



## Improving Higher Order Thinking Skills Through Problem Based Learning with a Scientific Approach

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### Abstract

This study aims to describe the effectiveness of the problem-based learning model with a scientific approach to improve higher order thinking skills. The type of research used in this study was quasi-experimental with pre-test and post-test group design. The study was conducted by using one control class and one experimental class. The study was conducted on vocational students with a sample of 64 students consisting of 32 students in experimental class and 32 students in control class. The essay test was used as an instrument for retrieving data. Descriptive analysis and t-test were used to do data analysis. The descriptive test results showed that the average score of HOTS in the control class and experimental class had increased. The results of the t-test showed that there was a significant difference in the score of the pre-test and the post-test in the experimental class, whereas the control class had no significant difference. The conclusion of the results of the study shows that there was a difference between the improvement of higher order thinking skills using conventional models and PBL models. The PBL model was able to improve students' Higher Order Thinking Skills.

### How to Cite

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## INTRODUCTION

Teaching and learning activities carried out by the teacher, both goals, processes, evaluations and final results must give meaning to students. Learning carried out by students must be able to increase knowledge, experience, skills, understanding and creativity. Therefore, learning carried out by students is a series of processes that are very important at each passed stage. As stated by Nuryana, Widhiastuti, and Murniawaty (2016) that the learning process plays an important role in education as an effort to transfer structured and organized knowledge between teachers and students. This goal can be achieved if students are actively involved and gain flexibility in undergoing a series of learning processes. But in practice, the learning carried by the teacher still does not involve many students.

Based on the results of questionnaires from 20 accounting teachers, it was obtained data that 75% of teachers still use traditional learning models with lecture methods, while 25% used problem based learning models. The conventional learning model should begin to be minimized because it is no longer relevant to the demands of learning in this century. The presumption that students still have to be given subject matter with detailed explanations must be abandoned. The habit of teachers dominating learning must be minimized. Students must be given enough space to be able to explore knowledge so that the learning conditions are not monotonous and passive. Ruski (2016) states that activating students in the classroom or involving students in learning activities is an effective way to improve students' understanding of learning material. But in practice, the teacher does not dare to leave the comfort zone of learning. The teacher still dominates the implementation of learning. The teacher still considers that students cannot learn more independently. Students still need to be given a detailed explanation of the material in order to understand the material.

The results of the study of learning media made by teachers, teacher activities still

dominate learning. This can be seen from the implementation of the lesson plan made by the teacher which is still dominant using the lecture method and giving assignments. This condition is reinforced by the results of interviews with teachers which show that the teacher is still dominant using the lecture method and assignments. The teacher considers that the material delivered is not in accordance with the learning objectives when using a student-centered teaching and learning process such as a problem-based learning model, project based learning, and discovery learning.

The results of field observations on accounting learning also show teacher dominance. The implementation of learning begins with the teacher's explanation and giving examples. The next step is assigning assignments to students to be completed based on the instructions and examples given by the teacher. Accounting learning atmosphere tends to be passive and there is no discussion between students. The teacher only monitors as long as students do the assignments and give explanations when there are students who have difficulty. Based on the study of the learning media made by the teacher, the achievement of learning objectives and assessment instruments is still in the low level of cognitive domain of knowing, understanding, and applying. The results of interviews with teachers show that the teacher still had difficulty in conducting learning and compiled assessment instruments on high level cognitive achievement. This was supported by the results of questionnaires from 20 new accounting teachers. 40% had measured the HOTS domain while 60% had not.

This condition needs to design a learning model development that further increases the active role of students and is able to increase student activeness in the learning process. One of the learning models that can foster student activeness in teaching and learning activities is a problem-based learning model. The teaching model is one of the learning models that must be mastered by the teacher in learning in the classroom (Farihatun & Rusdarti, 2019).

The problem-based learning model aims to be able to optimize students' thinking skills, because the learning process prioritizes discussion with groups so that they are able to hone, empower, test, and develop students' thinking skills systematically. The problem based learning model with the Scientific Approach is a model that is considered appropriate to overcome these problems. This learning model is a learning model that will be able to answer the needs of teachers in improving the learning process. This learning model is also able to overcome the obstacles that occur in learning to improve higher order thinking skills.

Higher order thinking skills are skills needed in a person's situation when faced with a problem that must be solved. These objectives will be achieved if the implementation of learning carried out by teachers uses a learning model that involves higher order thinking processes. The orientation of learning carried out by the teacher, according to Abidin (2014) must be directed at the activities of students to find and establish meaning independently which in turn can foster the skills of higher order thinking students. One of teaching and learning processes that are able to form higher order thinking skills of students is a problem-based learning model.

According to the results of Ersoy & Burser's (2014), problem-based learning contributes to the development of creative thinking skills. This learning model is different from the traditional learning model. This learning model aims to improve students' creative thinking skills, which is one indicator of higher order thinking skills. These skills are very important and are needed for students to be able to think creatively. According to Hassan, Yusof, Mohammad, Abu, & Tasir (2012) in the most complex intellectual functions, problem-based learning has high-level cognitive processes that require certain pedagogical strategies to develop them.

Higher Order Thinking Skills (HOTS) according to Brookhart (2010) trains students to learn by building meaning, incorporating new content into existing mental representa-

tions, improving skills of thinking, knowledge and understanding. Conditions like this require students to be able to understand, interpret, analyze, and manipulate existing information so that they can solve the problem well. HOTS encourages students to be able to think critically in evaluating information, making conclusions through an intensive communication process so as to arrive at a new and appropriate solution to a problem. It is expected that students are able to evaluate ideas, express opinions, and make choices, and make the best decisions in solving problems. According to Heong et al. (2013) students need to learn and be introduced to higher order thinking skills to overcome difficulties so they can produce ideas to solve a problem. Higher order thinking skills are very important because they can help students complete their learning assignments. Therefore students need to be trained with these skills.

Higher Order Thinking Skills according to Ramos, Dolipas, & Villamor (2013) there are four levels, namely: the skills of analyzing, comparing, drawing conclusions, and evaluating. According to Bloom's taxonomy Higher Order Thinking Skills consist of: (1) analyzing; (2) evaluating; and (3) creating (Susetyo, 2015). Analyzing is an activity that requires students to be able to identify parts and relationships so that they form a unity. According to Brookhart (2010), the activity of analyzing is expected that students are able to provide logical reasons from the results of the analysis carried out, both deductively and inductively so that they can draw conclusions. According to Ramos et al. (2013) through analyzing activities, students are expected to be able to understand between the whole problem with its parts and with their causes and consequences. These analytic skills need to be given so students can think critically and logically.

Evaluating is an activity to assess information based on evidence. Students is expected to be able to assess the credibility of an information source, identify the assumptions in that information, and identify the existence of rhetorical methods and persuasive methods

used in information (Brookhart, 2010). According to Ramos et al. (2013) evaluating is training students to be able to assess the quality, credibility, and usefulness of the criteria and give reasons and be able to maintain the conclusions drawn by exposing real and strong evidence.

Creating is the highest stage of Bloom's taxonomy in cognitive domain which is revised by Anderson. Through the creating stage, students are expected to be able to display their innovation and creativity. Creating activities in this study, students are taught to make presentation materials that are more creative and interesting to communicate results. Indicators to measure the success of this skill according to Brookhart (2010) are: (1) able to create a solution to the problem during learning; (2) able to make new completion steps to resolve similar problems; and (3) able to use various solutions to solve problems based on the steps learned previously

Results of research by Ganiron Jr. (2014) show that: (1) Learning that promotes higher order thinking skills can improve student learning outcomes; (2) Problem-based learning results in increased student skills in understanding concepts, solving problems and managing cases; (3) The experimental class gets better learning outcomes from the control class based on the problem scenario presented, connects it with real problems, investigates and achieves learning objectives through Higher Order Thinking Skills; and (4) Students can better understand the learning objectives because of learning that builds higher order thinking skills, so as to improve academic skills and learning outcomes. Bayat & Tarmizi's (2012) Problem-Based Learning model as a new approach has positive performance because it found significant performance differences between the problem-based learning group and conventional learning groups.

Learning experienced by students is expected to increase the independence of learning through scientific activities. Students are trained with problem solving through investigative and research activities. One approach is

to train students with these skills through the use of a scientific approach. This approach is a learning approach that focuses on the scientific work process.

The scientific approach is an inductive learning approach (Ary, Jacobs, Sorensen, & Razavieh, 2014). The inductive learning approach is often referred to as the scientific learning approach or scientific learning method because this learning approach has certain learning steps that must be followed (Suyanto & Hariyanto, 2015). According to Abdulhak (2017) to foster student learning motivation, one of the learning approaches that teachers can apply is the scientific approach. Problem-based learning is one learning model with a scientific approach. According to Manchekar (2015) the principle of the scientific approach is that students must collect empirical and measurable evidence to be observed. This approach is a systematic approach so students get new knowledge or information and try to prove it rationally.

Problem-based learning model is a learning model that is felt to be able to provide active learning situations for students. In this model, it is able to train students to solve problems based on scientific stages. According to Mudlofir & Rusydiyah (2016) the problem-based learning model is a learning model that is used to solve a problem through the stages of the scientific method. This learning model can teach students to understand hands-on experience with problems while having skills in solving problems.

In line with the results of the research conducted by Erdogan & Senemoglu (2013), it shows that problem-based learning has a significant effect on student achievement at a level of knowledge, understanding and higher levels (synthesis, analysis, and evaluation). Research by Ari & Katranci (2014) provides results that problem-based learning forms permanent learning outcomes and makes the role of students more active. The application of a problem-based learning model is proven to be able to apply better results than conventional learning models.

Problem-based learning is a learning model that trains student's learning independence. Marsnik & Thompson (2013) stated that to prepare students to be independent, lifelong learners, and practical problem solvers. Students given Problem-based learning gains deeper knowledge and understanding of concepts than students taught by Teacher Centered Learning (Jalani & Sern, 2015).

There are several characteristics of problem based learning. Problem-based learning prioritizes student's centered learning and reduces the teacher's role in providing classroom instruction. According to Suyanto & Jihad (2013) the submission of a problem, focusing on the inter-disciplinary linkages, authentic inquiry, cooperation and producing work are the main characteristics of problem-based learning. According to Rusman (2011) indicators that are characteristics of problem-based learning include: (1) Learning begins with finding problems; (2) Problems used in the learning process are problems found in the unstructured real world; (3) Problems need a dual perspective; (4) Problems that are able to challenge students' knowledge, attitudes, and competencies so that it requires identification of learning needs and new fields of learning; (5) Learning self-direction is the main thing; (6) Utilizing varied sources of knowledge, on their use, and evaluating information sources are an essential process in problem-based learning; (7) Learning is collaborative, communicative, and cooperative; (8) Developing inquiry skills and problem solving skills are as important as mastering the content of knowledge to find solutions; (9) Problem-based learning processes include the synthesis and integration of a learning process; and (10) Involving evaluation and review of student experience and the learning process.

The scientific approach and problem-based learning are learning which together aim to foster student creativity. Ozgelen (2012) states that there are similarities in the first four steps of the two approaches, namely observing, asking, associating, and communicating. The statement is in line with the opinion ex-

pressed by Clouston, Westcott, Whitcombe, Riley, & Matheson (2010) that creativity can grow through habits in solving problems in problem-based learning.

Based on these two statements, it can be concluded that the steps contained in problem-based learning and learning using the scientific approach have similarities. Both of them start from giving problems and have several steps aimed at fostering the activeness and creativity of students. Problem-based learning framework and scientific approach includes six steps, namely interpreting and defining problems, determining questions that need to be answered about the problem, conducting research to find answers, proposing hypotheses and several possible solutions to problems supported by data, discussing the pros and cons from possible solutions, choosing and presenting the best possible settlement to the audience.

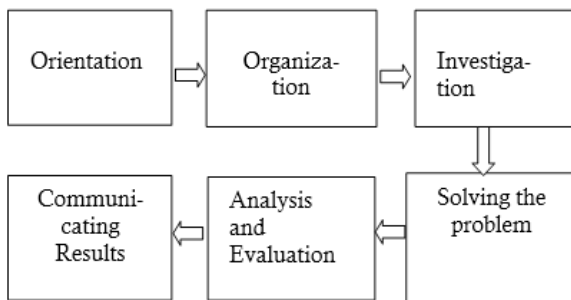
Based on the results of several explanations of the theory, relevant research results, and considering the location, the purpose of this study aims to improve the higher order thinking skills of SMK students in the Accounting expertise cluster using a problem-based learning model with a scientific approach. Previous studies were mostly carried out in higher education while this research was conducted at the vocational school level.

## METHODS

This type of research is a quasi-experimental design with pre-test – post-test group design. This research was conducted on class XI students of SMK 2 Madiun. The sample used in this study was 64 students consisting of 32 students as the experimental class and 32 students as the control class. Data collection techniques used essay tests. Data analysis techniques used descriptive analysis and t-test. Descriptive analysis was used to determine the average score of each class, while the t-test was to determine the difference in the pre-test score and the post-test score found in each class. The problem-based learning model with

the Scientific Approach proved to be effective in improving higher order thinking skills if the results of post-test of the experimental class were higher (increased) compared to the pre-test results and the average post-test score in experimental class were higher than the average post-test score in the control class.

Application of problem-based Learning Model with Scientific Approach using 6 syntaxes, namely: Orientation, Organization, Investigation, Solving problems, Analysis and Evaluation, and communicating the results. The syntax is a combination of problem-based learning syntax with the scientific approach syntax. Six syntaxes of Problem-based learning with the Scientific (PBLs) approach are summarized in the following figure.



**Figure 1.** Syntaxes of PBLs

**RESULT AND DICUSSION**

The results used in this study are in the form of test score obtained by students in completing questions about the preparation of financial statements, pre-test and post-test in experimental class and control class. The experimental class was first given a test before learning with PBLs and after learning the experimental class was also given a test.

Likewise in the control class, the test was carried out before learning and the test

was conducted after learning. The difference is the learning done in the control class did not use PBLs. Data on descriptive analysis of the score of higher order thinking skills (HOTS) are presented in Table 1.

**Table 1.** Data Description of HOTS

	N	Min	Max	Mean	Std. Dev.
HOTS_control_pre	32	35	100	72.81	17.398
HOTS_control_post	32	35	100	73.84	17.778
HOTS_exp_pre	32	35	100	71.37	17.290
HOTS_exp_post	32	35	100	76.94	15.674
Valid N (listwise)	32				

Source: Processed Primary Data (2018)

Based on Table 1, the average score of the HOTS post-test is higher than the pre-test. When viewed from the average, the conventional model and PBLs can both increase HOTS but the increase in the average score in the experimental class is higher than the increase in the control class. The average score of HOTS pre-test 72.81 rose to 73.84 in the post-test or rose 1.03 in the control class. Meanwhile, the average score of HOTS pre-test 71.37 rose to 76.94 in post-test or rose 5.57 in the experimental class. Thus, the use of the problem-based learning model with the Scientific Approach (PBLs) can increase the HOTS in experimental class higher than in the control class. Further analysis was carried out by using the two-sample t-test. The t-test was conducted to determine the effect of HOTS score between

**Table 2.** Result of Two Sample t-test by SPSS

Pair 1	HOTS_control_pre - HOTS_control_post	-1.031	3.043	.538	-2.128	.066	-1.917	31	.064
Pair 2	HOTS_exp_pre - HOTS_exp_post	-5.563	5.224	.923	-7.446	-3.679	-6.024	31	.000

Source: Processed Primary Data (2018)

the pre-test and the test-post in each class. The results of the t-test are presented in Table 2.

Based on Table 2, the results of the t-test show that  $\text{sig. } 0.064 > 0.05$  for HOTS in the control class and  $\text{sig. } 0,000 < 0.05$  for HOTS in the experimental class, so it can be concluded that: (1) there was no significant difference in the score of higher order thinking skills between the pre-test and the post-test in the control class; and (2) there was a significant difference in the score of higher order thinking skills between the pre-test and the post-test in the experimental class. Based on these results it can be concluded that the PBL model had a significant effect on increasing students HOTS in the experimental class. The results of the post-test in experimental class were better than the results of the pre-test, whereas in the control class there was no significant difference in the HOTS pre-test score with the HOTS post-test score. The HOTS score of the experimental class experienced a significant increase between the pre-test and the post-test score, while the control class did not experience a significant increase between the HOTS pre-test and the test post score.

Based on the results of the analysis of the data studied it turns out that the problem-based learning model with an effective scientific approach is able to improve higher order thinking skills. This is shown by the score of students' HOTS in the experimental class is higher than the score of HOTS in the control class. The average score of HOTS achieved by students in the experimental class is 76.94 higher than the average score achieved by students in the control class (73.84). The experimental class average score also increased higher than the pre-test (71.37) up to 76.94 (rise 5.57). Meanwhile, the HOTS pre-test score of the control class 72.81 rose to 73.84 in the post-test (rise 1.03).

Students in the experimental class were trained to solve problems through scientific stages using the PBL model. Using this scientific stage, students were more actively involved in learning. Students were not only asked to solve financial report preparation problems

but students were trained to identify, analyze, provide arguments, and communicate results through presentations, thus skills that were trained to students became more complex because students were not just memorizing and recalling ways - how to complete financial statements. The use of the PBL model also trained students to collaborate between students through group discussions.

Problem based learning with the Scientific Approach used in this learning consists of 6 syntaxes, namely: (1) Orientation; (2) Organization; (4) Solving Problems; (5) Analysis and Evaluation; and (6) Communicating Results. In accordance with the syntax stages used in the problem-based learning model with the Scientific Approach, students develop higher order thinking skills starting from the orientation stage to the stage of communicating the results.

The orientation stage (orienting students to problems) is the initial stage in PBL syntax. The orientation stage is an important stage in training students to be ready to take part in learning and understand the learning objectives to be achieved. At this stage, students are expected to be able to identify and describe the ultimate goal of learning. This stage is important so that students are ready to take part in learning and know the goals to be achieved. The purpose of this stage is for students to have motivation and grow a positive attitude during the learning process.

The second stage in PBL is an organization (organizing students to learn). Students at this stage are prepared to do group learning by forming groups. The purpose of this stage is for students to grow cooperation and mutual respect and be able to arrange the steps of learning well.

The third stage is investigation (conducting an investigation through observing and asking). Students are trained to identify and find problems and develop strategic and systematic steps to complete and analyze the tasks given by the teacher. Students at this stage are given guidance to be able to define and organize learning tasks related to the problem. Skills

in observing, asking questions, and gathering information are keys to students' success in solving problems. Observing activities aim to arouse curiosity so that the learning done by students becomes more meaningful. The questioning activity aims to make students dare to raise questions and open themselves to problems that have not been understood.

The fourth stage is solving the problem. Students at this stage are trained to solve financial statement problems. Students are expected to be able to compile financial statement according to the procedures prepared in the planning that have been made. This stage trains students to work according to the responsibilities given to each group member. Success at this stage is determined by the cooperation and cohesiveness of group members in solving problems.

The fifth stage is analysis and evaluation (conducting analysis and evaluation). Students at this stage are trained to be able to carry out analysis and evaluation of work results and provide arguments based on the results of analysis of the tasks. Students are not only required to understand and apply the concept of preparing financial statements but also must be able to analyze and evaluate and give interpretations. The activity of analyzing and evaluating is done so that students are careful in drawing conclusions and giving interpretations of the results of problem solving.

The sixth stage is communicating the results. Students at this stage are trained to be able to present the results of problem solving in front of other students. At this stage students are expected to bring up their creativity in making presentation materials and presentation methods. Communicating the results trains students to dare to express their opinions. The ability to communicate this according to Sani (2014) is very important for students to have this ability as important as knowledge, understanding, experience, and skills.

Overall in the experimental class, students' higher order thinking skills increased significantly compared to the control class. There are three levels of higher order thinking

skills measured in this study. These three levels include the skills of analyzing, evaluating, and communicating results.

The test results show that the average score obtained by students in the experimental class has increased after participating in learning using the PBL model. Positive habits in learning also arise through discussion with groups and actively ask the teacher. These results are in accordance with the results of the Vijayaratnam (2012) study which shows that: (1) More than 75% of students show positive learning attitudes with problem-based learning in the form of groups through exchanging ideas, insights, ideas and knowledge and working together to achieve targets; (2) Able to find solutions to problems given with various ideas and creativity; (3) Able to provide very interesting presentations with detailed explanations and answer problems and questions well and satisfactorily.

This research is also supported by Etherington (2011) research which states that problem-based learning through a scientific approach can improve students' knowledge and understanding of a material. Creative innovation can be done by students in solving problems. Innovation in finding new findings can also be done by students in solving problems, gaining valuable experience in innovating, researching and conducting exhibitions and presenting results. The same result also supports this research is Unal & Özdemir (2013) research which shows that students can determine the problem and find the solution through the process that is passed according to the scientific skills.

Problem based learning model with a scientific approach opens opportunities for interaction between students. This interaction is one of the characteristics of the problem-based learning model. Interactions between students and between students and teachers support the achievement of learning goals (Anwar, 2018). This result is supported by Layli's (2012) research which provides information that in learning, interaction between fellow students, as well as with teachers is able to streamline the



learning process so that learning objectives can be achieved.

Researcher Tasoglu & Bakaç (2010) also provides results that learning that begins with the giving of a problem to be solved makes students use the scientific approach to solve problems. The activities carried out by students in the scientific process to solve problems make students more aware of the material. Problem-based learning is also able to increase the activeness and independence of students in learning.

The PBL model is designed not to be used by the teacher to convey the contents of the lesson in detail and in full. PBL models are designed to be more emphasized in the activity of students in learning to seek and construct knowledge more independently. In accordance with the opinion of Suyanto & Jihad (2013) which states that problem-based learning is designed to help students to: (1) develop thinking and problem solving skills; (2) learn authentically the role of adults; and (3) become independent learners.

The role of the teacher in learning the PBL model, though it is no longer dominant, is still very necessary. Teacher monitoring during the learning process and giving feedback are very important activities in the success of learning with the PBL model. Feedback given by the teacher is part of the implementation of the problem-based learning syntax with the scientific approach to the orientation stage and the giving of problems. Feedback from the teacher is able to stimulate students to answer questions, discuss among colleagues, and provide solutions to problems. One activity in the student-centered learning model is giving feedback. Giving feedback has a significant effect on developing students' competencies and self-confidence (Hardavella, Gaagnat, Saad, Rousalova, & Sreter, 2012).

Giving feedback is important for teachers to develop teacher-student relations and improve learning outcomes and the quality of learning (Leibold & Schwarz, 2015). Giving feedback aims to motivate and stimulate students to ask questions, express opinions, and

find solutions if the feedback function is well understood by students (Leibold & Schwarz, 2015). Therefore giving feedback greatly influences the achievement of learning objectives. The application of problem-based learning models with the Scientific Approach can improve students' higher order thinking skills because students are able to stimulate themselves to solve problems given by the teacher through giving feedback.

The PBL model is able to improve students' higher order thinking skills in completing tasks, especially in this research, compiling financial statements. However, the PBL model still has weaknesses. The weaknesses are: (1) teachers need to prepare more carefully and carefully in choosing the problems to be presented in learning; (2) students still need material explanations from the teacher; (3) this model has not been able to motivate highly passive students; and (4) implementation of this model takes a long time.

## CONCLUSION

Based on the results of the study it can be concluded that problem-based learning with a cognitive approach is able to improve higher order thinking. This is evidenced by the results of the post-test having increased compared to the results of the pre-test in the experimental class. Comparison of the test results between the experimental classes showed better than the results of the control class test. Problem based learning model with scientific approach can improve students' higher order thinking skills.

The implications of the results of this study are: (1) Accounting Learning conducted by teachers must change from teacher-centered learning to student-centered learning through the use of problem-based learning models. Problem-based learning is an innovative learning model that uses problems to stimulate students in learning. The teacher must have the courage to change the learning model that has been carried out from the conventional model with the lecture method and question and

answer with problem-based learning models; (2) teachers must change the learning that has been done so far with an achievement of low-level goals but on higher order thinking skills. In higher order thinking skills, teachers should improve students' skills to think critically, express opinions, develop alternative solutions to problems, and make the best decisions; (3) Implementation of problem-based learning models with an effective scientific approach to improve higher order thinking skills. This model puts forward the active involvement of students in learning. The activity of students is trained starting from the implementation of the orientation stage to the stage of communicating the results. To use this model, the teacher in designing learning needs to package teaching material in the form of problems.

The recommendations of this study are: (1) PBL models are proven to be able to develop higher order thinking skills and can improve student learning outcomes, for which teachers can apply the PBL model in the form of classroom action research (CAR); and (2) For future researchers, it is recommended to develop PBL models that can stimulate students to create innovative products, for example, making simple Excel-based financial statement software.

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