' statistical abilities based on statistical calculations using the three online learning platforms (YouTube, WhatsApp, and Zoom Meetings). Table 3 shows that there are no significant differences in the students' early statistical skills (pre-test data) across the three groups. Meanwhile, the Asymp.Sig test was 0.000 < 0.05 in the post-test data analysis using the Kruskal-Wallis test, indicating that a significant difference existed between the three groups. The difference in increasing students' statistical abilities in the three uses of online learning platforms is based on the characteristics and advantages possessed by each of these online learning platforms.

The advantage of YouTube is that video contents can be watched repeatedly without having them saved to storage memory. The advantage of Zoom Meetings is that the users can interact directly with each other during video conferences. The advantage of WhatsApp is that it can make video calls, send messages, videos, and other types of files. The researchers when using WhatsApp during the online learning sent materials in the form of .ppt type file then conduct a discussion during the ongoing lesson schedule. However, students are not triggered to be actively discussing the material in WhatsApp group column. Weakness by weakness in using WhatsApp as online-learning platform then was found. The teaching actor could not confirm who had studied the material provided. As the files sent by the teacher are stored in the storage memory, the user must delete contents if the memory is full. Video calls on WhatsApp are limited to a few users. When the lecturer asked the students about the previous material, some of them said they had forgotten, and complained that they could not repeat the lesson because the material had been deleted to free up a full storage area. This is a separate reason why the learning process carried out through WhatsApp is not effective for a long time. The full use of WhatsApp can only be used as a platform of discussion to ensure if the students have understood the learning material. Suana et al, (2019) explained that all online activities on WhatsApp are stored in one chat place, so students and lecturers will find it difficult if the learning process is completely carried out in one chat application. Learning materials that are prone to being lost or deleted if the storage capacity of the smartphone is full will result in students losing focus in studying the material provided. Naidoo & Kopung (2016) added that it is a challenge to discuss mathematics through short message applications such as WhatsApp, where this application is only limited to 140 characters and can write a text message once, so students and lecturers will be challenged by the length of the message on the WhatsApp application and the simplicity of the language used written. In addition, the difficulty of writing mathematical symbols through WhatsApp is also a difficulty in implementing WhatsApp as online-learning platform.

Slightly different from learning with YouTube as online-learning platform. Researchers created their own YouTube channel so that the contents are trustworthy as they came from the researchers themselves. The next step was to share it with students to be watched and studied together. The way to control if the students watched it is to ask them to subscribe, like and comment on the learning video content first, just so there will be a notification from YouTube on the teacher's account on how many views and subscribers and by that means the teaching actors are able to match the number of students. Teachers can also provide stimulus to students to make sure if there are still some students who have not watched the material. Interestingly, during research using YouTube, students actively asked what was not understood in the video. They could also swiftly repeat the video in case of discussing previous meetings on the lecturer's YouTube channel. In addition, the video materials do not add up storage so there's no action of deleting files need and worry of having full storage.

They can also play the video over and over again anytime and anywhere. The results obtained are strengthened by Subhi et al (2020) which explained that YouTube is an effective and efficient online learning platform used in online-based mathematics learning. Research conducted by Tisdell & Loch (2017) also strengthens the research results obtained by the researchers. Tisdell obtained the results that 71% of students chose to use online-based learning videos presented on YouTube as a learning medium. In addition, it was also found that more than 96% of students agreed that the use of learning videos was effective in helping them understand the learning material. Learning mathematics through YouTube has also been proven to strengthen students' online experience; in accordance to the opinion of Lazarus & Roulet (2013) that through the use of YouTube as learning-based videos, students can increase their commitment as well as desire to be more creative especially in scope of mathematics.

Not much different from YouTube experience also carried out using Zoom Meetings. Researchers conduct video conferences during teaching hours, shared screens in the form of .ppt learning materials, and explained them by writing on the monitor screen using a stylus pen – just like writing on a whiteboard during face-to-face learning process. Interesting in terms of facilities, but it only provides free access for 45 minutes; more than that the video conference will be automatically disconnected. This video conference requires fairly high internet data, and strong network stability since it will cause interference and discomfort during video conferences if the network is not stable. It is different from YouTube where students can download it first to watch offline so it doesn't consume a lot of internet data. During the research, there were several obstacles, namely during the first week of the research, the laptops tend to freeze and took a few minutes to repair. Some students with clashed schedules between work and class could not attend the video conference meetings. However, even so, the use of Zoom Meetings provides its own advantages, namely students can freely discuss with lecturers and other fellow students directly. Discussions are not limited to just writing short messages like in WhatsApp. Through video conferences using Zoom Meetings, interactions between students and lecturers, as well as between students can be carried out. The findings when using WhatsApp for discussions in WhatsApp Group are contrary to the effectiveness of communication that is established through the use of Zoom Meetings. Below is a display of the forms of learning carried out by researchers through the three platforms.

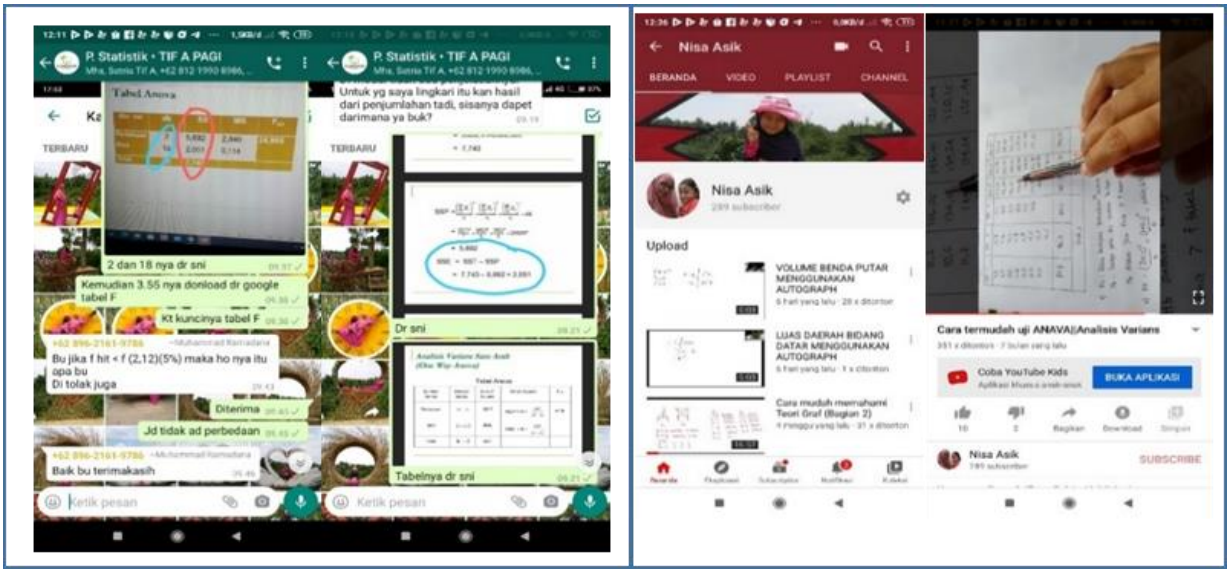

Figure 3. Learning using WhatsApp and YouTube

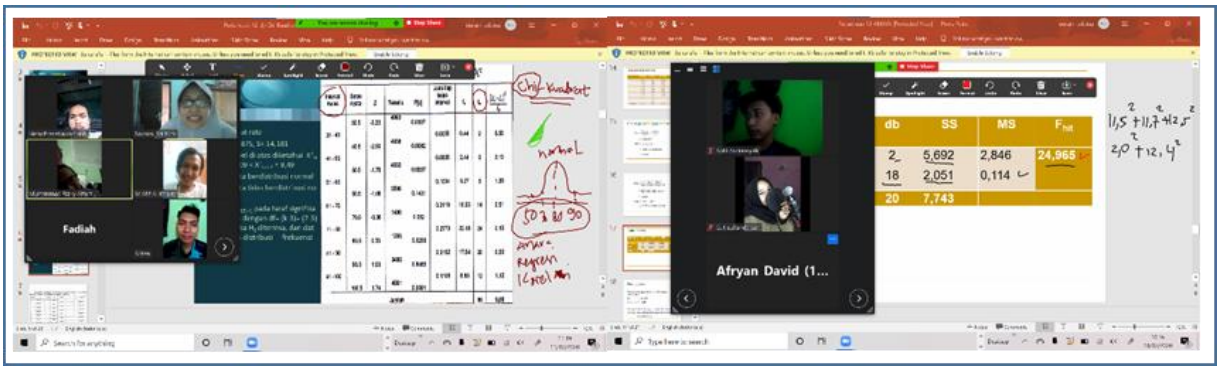

Figure 4. Learning using Zoom Meetings

Figure 3 and Figure 4 obtained by researchers using Zoom Meetings in online learning are also strengthened by the results obtained by Lathifah & Lestari (2020) where Zoom Meetings provide improvements related to students' communication skills, especially in terms of learning mathematics. In addition, Zoom Meetings has also been proven to support the learning assessment process using form links that can be provided in the chat feature when learning ends by using additional form links, such as google forms, type forms, or other online forms. Direct assessment with the help of this link form also serves to determine the communication skills and cognitive skills of each student. However, using Zoom Meetings also requires a lot of internet data. This makes using this platform a challenge for both lecturers and students. This is in accordance with the results of research conducted by Pratama, et al (2020) where Zoom Meetings requires a bandwidth of around 700 kbps but is still more efficient than other video-conferencing platforms, such as Skype, Hangouts, and Webex (McHugh et al., 2012).

Respondents who like YouTube better state that in YouTube, the explanation is easier to understand, it allows them to multitask – working while studying, it has clear and good quality picture and sound, the contents can be played repeatedly if the material is not yet understood without having it adding the cell phone's storage. This is supported by research by DeWitt, et al., (2013) which suggests YouTube, as a Web 2.0 tool, can be used to generate knowledge through observation and social interaction. YouTube has the potential to be used as a learning tool (DeWitt et al., 2013), and YouTube is also an educational tool (Kanematsu et al., 2016). From the results of data analysis and questionnaires, it can be concluded that YouTube is the most innovative and preferred platform for students in understanding online statistical learning, this is supported by research by Choi & Behm-Morawitz (2017) which stated that videos presented on YouTube can motivate students to learn due to clear sound and picture provision and can be designed as good as possible. Therefore, the results of this study are appropriate and significant where the use of an effective and efficient online-learning platform is YouTube platform, compared to WhatsApp and Zoom Meetings, seen from the results of interviews, questionnaires, tests as tools to compare the use of the online-learning platforms, to the results of previous research.

D. CONCLUSION AND SUGGESTIONS

From the results of the following research, several conclusions have been obtained. First, there are significant differences in student statistical skills between those using WhatsApp, YouTube, and Zoom Meetings in online learning during the COVID-19 pandemic; the average statistical skills of students using YouTube during online learning is the highest. The statistical skills of students who use YouTube during online learning is better than those who use Zoom Meetings and WhatsApp. The statistical skills of students who use Zoom Meetings during

online learning is better than WhatsApp. Student responses are very good for using YouTube when learning online. The most preferred platform for students to learn statistics online is YouTube.

Based on the research results obtained, it is hoped that future researchers will develop similar research. Further research can be developed by increasing and uniform the number of samples used for each sample group. Future researchers can also make changes in terms of the type of mathematical skills improvement and different types of samples, e.g. elementary, junior high, or high school level.

REFERENCES

Al-Rahmi, W. M., Othman, M. S., Yusof, L. M., & Musa, M. A. (2015). Using social media as a tool for improving academic performance through collaborative learning in Malaysian higher education. *Review of European Studies*, *7*(3), 265–275. https://doi.org/10.5539/res.v7n3p265

Alabdulkareem, S. A. (2015). Exploring the Use and the Impacts of Social Media on Teaching and Learning Science in Saudi. *Procedia - Social and Behavioral Sciences*, *182*, 213–224. https://doi.org/10.1016/j.sbspro.2015.04.758

Albahlal, F. S. (2019). The Impact of YouTube on Improving Secondary School Students' Speaking Skills: English Language Teachers' Perspectives. *Journal of Applied Linguistics and Language Research*, *6*(2), 1–17. http://www.jallr.com/~jallrir/index.php/JALLR/article/view/971

Aridor, K., & Ben-Zvi, D. (2018). Statistical modeling to promote students' aggregate reasoning with sample and sampling. *ZDM* , *50*(7), 1165–1181. https://doi.org/10.1007/S11858-018-0994-5

Cetinkaya, L. (2017). The Impact of Whatsapp Use on Success in Education Process. *International Review of Research in Open and Distributed Learning*, *18*(7), 59–74. https://doi.org/10.19173/irrodl.v18i7.3279

Choi, G. Y., & Behm-Morawitz, E. (2017). Giving a new makeover to STEAM: Establishing YouTube beauty gurus as digital literacy educators through messages and effects on viewers. *Computers in Human Behavior*, *73*, 80–91. https://doi.org/10.1016/j.chb.2017.03.034

Conway, B., Gary Martin, W., Strutchens, M., Kraska, M., & Huang, H. (2019). The Statistical Reasoning Learning Environment: A Comparison of Students' Statistical Reasoning Ability. *Journal of Statistics Education*, *27*(3), 171–187. https://doi.org/10.1080/10691898.2019.1647008

Crescente, M. L., & Lee, D. (2011). Critical issues of m-learning: Design models, adoption processes, and future trends. *Journal of the Chinese Institute of Industrial Engineers*, *28*(2), 111–123. https://doi.org/10.1080/10170669.2010.548856

Dashraath, P., Wong, J. L. J., Lim, M. X. K., Lim, L. M., Li, S., Biswas, A., Choolani, M., Mattar, C., & Su, L. L. (2020). Coronavirus disease 2019 (COVID-19) pandemic and pregnancy. *American Journal of Obstetrics and Gynecology*, *222*(6), 521–531. https://doi.org/10.1016/j.ajog.2020.03.021

delMas, R. C. (2002, January). *Statistical Literacy, Reasoning, and Thinking: A Commentary*. Journal of Statistics Education. https://doi.org/10.1080/10691898.2002.11910674

DeWitt, D., Alias, N., Siraj, S., Yaakub, M. Y., Ayob, J., & Ishak, R. (2013). The Potential of Youtube for Teaching and Learning in the Performing Arts. *Procedia - Social and Behavioral Sciences*, *103*, 1118–1126. https://doi.org/10.1016/j.sbspro.2013.10.439

Duncan, I., Yarwood-Ross, L., & Haigh, C. (2013). YouTube as a source of clinical skills education. *Nurse Education Today*, *33*(12), 1576–1580. https://doi.org/10.1016/j.nedt.2012.12.013

Elliott, A. C., & Hynan, L. S. (2011). A SAS® macro implementation of a multiple comparison post hoc test for a Kruskal-Wallis analysis. *Computer Methods and Programs in Biomedicine*, *102*(1), 75–80. https://doi.org/10.1016/j.cmpb.2010.11.002

Fadillah, A., Nopitasari, D., & Pradja, B. P. (2020). Blended Learning Model During the Covid-19 Pandemic: Analysis of Student's' Mathematical Disposition. *JTAM (Jurnal Teori Dan Aplikasi Matematika)*, *4*(2), 173–181. https://doi.org/10.31764/jtam.v4i2.2582

García-Cuenllas Álvarez, L., Gutiérrez-Larraya Aguado, F., Maroto Álvaro, E., Rodríguez-López Domingo, A., Sánchez Fernández, P. L., García-Guereta Silva, L., & Lorente Toledano, F. (2020). Reference values (Z-score) of inlet and trabecular portion diameters of the right ventricle: First description in Spanish healthy children. *Anales de Pediatria*, *92*(3), 147–155.

https://doi.org/10.1016/j.anpedi.2019.05.004

Hassannejad, S., Porheidar Ghafarbi, S., & Lotfi, R. (2020). The effect of nicosulfuron and bentazon on photosynthetic performance of common cocklebur (Xanthium strumarium L.). *Environmental and Sustainability Indicators*, *6*(January), 100026. https://doi.org/10.1016/j.indic.2020.100026

Hertzog, P. E., & Swart, A. J. (2018). The use of WhatsApp in design-based modules. *IEEE Global Engineering Education Conference, EDUCON*, *2018-April*, 445–450. https://doi.org/10.1109/EDUCON.2018.8363264

Hidayatullah, A., & Suprapti, E. (2020). The Affect of The Internet and Social Media: Mathematics Learning Environment Context. *IOP Conf. Series: Earth and Environmental Science 469*, 012080. https://doi.org/10.1088/1755-1315/469/1/012080

June, S., Yaacob, A., & Kheng, Y. K. (2014). Assessing the Use of YouTube Videos and Interactive Activities as a Critical Thinking Stimulator for Tertiary Students: An Action Research. *International Education Studies*, *7*(8). https://doi.org/10.5539/ies.v7n8p56

Kanematsu, H., Ogawa, N., Shirai, T., Kawaguchi, M., Kobayashi, T., & Barry, D. M. (2016). Blinking Eyes Behaviors and Face Temperatures of Students in YouTube Lessons-For the Future E-learning Class. *Procedia Computer Science*, *96*(September), 1619–1626. https://doi.org/10.1016/j.procs.2016.08.209

Kauffman, L., Weisberg, E. M., Eng, J., & Fishman, E. K. (2021). YouTube and Radiology: The Viability, Pitfalls, and Untapped Potential of the Premier Social Media Video Platform for Image-Based Education. *Academic Radiology*, *January*, 1–2. https://doi.org/10.1016/j.acra.2020.12.018

Kitta, M. I., Ismiarto, Y. D., Saleh, M. R., Sakti, M., Abidin, M. A., & Putra, L. T. (2020). Analysis of radiological alignment and functional outcomes of pediatric patients after surgery with displaced supracondylar humerus fracture: A cross-sectional study. *International Journal of Surgery Open*, *24*, 136–142. https://doi.org/10.1016/j.ijso.2020.05.011

Kustiyani, A., W, S. S., & Suad. (2021). Implementation problem based learning model using zoom meeting application. *Journal of Physics: Conference Series 1823*, 012077. https://doi.org/10.1088/1742-6596/1823/1/012077

Lathifah, N. D., & Lestari, W. (2020). Needs Analysis on Zoom Meeting-Based Learning in Enhancing Elementary Students' Mathematic Communication Skill. *Proceeding International Conference on Islamic Education "Innovative Learning Designs to Empower Students in Digital Works" Volume 5*, 181–185.

Lawson, T. J., Schwiers, M., Doellman, M., Grady, G., & Kelnhofer, R. (2003). Enhancing Students' Ability to Use Statistical Reasoning with Everyday Problems. *Teaching of Psychology*, *30*(2), 107–110. https://doi.org/10.1207/S15328023TOP3002_04

Lazarus, J., & Roulet, G. (2013). Creating a YouTube-Like Collaborative Environment in Mathematics: Integrating Animated GeoGebra Constructions and Student-Generated Screencast Videos. *European Journal of Contemporary Education*, *4*. https://homeworkhelp.ilc.org/

Lepak, J. R., Wernet, J. L. W., & Ayieko, R. A. (2018). Capturing and characterizing students' strategic algebraic reasoning through cognitively demanding tasks with focus on representations. *Journal of Mathematical Behavior*, *50*, 57–73. https://doi.org/10.1016/j.jmathb.2018.01.003

Mahr, A., Cichon, M., Mateo, S., Grajeda, C., & Baggili, I. (2021). Zooming into the pandemic! A forensic analysis of the Zoom Application. *Forensic Science International: Digital Investigation*, *36*, 301107. https://doi.org/10.1016/j.fsidi.2021.301107

Masrul, Abdillah, L. A., Tasnim, Simarmata, J., Sulaiman, D. O. K., Prianto, C., Agung, M. I. P., Febrianty, & Saputra, D. H. (2020). *Pandemik COVID-19 Persoalan dan Refleksi* (T. Limbong (ed.); 1st ed.). Yayasan Kita Menulis.

Mayo, I., Manivannan, S., Bisson, J., Leach, P., & Zaben, M. (2021). YouTube as a neurosurgical training tool for the insertion of external ventricular drain. *Interdisciplinary Neurosurgery: Advanced Techniques and Case Management*, *24*, 101079. https://doi.org/10.1016/j.inat.2020.101079

Mbuli, N., Mendu, B., Seitshiro, M., & Pretorius, J. H. C. (2020). Statistical analysis of forced outage durations of Eskom subtransmission transformers. *Energy Reports*, *6*(2020), 321–329. https://doi.org/10.1016/j.egyr.2020.11.235

McHugh, J. E., Wherton, J. P., Prendergast, D. K., & Lawlor, B. A. (2012). Teleconferencing as a source of social support for older spousal caregivers: Initial explorations and recommendations for future

research. *American Journal of Alzheimer's Disease and Other Dementias*, *27*(6), 381–387. https://doi.org/10.1177/1533317512453491

Mulyana, D., Taufan, M., & Nurafifah, L. (2021). Improved Math Connection Skills Through Online Learning Using MATH-UNWIR. *JTAM (Jurnal Teori Dan Aplikasi Matematika)*, *5*(1), 171–181. https://doi.org/10.31764/jtam.v5i1.3828

Naidoo, J., & Kopung, K. J. (2016). Exploring the Use of WhatsApp in Mathematics Learning: A Case Study. *Journal of Communication*, *7*(2), 266–273.

Navarro-Ibarra, L., García-Santillán, A., Cuevas-Salazar, O., & Ansaldo-Leyva, J. (2017). *Mathematics, technology and learning: How to align these variables in order to explain anxiety towards mathematics and attitude towards the use of technology for learning mathematics*. Eurasia Journal of Mathematics, Science and Technology Education; Modestum LTD. https://doi.org/10.12973/eurasia.2017.01060a

Negara, H. R. P., Santosa, F. H., & Ibrahim, M. (2019). Mengidentifikasi dan Mengembangkan Kemampuan Penalaran Statistis. *MES: Journal of Mathematics Education and Science*, *5*(1), 29–41. https://jurnal.uisu.ac.id/index.php/mesuisu

Oktaviani, M. A., & Notobroto, H. B. (2014). *Perbandingan Tingkat Konsistensi Normalitas Distribusi Metode Kolmogorov-Smirnov, Lilliefors, Shapiro-Wilk, dan Skewness-Kurtosis*. Jurnal Biometrika Dan Kependudukan.

Pertiwi, C. M., Rohaeti, E. E., & Hidayat, W. (2020). The Students' Mathematical Problem-Solving Abilities, Self-Regulated Learning, and Vba Microsoft Word in New Normal: a Development of Teaching Materials. *Infinity Journal*, *10*(1), 17. https://doi.org/10.22460/infinity.v10i1.p17-30

Pratama, H., Azman, M. N. A., Kassymova, G. K., S, S., & Duisenbayeva. (2020). The Trend in Using Online Meeting Applications for Learning During the Period of Pandemic COVID-19: A Literature Review. *Journal of Innovation in Educational and Cultural Research*, *1*(2), 58–68. https://doi.org/10.46843/jiecr.v1i2.15

Rady, E. H. A., Mohamed, S. M., & Abd Elmegaly, A. A. (2018). Statistical analysis of the count and profitability of air conditioners. *Data in Brief*, *19*, 413–423. https://doi.org/10.1016/j.dib.2018.05.035

Ramadhani, R., Bina, N. S., Sihotang, S. F., Narpila, S. D., & Mazaly, M. R. (2020). Students' critical mathematical thinking abilities through flip-problem based learning model based on LMS-google classroom. *Journal of Physics: Conference Series 1657*, *1657*(1), 12025. https://doi.org/10.1088/1742-6596/1657/1/012025

Ramadhani, R., & Fitri, Y. (2020). A Project-based learning into flipped classroom for ePUB3 electronic mathematics learning module (eMLM)-based on course design and implementation. *Universal Journal of Educational Research*, *8*(7), 3119–3135. https://doi.org/10.13189/ujer.2020.080740

Ramadhani, R., & Narpila, S. D. (2018). Peningkatan Kemampuan Berpikir Statistik Melalui Problem-Based Learning Berbudaya Lokal pada Siswa Kelas XI SMA YPK Medan. *Jurnal PARADIKMA*, *11*(1), 74–84.

Rizkan, A. M., Mukhaiyar, & Refnaldi. (2018). The Effect of Using YouTube as A Teaching Media on the Students' Listening Skill (The Case of 2nd Semester Students of English Education Study Program of IKIP PGRI Pontianak). *Advances in Social Science, Education and Humanities Research, Volume 301*, 286–291.

Rosenberg, H., & Asterhan, C. S. C. (2018). "WhatsApp, Teacher?" - Student Perspectives on Teacher-Student WhatsApp Interactions in Secondary Schools. *Journal of Information Technology Education: Research*, *17*, 205. https://doi.org/10.28945/4081

Safar, A., & Alkhezzi, F. (2016). Students' perspectives of the impact of online streaming media on teaching and learning at the college of education at Kuwait University. *Eurasia Journal of Mathematics, Science and Technology Education*, *12*(12), 2975–2989. https://doi.org/10.12973/eurasia.2016.02317a

Sari, W. N., Samosi, B. S., Sahara, N., Agustina, L., & Anit, Y. (2020). Learning Mathematics "Asyik" with Youtube Educative Media. *Journal of Physics: Conference Series 1477*, 022012. https://doi.org/10.1088/1742-6596/1477/2/022012

Suana, W., Distrik, I. W., Herlina, K., Maharta, N., & Putri, N. M. A. A. (2019). Supporting Blended Learning Using Mobile Instant Messaging Application: Its Effectiveness and Limitations.

International Journal of Instruction, *12*(1), 1011–1024. https://doi.org/10.29333/iji.2019.12165a

Subhi, M. A., Nurjanah, N., Kosasih, U., & Rahman, S. A. (2020). Design of distance lectures in mathematics education with the utilization of the integration of Zoom and YouTube application. *Journal of Physics: Conference Series 1663*, 12058. https://doi.org/10.1088/1742-6596/1663/1/012058

Suryati, K., & Gede Adnyana, I. (2020). Blended Learning Strategies of Telegram-Assisted Learning Towards Student Mathematics Learning Results Reviewed from Learning Style. *JTAM (Jurnal Teori Dan Aplikasi Matematika)*, *4*(2), 133–144. https://doi.org/10.31764/jtam.v4i2.2438

Szeto, E., & Cheng, A. Y. N. (2014). Exploring the Usage of ICT and YouTube for Teaching: A Study of Pre-service Teachers in Hong Kong. *Asia-Pacific Education Researcher*, *23*(1), 53–59. https://doi.org/10.1007/s40299-013-0084-y

Tisdell, C., & Loch, B. (2017). How useful are closed captions for learning mathematics via online video? *International Journal of Mathematical Education in Science and Technology*, *48*(2), 229–243. https://doi.org/10.1080/0020739X.2016.1238518

Trouche, L., & Drijvers, P. (2010). Handheld technology for mathematics education: Flashback into the future. *ZDM - International Journal on Mathematics Education*, *42*(7), 667–681. https://doi.org/10.1007/s11858-010-0269-2

Trujillo Loli, Y., D'Carlo Trejo Huamán, M., & Campos Medina, S. (2021). Telementoring of in-home real-time laparoscopy using whatsapp messenger: An innovative teaching tool during the COVID-19 pandemic. A cohort study. *Annals of Medicine and Surgery*, *62*(January), 481–484. https://doi.org/10.1016/j.amsu.2021.01.085

Yousif Abdelraheem, A., & Mohammed Ahmed, A. (2018). The impact of using Mobile Social Network Applications on Students' Social-Life. *International Journal of Instruction*, *11*(2), 1–14. https://doi.org/10.12973/iji.2018.1121a

Zhang, D., & Liu, L. (2016). *How does ICT use influence students' achievements in math and science over time? Evidence from PISA 2000 to 2012*. Eurasia Journal of Mathematics, Science and Technology Education; Modestum LTD. https://doi.org/10.12973/eurasia.2016.1297a