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Analysis of the Problem Based Learning Syntax in Vocational Mathematics Books on Matrix Material

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Abstract

Books, as one of the many sources of learning and learning materials, are commonly used by teachers and students in the learning process of Mathematics, so that students can experience the most of learning of mathematics / students can learn Mathematics best. Based on 2013 Curriculum in which the learning process is students-centered, there needs to a model of learning which is based on problem, namely PBL. This model will run best when the books used during the learning process meet the syntax of PBL. This study aims at analyzing Mathematical book for Vocational School on Matrix subject, based on the syntax of PBL. The method used for the study is descriptive. The instruments which are developed based on the Syntax of PBL includes: students' orientation on the problems, organizing students for the learning process, guiding students individually or in groups, developing and presenting the result / work piece, analyzing and evaluating the process of problem solving. The study will analyze 3 Mathematics books which are mostly used by teachers, coded A, B, and C. The focus of the analysis is Matrix, covering the explanation of the concept and students' activities. The result of the study will show that syntax of PBL are present in the three Mathematics Textbooks analyzed. Book C is better than Book A and Book B, analyzed from the syntax of PBL. From the analysis, it is found that Book C is more suitable to be used in a learning process using PBL model. Further study is recommended for analysis on which book is much more suitable to be used in a learning process using certain model of learning.

Keywords: *Books; Matrix; Syntax of PBL*

Introduction

Problems in life must be dealt with and resolved immediately, before any other problems arise. The ability of students to solve a problem can be honed in learning with Problem Based Learning (PBL) learning models. Currently, the learning process tends to be less intense and less meaningful for students. This is due to the demands of the curriculum in completing the material which results in the teacher teaching quickly. The conventional learning model is the choice for teachers in completing the material in accordance with the curriculum target, so that the teacher as a learning center. Problem-based learning models require the participation of students, by being actively involved or as learning centers in learning. The PBL learning model was first used in 1960 by Howard Barrow at the Mc Master University Medical

School in Canada. Therefore, the PBL learning model is very appropriate for students to develop their own knowledge, train and develop the ability of students to solve problems that are problem-oriented from the real life of their own students. In addition, PBL also sharpens students' high-level thinking skills.

Problem-based learning provides opportunities for students to play an active role in learning. This is in accordance with PBL's goal that in learning, students as learning centers. PBL invites students to discuss, work together in solving problems and determining appropriate solutions to real life problems. The existence of real and meaningful problems for students is the main thing of PBL learning, which can be the basis of investigation. According to Arends, there are five syntaxes in PBL (Table 1), namely the orientation of students on the problem, organizing students to learn, guiding individual and group investigations, developing and presenting the work, and analyzing and evaluating problem solving processes.

Table 1. Syntax of Problem Based Learning (PBL)

Stage	Activity of Students
1st Stage Student orientation on the problem	Students are actively involved in submitting phenomena or demonstrations (stories) to raise problems, and engage in problem solving.
2nd Stage Organize student to learn	Learners define and organize learning tasks related to the problem.
3rd Stage Guiding individual or group	Students gather appropriate information, conduct experiments to get explanations and problem solving.
4th Stage Develop and present the group	Learners share assignments with friends, plan and prepare suitable works such as reports, videos and models.
5th Stage Analyze and evaluate the problem solving process	Students reflect or evaluate the investigations and processes that students use.

Based on the results of interviews with students and teachers from several Vocational High Schools in Surakarta, revealed that the concept of matrices, especially the two matrix multiplication operations, determinants and inverses is material that is difficult to understand. Understanding of students in receiving subject matter is certainly influenced by models, methods and learning media used by teachers. Some learning media are used by teachers to support learning, one of which is a textbook. Textbooks are books that provide instruction in the principles of study subjects, each book being used as a basis for only part of the study. Textbooks are designed to be used in the classroom, carefully prepared by experts and include suggestions for good learning. Research related to matrices shows that in mathematics it is not easy to get a better understanding of the concepts of matrix operations, determinants and inverses. Students' misunderstanding that is often done is in determining the results of the multiplication of two matrices or the measurement of a matrix. Learners think that the multiplication of two matrices has the same way as addition or subtraction of two matrices. In adjusting a matrix, students think that to solve it

by squaring each element of the matrix. The concept of multiplying two matrices, determinants and inverses is too difficult for students, if the teacher only explains or as a learning center. In other words, students are only listeners and do not play an active role in exploring the material so that students become bored and increasingly do not understand the concept of the material.

PBL learning model has advantages where students will play an active role in solving a problem. Students will be motivated to work together in groups and demand high-level thinking skills. Conditioning learners in groups that interact with each other on learning and their friends will shape the character of students. The expected character of students is to become more independent and mature, able to give aspirations and accept the opinions of other friends, and instill positive social attitudes with friends.

The book, which is one of the learning materials, becomes a teacher's handbook to help students obtain correct information about a material. Sometimes students have difficulty understanding long diagrams, pictures or statements in a book. For this reason, it is necessary to analyze the contents of the book as teaching material. Krippendorff defines the analysis of book content as a research technique to make conclusions that can be accounted for and valid from existing data. Analyze the contents of this book by looking at the contents and counting the frequency of words, photos, images and statements based on their cognitive level. This study aims to analyze the PBL syntax in vocational mathematics books on matrix material.

1.1 Research Methods

This research method uses qualitative and quantitative analysis. The technique of collecting data is by calculating the frequency of PBL syntax that appears in a math book. The instrument was developed based on five PBL syntaxes as found in Table 1. Researchers analyzed matrix material in three math books that are often used by teachers in learning. The three mathematics books can be seen in Table 2. Book A is a handbook that is lent to students and is also used by most students in the Surakarta City Vocational School. Books B and C are supplementary books in the library.

Table 2. Mathematical Textbooks

Books	Title	Author
A	Matematika SMA/MA/SMK/MAK Kelas XI	Sudianto Manullang Andri Kristianto S.
B	Matematika Jilid 1 untuk SMK-MAK Kelas X	Kasmina dan Toali
C	Matematika SMA/MA/SMK/MAK Kelas XI	Suwah Semiring Marsito

The three books were examined by two researchers so that the data obtained fulfills reliability. The results obtained are calculated using Cohen's Kappa. If the Kappa coefficient is close to 1, the coding is said to be very reliable, whereas if the number 0 is obtained, the coding is said to be unreliable or when there is no agreement between the two researchers. The calculation results obtained show the Kappa coefficient value is 0.6 - 0.7. This means there is an agreement between the two researchers or the agreement obtained from the two researchers is quite good. This study uses a triangulation technique to check the validity of data. After that, the percentage of problem-based learning syntax is calculated with the following formula,

$$\%PBL = \frac{SS}{ST} \times 100\% \quad .$$

The formula description for% PBL is the percentage of problem-based learning, SS is the appropriate number of syntaxes and ST is the total syntax. Then the results of the PBL percentage can be categorized according to Table 3.

Table 3. Library Compatibility Percentage Categories

Value %	Percentage of Compatibility
81 < % ≤ 100 Very Good	81 < % ≤ 100 Very Good
70 < % ≤ 80 Nice	70 < % ≤ 80 Nice
41 < % ≤ 69 Enough	41 < % ≤ 69 Enough
21 < % ≤ 40 Less	21 < % ≤ 40 Less
≤ 20 Very Less	≤ 20 Very Less

1.2 Results and Discussion

Based on 5 PBL syntax, researchers analyzed three different books. The frequency of each syntax in the three books (Books A, B and C) can be seen in Table 4. Of the five PBL syntax, there are two syntaxes that rarely appear, namely developing and presenting works, analyzing and evaluating problem solving processes.

Table 4. Frequency of PBL Syntax in Mathematical Textbooks

In book A, the syntax of student orientation on the problem can be seen in table 4, the problem raised for example is "It is known that the entrance ticket price for a museum is as follows". In book B, using statements and question sentences, for example "A table is often found around us, for example a table of results of the UEFA Champions League Group A temporary match, a table of certain chemical substances in a drug, a conversion table of dollars against rupiah in a certain period of time , and other tables. Why is the data presented in the table? ". The syntax of problem orientation is directly made in the question sentence. Whereas in book C, the syntax of problem orientation is stated in the statement, for example, "Because the number of Deni and Wendi's report cards is the same as in Indonesian and is different from the mathematics test, how is the sum of the test values using matrix operations?". In book C it gives more problem orientation than books A and B. Book C presents more challenging problems than books A and B, thus motivating students to solve existing problems.

For the syntax of organizing learners to learn, in book A, for example, is given a statement "Interview each member of the group to get information on the value of students to the three subjects that interest him" This statement will guide students to answer the questions which subjects are preferred? In book B, students are given two tables about UEFA Champions League Group A and a comparison of the composition of substances on several types of fertilizers, then students form a table arrangement into a matrix form. While in book C the explanation is given with a diagram and description of the diagram in

detail. So books B and C are better than book A because in both of these books students are invited to learn and solve problems.

Books A and B show the same number of syntax guiding individual and group investigations. The indication of this syntax motivates students to gather appropriate information, carry out experiments, provide explanations and problem solving. In book A there is a command sentence "Present data obtained in the form of tables and in the form of a matrix". In book C there is a command sentence "Write each example for a triangular matrix, diagonal matrix, identity matrix and scalar matrix!".

In book A there is no syntax for developing and presenting the work. There is no opportunity for students to work in groups and present work or problems that are solved. In the third book is equipped with questions that can be solved by students. In order for PBL syntax to emerge, the teacher must give them the opportunity to share their assignments and present their work.

In the syntax of analyzing and evaluating the problem solving process, in book B appears three times and book C appears fourteen times. Whereas in book C the analysis requested is "Can a scalar matrix be converted into an identity matrix with its scaler? If you can, give an example. In book B there is the sentence "Add the two matrices from the number a problem and conclude the number of motorcycle sales in the last 2 years".

Table 5. Amount of PBL Syntax in Mathematics Books

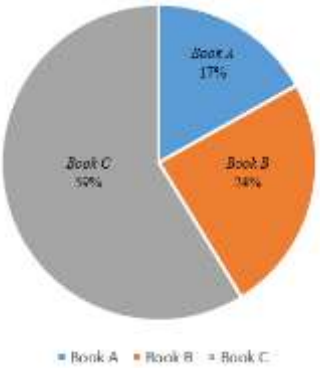
No.	Syntax	Book A	Book B	Book C	%
1	Student orientation on the problem	12	17	22	34,2
2	Organize student to learn	12	13	22	31,5
3	Guiding individual or group	1	1	17	12,8
4	Develop and present the group	0	2	12	9,5
5	Analyze and evaluate the problem solving process	0	3	14	11,4

In Table 5, it can be explained that the syntax that appears most in all books is the syntax of student orientation on the problem (34.2%), followed by organizing students to learn (31.5%), guiding individual and group investigations (12 , 8%), analyze and evaluate the problem solving process (11.4%), analyze and evaluate the problem solving process (9.5%). The syntax of analyzing and evaluating the problem solving process does not appear in book A. From the percentage of PBL syntax it can be seen that books A and B give less space for creativity and the ability to think highly in students.

The PBL syntax that appears most in all books is the first syntax of student orientation to the problem. In book C, there are 22 syntax of student orientation more than in books A and B. In book C, every time a subtopic will be started students are given an introduction in the form of interesting sentences. An interesting sentence in the introduction, will motivate students to read it further. In books A and B, the introduction with a few sentences is less than the book C. The three books provide motivation to students to learn the material to be learned.

In the syntax of guiding individual and group investigations, books A and B get the same number, namely 1, while in book C there are 17. After the third syntax, in the syntax of the four students are given the opportunity to develop and present their work by presenting the results of the discussion process what students have done. But in book A this fourth syntax is not found.

Table 6. Percentage of PBL Syntax



From the percentage category of library compatibility, book A has 60% syntax in PBL, so this book falls into the sufficient category. While books B and C have 80% syntax in PBL so that both books are included in the good category and can be used in PBL model learning. When compared to the total PBL syntax in the three books as shown in Table 5 above, Book C displays more PBL syntax than books A and B. Thus book C, is good for use in learning with PBL learning models.

1.3 Summary

The syntax of PBL is found as much as 80% in books B and C. Nevertheless, in book B it is still lacking in the syntax of developing and presenting the work, as well as in the syntax of analyzing and evaluating the problem solving process. However, in book A there is neither syntax of developing and presenting the work, nor the syntax of analyzing and evaluating the problem solving process. Book C gives more PBL syntax than book A and book B. Thus it can be concluded that, book C is more appropriate to be used in learning with PBL learning models.

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