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Human Cognitive: Learning Mathematics through Python Programming to Support Students' Problem-Solving Skills

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Programming languages have been used and developed in the field of education. Python programming was employed in this study. The goal of this study is to see whether there is an effect of using Pydroid in mathematics learning on students' problem-solving abilities and to see if this software satisfies or does not match the criteria for mathematics learning. This study was done on vocational students who give fresh learning experiences, improve problem-solving abilities, and acquire mathematics as structural from a clear explanation step by step. This study was developed as an experimental investigation using a descriptive form of research on 60 pupils. The use of Pydroid for studying mathematics demonstrates that students are assisting in the understanding of fundamental mathematical ideas. They study maths with Pydroid. Instead of counting on paper, Pydroid allows them to readily see words and/or numbers. This aids in the learning process, and Python programming can enhance the cognitive processes of mathematical problem-solving for DPIB 2 Session 2 and DPIB 3 sessions (1 and 2). Yet, in DPIB 2 Session 1 class with Sig. 0.242, it has no effect on mathematical problem-solving ability. Studying mathematics with Pydroid met has an impact on students' outcomes because by integrating students in mathematics learning, they comprehend the core concept. Students' activities on Pydroid can help them comprehend ideas and spark their enthusiasm in learning. It explicitly focuses students' attention on mathematics learning by utilizing Pydroid.

Keywords: Pydroid-3 IDE, learning mathematics, smartphone, students' attention, problem-solving

INTRODUCTION

Learning is a perpetual process which students must evolve a solid understanding of appropriate mathematics concepts and procedures (Abdolreza Lessani et al., 2016:166). Cognitive psychology is one of the triggers for students' factors in learning and understanding mathematics and well (Wahyudi & St. Budi Waluya, 2018:4). Zevenbergen (2004: 23) and Ojose (2008: 26-27) impugned that cognitive psychology fit out an urgent role in mathematics, uniquely in the cognitive development of student. Considering that learning in the world of education continues to grow, making teachers and students in learning begin to use technology to facilitate the delivery and activities of the learning and teaching process, in the era of the industrial revolution 4.0, the role of education is challenged to utilize technology. This can be felt by all levels, ranging from the world of education, offices, business, etc. during a pandemic.

Fourth Industrial Revolution technologies will create new ways to gain access to new sources of information (for example, news and market prices) and also new forms of education (World Economic Forum and Asian Development Bank Some rights reserved. 2017:7). The context of the 4th Industrial Revolution undoubtedly affects the field of education, where emerging digital technologies are coming

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to transform education and the current role of the teacher (George A. Panagiotopolos & Zoe A. Karanikola. 2020: 119). Computer technology as a tool, develop thinking skills, inclusive education, and helps them to become involved in complex issues, develop approaches to solve problems in group and individual accountability for increasing their learning. (Fakhteh Mahini, et al. 2012).

In this era, teachers are subject to making success in learning with integrated technology in the classroom. Teachers seek their professional growth and development in order to improve both students' learning and their own performance (Xing & Marwala, 2017). The existence of technology can be one way to improve the quality of education, student motivation, especially the quality of education in learning mathematics and can be cognitive tools to solve problems (Yurniwati & Soleh, 2020, Rais & Zhao, 2022) for instance, learning by using programming language technology. Programming languages are beginning to be transitioned into the world of education. Programming languages can be used as a tool to facilitate the teaching process by educators. In addition, it can be used by students to explore more knowledge. If the teachers are able to use this programming language well, then students' interests and quality of education will improve.

Students and teacher use programming languages to learn mathematics, which transitions mathematics into programming languages so that the results and illustrations learned can be presented accurately. However, the difficulties in the teaching process of programming occur from teaching perspectives, concerning aspects such as motivation and technical issues. To address these challenges, teaching programming should follow an effective teaching sequence, which offers students a simple language, and choose various problems to solve (Saeli, M. et al., 2011). Thus, there is a need for more educators to apply diverse teaching methods to provide meaningful programming learning to students. By applying learning innovations that are livelier with programming languages, learning in the classroom will be more fun. Students will also be more enthusiastic about receiving the subject matter.

Python Programming in Learning Mathematics

In this study, the programming language is Python. Python programming is a general-purpose programming language (Irv Kalb, 2016). Python programming is a powerful tool for mathematical calculations. This program was chosen for their ease of use and suitability for solving science problems (Charles J. Weiss, 2021:489; Wilver Auccahuasi, 2018:71) and also because this program can be accessed on smartphones or laptops/PCs and is available for free. Students can use the Python programming version mobile user named Pydroid, so in this study, student use Pydroid on their smartphones as a representative of using Python programming in PC/laptops. Doing mathematics makes learning both programming and math more exciting, fun, and rewarding (Amit Saha. 2015). "During learning, information must be held in working memory until it has been processed sufficiently to pass into long-term memory and working memory's capacity is very limited (Anderson, J. R, 1986)." Studying with Python program makes the learners learn mathematics as structural from a clear explanation step by step.

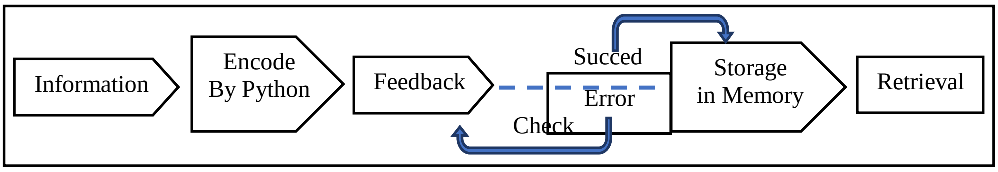


Figure 1
Learning through Python Programming Model

Mathematical Problem Solving

In the learning process, we are always faced with solving the problems. Therefore, mathematics teachers should show students how to solve problems (Lester, 2013). When students are given a learning process that includes problem solving skills, they will be able to face problems in various areas of their lives. The problem solving process begins with the transfer of information simultaneously from memory to the human brain (Aydoğan and Özyürek, 2020). The best points of applying problem solving to learning mathematics are that it supports making connections across disciplines; prepares students for future professional opportunities; develops students' positive mathematical identity; is a matter of equity and access; builds students' confidence, persistence, flexibility, creativity, perseverance, and curiosity; gives students voice and promotes discussion; shifts math authority to students; and has a positive effect on learning. (NCTM 2000; 2014, 2018, 2020a, 2020b)

According to NCTM (2010), the term "problem solving" refers to mathematical tasks that have the potential to provide intellectual challenges for enhancing students' mathematical understanding and development. Worthwhile problems include problems that are truly problematic and have the potential to provide contexts for students' mathematical development. There are indicators of mathematical problem solving such as Understand the problem; Create the plan; Doing a plan; and Recheck the solution. According to Greeno 1973 (in Nwaodo & Oluwatimilehin, 2020) problem solving model is highly innovative, activity based and student-centered, which helps the students to acquire appropriate problem-solving skills and offers students the opportunities to work at different levels of basic technology abstractions (Nwaodo & Oluwatimilehin, 2020). The key to solving a problem is to translate the problem statement into a mental representation of the base type of mathematical situation that is embedded in the problem (Kintsch and Greeno's (1985) in Koning et al, 2022).

Table 1
Polya Problem Solving Strategy

Indicator	Description
Understand the problem	Identifying the known aspects of a problem, mentions the questions asked based on the given problem, and connect the issues with other mathematical topics
Devise the plan	Make the mathematical problem based on problem, show mathematical concepts that would be used to solve the problem.
Carry out the plan	Analyze the process based on a plan and find the answer
Looking back	Check the accuracy of answers of problem solving

(Lee, 2015 and Nurkaeti, 2018)

METHODS

This study is designed as experimental research chosen quantitative research with descriptive research type, in which descriptive analysis presents facts systematically so that it can be easier to understand and conclude. The conclusions given are always clear on the factual basis so that everything can always be returned directly to the data obtained. Descriptive research aims to find basic answers about cause and effect, by analyzing the factors that cause the occurrence or emergence of a certain phenomenon.

Participants

This experiment was done in Vocational State School 2 Pekanbaru, subject of this experiment is students in Design Graphics and Building (DPIB) grade XI. This experiment starts from January to March 2022 with partial sessions (session 1 and 2) in different schedule. Ideally, a sample is selected that is representative of a population (Patrick Dattalo, 2008:3). The sample for this study came from students in grade eleventh majoring DPIB (class B and C) with total sample is 60 students.

Table 2
List of participating XI DPIB

Class	Session 1	Session 2
B	14 students	15 students
C	15 students	16 students

Note: Session 1: Attendee in odd week; Session 2: Attendee in even week.

Data Collection and Analysis

In this study, students were given pre-test and post-test activities to determine mathematical problem-solving skills. The pre-test activity was carried out at the beginning of the meeting by giving a test of four questions that could measure mathematical problem solving and the same number of questions in the post-test activity were given to students after students were given treatment by learning using Python programming. At the end of the research activity, the questionnaire was distributed to determine the effect of learning through Python programming on student's satisfaction towards the teaching and learning process. The questionnaire consists of 21 items to measure their attitudes towards learning through Python programming.

Data analysis in this study includes descriptive analysis for the implementation of learning using Python programming and it is on the impact of using python programming on students' mathematical problem solving before and after learning. By using the indicator score of the mathematical problem-solving framework, data was carried out (pre and post-test), in the parametric test analysis of variance was carried out to determine the effect that occurred using SPSS 25.

FINDINGS AND DISCUSSION

The data in this study includes data on students' mathematics learning outcomes through Pydroid. The data obtained from the results of students' answers when answering problem solving questions that have four indicators, they are; understand the problem, creating the plan, doing a plan, and rechecking the solution.

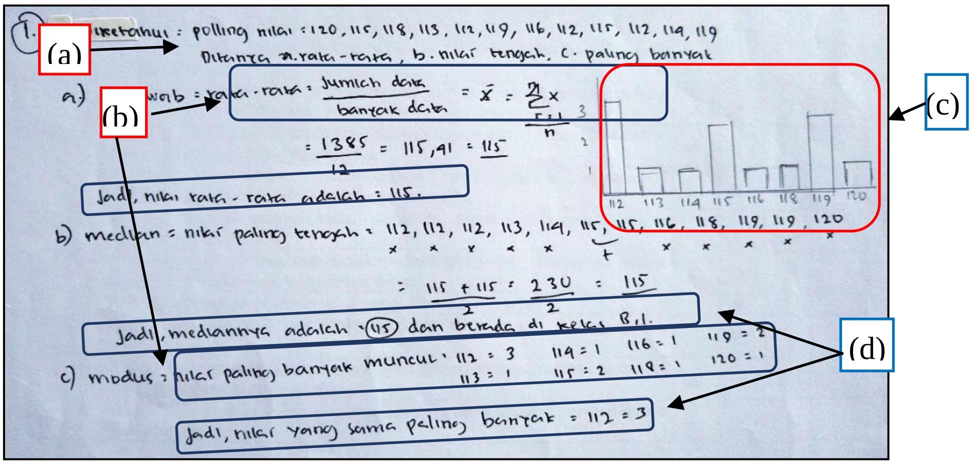


Figure 2
An illustrative work sample in solving problem

Based on problem solving indicators, illustrate that: (a) In identifying or understanding the problem, student can identify what is known and what needs to be determined from provided data. In this indicator, he understood the problem from the identifying question. Student(s) (b) creates the plan by writing the formula from what to determine in devising a plan indicator. Student writes the formula for mean, median, and mode by symbols and/or words and also collects data. After the student creates the plan, he (c) carries out the plan by doing some operational mathematics respectively and the last is (d) looking back at the result. In this indicator, student writes “therefore” at the end of solution and sign of “//” which means that this is the last answer and work is done. The awarding of points is found on the left-hand assessment grid sheet. The assessment of the results of problem-solving abilities is grouped based on the four indicators in range of 0 – 3 on the understood the problem, in range of 0 – 2 on the devise a plan, in range of 0 – 3 on carry out the plan, and in range of 0-1 on looking back the results.

Problem solving consists of four questions. In these four questions, there are routine and non-routine questions. Routine questions are general questions that are usually found in the student's book or worksheet and are given to students as an introduction to questions about a concept they are learning. There is one question in this routine. Non-routine questions are questions that are developed from routine questions and are rarely presented in the student's book or worksheet. This non-routine question is given the extent to which students understand a subject matter that has been studied. There are three non-routine questions. Non-routine questions are very good given to students because they will provide mathematical problem-solving ability so that students can explore their insights into mathematics and can use mathematics in social life.

The problems given to students using learning through Pydroid must be tested to answer the question, is this problem-solving problem valid and reliable so that it can be used as a tool to measure students' mathematical problem-solving abilities in statistical material. The following are the results of the validity test and problem-solving reliability test. A validity analysis was carried out using the product moment correlation. There are 21 items that have been conducted validity test. The results show that all items are validated with $r_{xy} > r_{table} = 0.367$ and with 0.894 reliable. It shows that the questions are feasible and can be used to measure mathematical problem solving in grade XI for statistics.

Based on the number of samples, it can be categorized as taking the Shapiro-Wilk normality test with $\alpha = 0.05$. Test of normality is 0.736 for class 2 and 0.129 for class 3 which is greater than α. This means that the data from the sample tested is normally distributed and Test of Homogeneity is 0.256 greater than α. After being declared to meet the criteria for parametric testing, a two-way ANOVA test was carried out to determine the effect of learning mathematics with Pydroid on the ability to solve mathematical problems and the interactions that affect it. To see if there is a difference in the average between the two samples that are related to each other in Table 3.

Table 3
Paired sample test

	Paired Differences									
				Std.	95% Confidence Interval of the Difference					
	Mean		Std. Deviation	Error Mean	Lower	Upper	T	df	Sig. (2-tailed)	Decision
PreB1 - PostB1	-8.750	26.724	7.142	-24.180	6.680	-1.225	13	.242		Reject H0
PreB2 - PostB2	-29.500	19.507	5.037	-40.303	-18.697	-5.857	14	.000		Accept H0
PreC1 - PostC1	-23.500	25.683	6.631	-37.723	-9.277	-3.544	14	.003		Accept H0
PreC2 - PostC2	-32.031	19.022	4.756	-42.167	-21.895	-6.736	15	.000		Accept H0

Based on the results of the t-test, significant values were obtained from the four subjects (DPIB 2 sessions 1 and 2 and DPIB 3 sessions 1 and 2). If the significant value $\leq$ 0.05 then there is a difference. In Pair 1 with degree of freedom (df) = 13 and tail probability (Sig-2tailed) = 0.025 found that $t_{count} < t_{table}$ or 1.225 < 2.16 then H_0 is accepted and rejected H1. Therefore, the students' outcome is not a significant difference while learning mathematics through Pydroid. In Pair 2 with df = 14 and a tail probability of 0.025 it is obtained that, $t_{count} > t_{table}$ or 5.857 > 2.15, then H_0 is rejected and H_1 is accepted. Therefore, the students' outcome is a significant difference while learning mathematics through Pydroid. In Pair 3 with df = 14 and a tail probability of 0.025 and t_{count} > ttable or 3.544 >

2.15, then H_0 is rejected and H_1 is accepted. Therefore, the students' outcome is a significant difference while learning mathematics through Pydroid. In Pair 4 with df = 15 and a tail probability of 0.025 and tcount > ttable or 6.736 > 2.13, then H0 is rejected and H1 is accepted. Therefore, the students' outcome is not a significant difference while learning mathematics through Pydroid.

In the results of the paired sample test, Pair 1 shows that there is no difference in students' mathematical problem-solving abilities using programming when applied in class. This is because there are several factors, namely the variability in the data was too high. The effect exists with the mean is 8,750, but the noise in the data swamped the effect in Pair 1 which was an unexpected internal obstacle in the learning process using programming such as some sick students.

The results of the paired sample test for Pair 2, Pair 3, and Pair 4 accept H_1 where there is an influence on students' outcomes by involving students in learning mathematics using Pydroid. In Pair 2, the mean difference between the pre-test and post-test is 29,500. Pair 3 has a mean difference of 23,500 and Pair 4 has the largest mean difference of 32,031. This facilitates the analysis of several different sample groups with minimal risk of error.

Table 4
Two-Ways Anova test

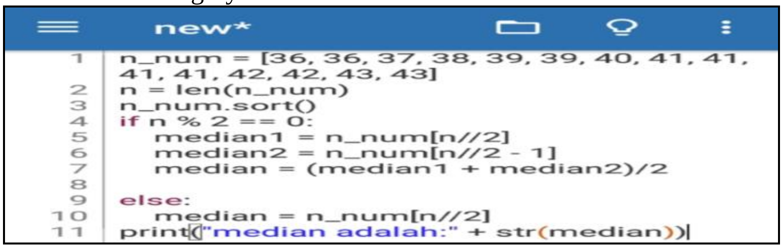
Tests of Between-Subjects Effects						
Dependent Variable: Score						
Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Decision
Corrected Model	959.479a	3	319.826	1.577	.205	
Intercept	309270.601	1	309270.601	1524.685	.000	
Session	99.881	1	99.881	.492	.486	Reject H0
Class	823.267	1	823.267	4.059	.049	Accept H0
Session * Class	23.385	1	23.385	.115	.735	Reject H0
Error	11359.167	56	202.842			
Total	323718.750	60				
Corrected Total	12318.646	59				
a. R Squared = .078 (Adjusted R Squared = .028)						

Students who have a study schedule in session 1 and 2 do not have a significant impact on the quality of student learning. This is indicated by Sig. (0.486) > α with f-value = 0.492. On the other hand, the four classes that received treatment had the same mathematical problem-solving abilities in terms of learning outcomes with Sig. (0.049) < α and f-value = 4.059. However, the interaction between the session and the class has no effect on the interaction between the two factors. Based on the above results, and by comparing significant levels, the decision to respond was made. (a). Students' capacity to solve mathematical problems is unaffected by their student group (Session 1 and 2). Consequently, the students' capacity for solving mathematics problems in classes XI DPIB leads in the same learning outcomes. It implies that the achievements of class XI DPIB students entering either session 1 or session 2 are unaffected by either choice; (b). Learning mathematics with a Python program has a result outside of the classroom. As long as students in DPIB B1, B2, C1, and C2 are exposed to both mathematics instruction and technology, their problem-solving skill will improve.

When compared to XI DPIB classes, there is a difference in the learning outcomes for students, while using Pydroid on a smartphone to learn produces superior outcomes. Additionally, it makes a big difference when teachers use Pydroid to teach their class. According to observations made during learning, the efficacy of student learning using Pydroid will be impacted by the number of students in learning if separated into two sessions (sessions 1 and 2); (c). When using the Python program to determine mathematical learning outcomes, there is no connection between students' entry and class sessions.

Pydroid does meet in Mathematics

When student learning to use worksheets, they well-understand and when student guided to learn mathematics through Pydroid they become enthusiastic to learn. The following are the results of student work using Pydroid.




```
1  n_num = [36, 36, 37, 38, 39, 39, 40, 41, 41,
   41, 41, 42, 42, 43, 43]
2  n = len(n_num)
3  n_num.sort()
4  if n % 2 == 0:
5     median1 = n_num[n//2]
6     median2 = n_num[n//2 - 1]
7     median = (median1 + median2)/2
8
9  else:
10    median = n_num[n//2]
11 print("median adalah:" + str(median))
```

Figure 3
An illustrative work sample of student learn through Pydroid

After student study with the next worksheet, they apply their knowledge that they have learned through Pydroid. In Figure 3, students use Pydroid to learn about medians. In median learning, students collect data on “the size of their classmates' shoes” and then write the data in a notebook. In line 1, students input shoe size data by giving the name n_num. in the next line students count the amount of data that is inputted by activating len() so that it will automatically determine the length of the data from the data that is inputted on Pydroid. Then sort the data by making sort(). From student activities to making commands in the form of len() and sort(), it provides information that the data from shoe sizes has been calculated how much the amount of data is and has been sorted from the smallest to the largest numbers with the program. If the number of data is odd, the student makes n % 2 == 0: and if the number of data is even, the student makes (n//2 + n//2 – 1)/ 2 which is shown in lines 5 to 7 with median = n_num [n//2]. This stage is a concept to understand the median for single data in statistics and the last step is print(), then students finish making coding flows to learn medians with Pydroid.

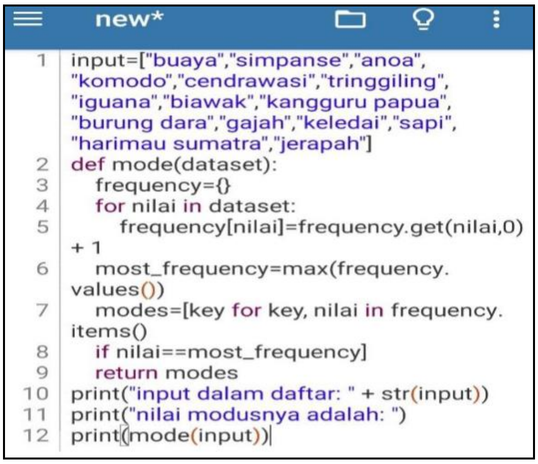
From the results of students' work in Figure 2, they learn mathematics connected to Pydroid. Mathematics does meet with Pydroid because; Understand the concept, from students' mathematics learning activities through Pydroid, students are helped to understand the basics of mathematical concepts. Students learn to look for relationships between concepts and their structures in mathematics lessons with Pydroid. Also, because students learn mathematics using smartphones, it allows them to easily visualize words or numbers instead of counting on the paper. Valero, A., et al. (2021) Abstractions help to strengthen the learning process, since they make students focus on specific aspects.

From the activities through Pydroid can improve student understanding on statistics concepts. By using Pydroid, it explicitly focuses on students' attention to the mathematical concepts within the programming commands in Pydroid. With symbols and concepts written on worksheets in Pydroid, it gives a mathematical intuition of basic concepts of computing (Simonot, M., Homps, M., and Bonnot, P (2012). So that students can understand the use of Pydroid including its programming language which relates statistics. When students create or debug a program in Pydroid, they practice solving problems. It is a great way to teach steps of solution by expressly and encourage students to find the solutions with mathematics. Students can assign activities such as count the length of data, sorted data, mean, median, and mode.

By coding, student can do it on Pydroid and get the desired output. It is the same with students doing problem solving activities that given on the worksheet. Students can understand each problem-solving procedure and solve problems given mathematically and problem-solving train student how to analyse problem situation and make decision based on analysis (Sari, et al. 2021). Although at first the students were confused with the coding that he did and the coding flow, the teacher gave instructions and finally understood it from the series of activities on the worksheet. This is in line with the learning outcomes of Wang, C., Vemula, S., & Frye, M (2020), students find ways to use codes to complete assignments, and the teacher presents different ways to code, then students compare each way and choose the codes optimal.

According to Kale et al (2018) a complete program that has an explanation explaining the key codes and their reasons can support the cognitive processes of these learners. As a result, 76.67% (46 students) stated that they were interested in learning mathematics with Pydroid. Because students can speak with their mind when they write code in Pydroid and this action can make them understand about the main concept of what they learned and it sees on students' outcome. It is similar to the study by Farid et al, 2021 which found the correlation between learning outcomes of mathematics and basic programming subjects. Some findings in this study by learning mathematics using Pydroid are students understand step-by-step statistical procedures and simultaneously manage information from identifying activities, creating a plan and code and then evaluating results. From this student activity, based on the results of the analysis on Table 7, the learning activities that have been carried out can stimulate the development of students' thinking progress to solve the problems they faced in terms of the results of the pre-test and post-test. Learn using Pydroid (Python programming in Android version) is the newest method in teaching and learning in Indonesia for students.

The indicators in solving problem, students understand the problem given. State the problem in their own words, identify the given and unknowns, and figure out what the problem tells is important. While students devise a plan, some of them make a diagram and write an equation then solve the problem. But many students skip to looking back. They think it is not really important to do it because they are confident with the problems that have been concluded and use the right formula. According to the four indicators, students did not well do in looking back, even though students answer correctly to the problems given at least they must consider whether the solutions made are logical and or make other alternative solutions so that they get the same answers so as to strengthen student understanding and ensure that students' answers are correct and can also make alternative solutions to the problems given.




```
input=["buaya","simpanse","anoa",
"komodo","cendrawasi","tringgiling",
"iguana","biawak","kangguru papua",
"burung dara","gajah","keledai","sapi",
"harimau sumatra","jerapah"]
def mode(dataset):
   frequency={}
   for nilai in dataset:
      frequency[nilai]=frequency.get(nilai,0)
+ 1
   most_frequency=max(frequency.
values())
   modes=[key for key, nilai in frequency.
items()
   if nilai==most_frequency]
   return modes
print("input dalam daftar: " + str(input))
print("nilai modusnya adalah: ")
print(mode(input))
```

Figure 4
An illustrative on students doing code in pydroid

In this study, the researcher gave a questionnaire to the students. This aims to determine the extent of the usefulness of Pydroid in learning mathematics. The following are the results of the calculation of student questionnaires on learning mathematics with Pydroid programming.

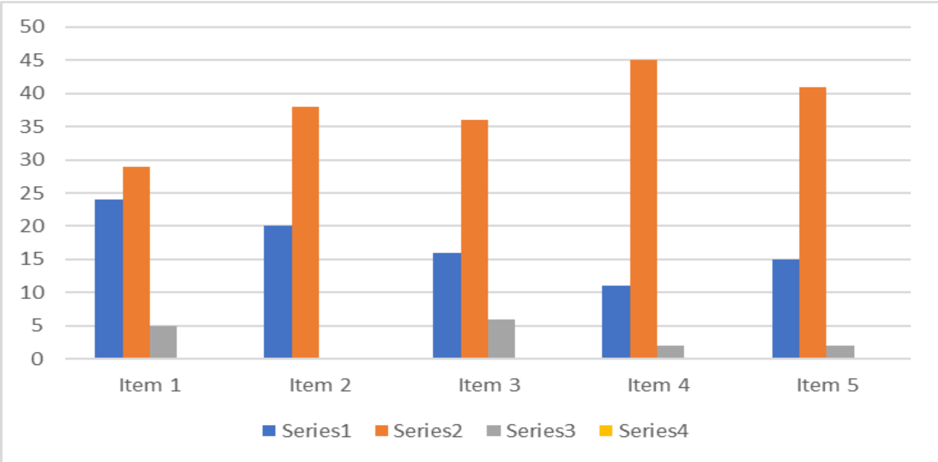


Figure 5
An illustrative presentmen Score 4 Score 3 Score 2 Score 1

The presentation aspect, 29.65% of the students strongly agree and 65.17% of the students agree that this Pydroid presentation aspect can be downloaded and run via a smartphone and python programming on Pydroid provides a clear description for each coding made. As many as 5.17% of the students stated that they did not agree that this aspect of Pydroid presentation could be downloaded and run via a smartphone and when programming on Pydroid made the student's smartphone screen black. This is caused by a full memory capacity. The solution given is for students to empty several files in smartphone memory so that there is sufficient storage space to download and run Pydroid on their smartphone.

This program works through a smartphone, does not require a lot of memory, and can be used without requiring internet data. Pydroid can be a learning tool for students in learning mathematics about statistics and understanding instructions in carrying out mathematical operations to help understand the concepts of mean, median, and mode during learning. This can be shown from the work of one of the respondents in running Pydroid.

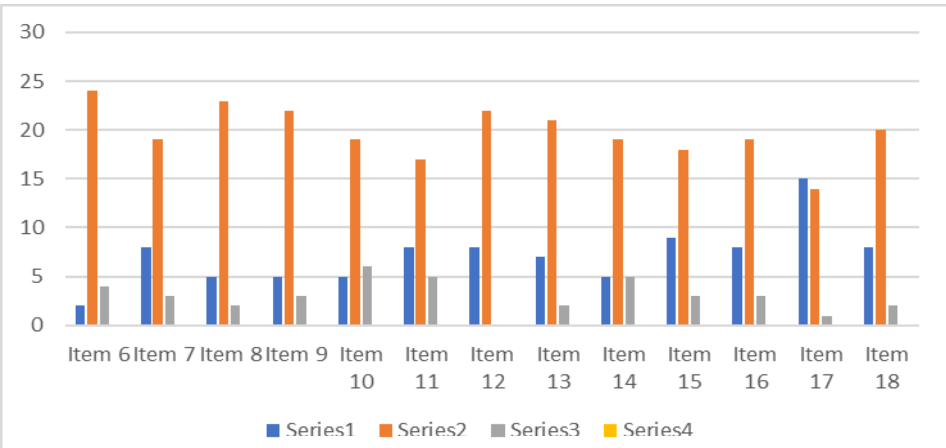


Figure 6
An illustrative material and content aspect

The terms of substance and content in Figure 5, the material covered is consistent with its application in the syllabus in the first semester of class XI. The questionnaire results show that 31.83% of students strongly agree and 62.60% agree that learning with Pydroid can be used as a tool to explain learning material, streamline time, increase student learning activities, and raise student interest in learning because learning is done in a new way, namely programming and using mobile phones.

Pydroid can be used as a communication medium for student learning since it helps students understand mathematical ideas. Learning to utilize Python programs can assist students learn concepts and norms in statistics and programming. If students get a notion wrong, it will interfere with the coding mechanism on Pydroid. Programming and mathematics education, like Misfeldt and Duun (2015), can be seen as true mathematics learning potentials in the sense that they entail epistemic mediations towards mathematical concepts. When learning to utilize Pydroid, students have the impression that no completion stage is skipped. This means that students comprehend every aspect of statistical information, from what is known to what is required and completed. Teachers serve as facilitators and informants in implementation efforts. As a result, learning to utilize programming can serve as a communication tool between professors and students as they are studying.

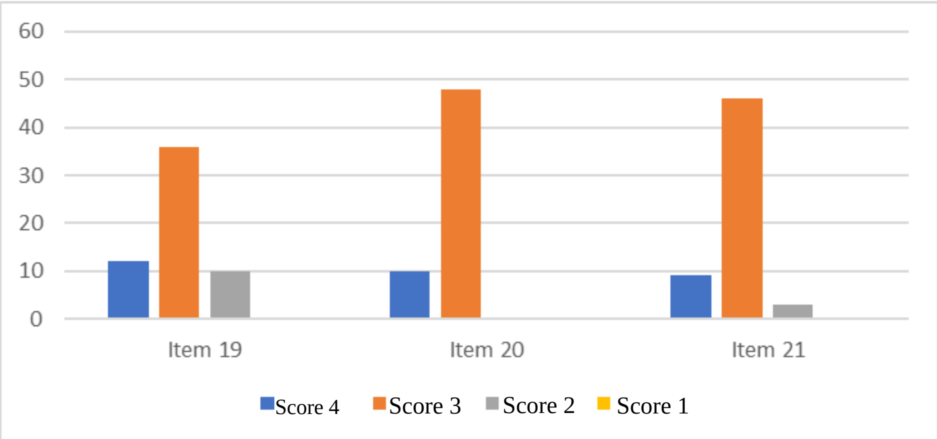


Figure 7
An illustrative view aspect

In the graphic-display aspect, 17.82% of students strongly agree and 74.71% of students agree that the shape and appearance of the letters in Pydroid are proportional, the background display does not reduce the clarity of writing and system errors in Pydroid can be traced from line (line by line). A total of 7.47% of students disagree because students have difficulty tracing errors in Pydroid. When students finish coding then students press play. If there is an error in entering a command or typing such as Len(), Sum(), Print(), etc, the result of the command will be an error. To see the error in the work, students have difficulty. The effect on student responses to learning mathematics using Python programming such as Pydroid is the student who is the sample in this study agrees that Pydroid can be a tool for interaction between teachers and students in learning mathematics. Students' cognitive results in learning experienced a significant increase of 8.75 in session 1 class DPIB B, 29.50 in session 2 class DPIB B, 23.50 in session 1 class DPIB C, and 32.03 in session 2 class DPIB C.

In the aspect of display, the output on Pydroid is small so that some students activate landscape mode on the cellphone layer. The appearance of the back layer can be adjusted according to color, black or white so that it does not reduce the clarity of writing. If there is an error output, the system will automatically show the location of the error that occurred, making it easier for students to observe the error part. In general, students often make errors in writing such as Len(), Sum(), Print(). This happens because the writing system on students' smartphone automatically uses capital letters at the beginning of writing. The solution to this error is, students re-check the writing and pay attention to the position of the error that occurs.

CONCLUSION

When used in conjunction with learning, such as learning mathematics, the programming language Python offers various benefits. Python programming is available via smartphone on Pydroid. The system functions the same as Python programming on a computer device in this portable version of the language. This study promotes instruction with the use of the Python programming language, or Pydroid, which is utilized on smartphones, as well as problem-solving activities and concept instillation in pupils. The activities conducted may be well welcomed by the students and provide as helpful information for the SMK mathematics teachers in running their classes. The study's findings suggested that Pydroid-assisted learning could assist learners become better problem solvers. Students are adept at comprehending statistical ideas and have the ability to comprehend and work through both routine and non-routine difficulties.

Students begin by acquiring data regarding the subject at question, including making known, inquiring, and solutions. For students, using a smartphone like Pydroid is a new experience. When learning how to use smartphones, this course offers students an impressive learning experience based on their responses. Students can understand conventional lessons, and the appeal comes when they apply that understanding to the programming language Pydroid by creating step-by-step coding syntax based on their own work. Even though this research was conducted at the Vocational School where learning using Pydroid had never been done before, it was nevertheless able to foster connection between students and teachers as well as between students and other students during research tasks. This has a positive effect on student activities in learning in the classroom

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