Analysis of Time Management, Problem-Solving Ability and Automotive Electrical Competence

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Abstract
In the 21st century, the industrial revolution 4.0 and regulations limiting fossil fuel use have caused the automotive industry to compete to create environmentally friendly vehicles. Electric-based vehicles are the right solution for future vehicles. Therefore, the workforce's ability in the electricity field is urgently needed. Therefore, there is a need to improve the quality of human resources, especially in the field of automotive electronics. The quality of human resources can be seen from their competence in working. Researchers want to identify internal factors that affect competence, especially in automotive electricity. The internal factors observed in this study are problem-solving ability and time management ability. The research sample is mechanical engineering education students of 2019-2021 who have taken automotive electrical practice courses. Before data collection, validation and reliability of the instrument are carried out. Data analysis of this study used a simple double regression analysis. The results showed that problem-solving ability significantly affects competence, while time management does not. Therefore, to improve student competence in the field of automotive electricity, it is necessary to enhance problem-solving skills.

Keywords: Time Management, Problem-Solving Ability, Automotive Electrical Competence

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Introduction

The 21st century, characterized by Industrial Revolution 4.0, is a period of rapid technological progress, requiring all elements to transform every aspect of human life. (Ali et al., 2020). The existence of the industrial revolution 4.0 and the impact of technological disruption are certainly very influential in the world of education. Education is fundamental in building each individual's character, so education is expected to optimize students to become competent human beings. Increased competence can bring a person into the world of associations, which can be done in the world of business, industry, social environment, management, and media technology.

In answer to 21st-century challenges, the key to the success of professional and continuous vocational education is determined by three aspects: teachers, curriculum, and learning(Nurtanto et al., 2020). The main goal of TVET is to produce graduates who must be able to produce graduates who are ready and capable of entering the world of work and industry. (Ali et al., 2020). In Indonesia, vocational education is undergoing a curriculum transition from initially based on the 2013 curriculum to an independent learning curriculum.

Educational institutions produce graduates who are not ready for work, causing a lot of unemployment; this is currently happening in Indonesia(Sarjono, 2019). We must take concrete and comprehensive steps to solve these problems to produce graduates who are ready to use, competent in the field of work, competitive, and have high selling points to compete in the global era.

Vocational school students tend to learn more functional and social competencies, such as technical skills and job-appropriate(Behle, 2017). Competence is a unified set of knowledge, skills, and attitudes that acquire meaning in the context (work) or task in which competence is used(Misbah et al., 2020). Höglund distinguishes between competence and qualification. The difference is that an individual has competence, while stuff is related to a work task(Backa & Wihersaari, 2014). Granberg defines competence as a formal qualification for a job assignment or position. According to Granberg, there are several competencies, one of which is legal competence. As a rule of proper competence related to the education that has been carried out by the individual(Backa & Wihersaari, 2014). Competence is defined as self-efficacy for a task or the degree to which a person believes they can complete a task successfully(Deci & Ryan, 2008).

Teachers do many things to improve student competence, one of which is by enhancing problem-solving skills. These capabilities can be applied, one of which is a problem-based learning model. Barrows and Tamblyn first introduced PBL in a medical class at McMaster University, Canada. (Engle, 1981). According to Barrows and Tamblyn, learning through problem-solving is much more effective than acquiring a large amount of practical knowledge, and problem-solving skills are more important to physicians than memory.(Engle, 1981).

Andis research shows that using PBL in large classrooms without tutors (thus avoiding additional costs) leads to a statistically significant improvement in students' general problem-solving skills(Klegeris et al., 2013). Hosseinzadeh teaches PBL in electrical engineering and is concerned about the breadth of content being discussed without detracting from the content topic. (Hosseinzadeh & Hesamzadeh, 2012). Problem-based learning is a constructive

learning paradigm in which learners select and transform information, generate ideas, and make decisions based on current or past knowledge. (Yoo & Park, 2015).

In general, problem-solving researchers usually define the term problem as a task or question that an individual or group does not immediately know how to answer. (Haavold & Sriraman, 2022). But this definition says little about how individuals can be trained to be better at problems. (Haavold & Sriraman, 2022). Therefore, several problem-solving models have been developed to describe and explain the factors and processes involved in problem-solving. Most were interested in relying heavily on Poriya's famous four-step problem-solving model. Hesse et al. problem solving involve students recognizing the difference between the current state and the desired state of the goal, acknowledging that there is no simple or routine solution to this difference, and responding to specific situations. Define it as the activity you are trying to accomplish. This goal involves several mental and behavioral processes that do not always occur sequentially but can occur in parallel. (Guaman-Quintanilla et al., 2022).

Problem-solving is the process of eliminating the gap between the desired state and the existing mind. Several indicators are included in problem-solving, such as finding a problem, describing a problem, creating several alternative solutions, evaluating alternatives, and choosing the best option(Zhang et al., 2021). Problem-based learning empowers students to respond appropriately during the first and second stages of learning and teaching and to successfully identify, analyze, and solve communication problems [(Jonassen & Hernandez-Serrano, 2002)(Allchin, 2013).

The ability to solve problems is influenced by several factors, namely internal and external factors. Internal factors come from the individual, e.g., motivation, interests, self/time management, etc. At the same time, external factors are conditions that are influenced outside the individual, for example, the environment, infrastructure, etc. The research discussed in this article is an internal factor: student time management in carrying out activities, especially in learning.

Work-based learning in groups is the largest consumer despite being distributed relatively homogeneously. In addition, students spend too much time in almost all activities, which causes general overloads to be handled correctly(Ruiz-Gallardo et al., 2016). It is known that time management is a technology to increase efficiency in the use of time for the implementation of tasks. Time management supposes conscious control over the amount of time spent on a particular type of work, thereby increasing the efficiency and product quality of the activity(Vladimirovich Kirillov et al., 2015). Numerous studies have identified the positive impact of time management. Time management skills have been shown to impact student learning and student outcomes[19] positively. (Krause & Coates, 2008) reports that the capacity to successfully manage their time is the basis on which students develop good study habits and strategies for success. In the study, Adam and Blair found students' understanding of time management behavior in contributing to students' academics(Adams & Blair, 2019).

Based on the above background, this research analyzes time management and problem-solving skills in expertise, especially in automotive electrical competencies. The formulation of the problem discussed in this article is:

1. How time management affects automotive electrical competence
2. How problem-solving ability affects automotive electrical competence

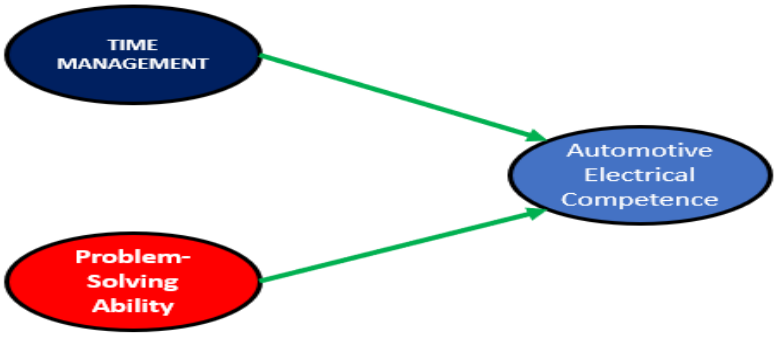

Figure 1. Skeleton Conceptual

Method

Design

The design of this study examines the factors that affect automotive electrical competence. Where researchers look at time management and problem-solving skills in undergraduate students of Mechanical Engineering Education, Surabaya State University, this study aims to obtain information on the effect of time management and problem-solving ability on automotive electrical competence. The research uses a quantitative approach *to ex post* facto survey methods.

Population and Sample

Where the population in this study is mechanical engineering education students who participated in the automotive electrical practices class of 2019 and 2021, the samples taken were 143 mechanical engineering education student class of 2019 and 2021 who had participated in automotive electrical practice activities.

Research Instruments

Data or information collection is a procedure and prerequisite in solving the construct research problem being tested. Then the data collection instrument is compiled into questionnaires and tests. Questionnaires are used to obtain time management data, while tests collect data on problem-solving ability and automotive electrical competence.

Multiple experts in the field have validated this tool: instructors and auto mechanics. Some devices are validated by validators and continue to be tested on equipment. The agency was tested in a non-research sample of vocational high school students who exhibited similar characteristics to the research sample. Devices for each structure can be described in the table below.

Table 1. Instrument Grid

No	Construct	Indicator	Instrument
1	Competence	1. Cognitive 2. Psychomotor 3. Affective	Test
2	Problem-solving ability	1. Understanding the Problem 2. Planning problem solving 3. Doing planning problem solving 4. Checking Troubleshooting Results Back	Test
3	Time management	1. Activities to do 2. Best activity conducted	Questionnaire

Data Analysis Techniques

Automotive electrical experts are used to assess the validity of contents using Aiken's V as an analytical technique to determine the validity of instruments (Aiken, 1980). The validity of the description using Average Variance Extracted (AVE) > 0.5 and the Loading Factor Value > 0.7 (Hair et al., 2010). Cronbach's alpha was used to analyze reliability, provided that the alpha value was >0.5(Hair et al., 2010). After the data is collected, the data is analyzed to map time management conditions, problem-solving ability, and automotive electrical competence. Analysis of Time Management and Problem Solving Skills by Automotive Electrical Skills, a double regression test was carried out. This study uses the Smart PLS 3 application. The resulting output of the Smart PLS application allows for finding the influence of free variables on independent variables.

Result

Descriptive statistics show that the study sample was 87% male and 13% female. Their age range is between 18-20 years. The instruments used in this study were tested for the validity of the contents by lecturers of electrical and mechanical subject matter. The test results were analyzed using Aiken'V (Aiken, 1980). The analysis results of each instrument are declared valid where the value of V is above 0.4.

Table 2. Instrument validation test results

Instruments	V	Information
Time Management	0,67	Valid
Problem-Solving Ability	0,726	Valid
Electrical Automotive Competence	0,778	Valid

A total of 143 students were asked to fill out instruments and take tests. The results show data like the table below.

Table 3. Average Variance Extracted Discriminant Validity Results

	Average Variance Extracted (AVE)
Electrical Automotive Competence	0,544
Problem Solving Ability	0,502
Time Management	0,653

Based on the table above, the AVE of each construct/variable has a value above >0.5. The results explained that the construct could explain more than half of the indicator variants of each construct.

Table 4. Result of Discriminant Loading Factor Validity

	Electrical Automotive Competence	Problem Solving Ability	Time Management
Affective	0,780		
Cognitive	0,711		
Psychomotor	0,720		
Problem Solving1		0,702	
Problem Solving2		0,715	
Problem Solving3		0,708	
Problem Solving4		0,708	
Time Management2			0,835
Time Management1			0,780

All indicators for each construct show loading factor values greater than 0.7. The results mean that the indicators are correlated with each component. The validity of the determinants of both AVE and stress factors allows us to conclude that the data are valid. After checking the validity, the next step is to check the data on reliability. The reliability test in this study used the reliability of Cronbach Alpha. The information is reliable if the Cronbach Alpha value is≥ 0.5.

Table 5. Cronbach Alpha Reliability Results

	Cronbach's Alpha
Electrical Automotive Competence	0,581
Problem Solving Ability	0,670
Time Management	0,570

The value of each construct on the Cronbach Alpha is above 0.5. In electrical competence, the value of 0.581 and time management of 0.570 indicates that the instrument on the construct is reliable. The ability to solve problems is 0.670, where the device is reliable.

After the data has been said to be valid and reliable, the data is analyzed to determine the effect of time management and problem-solving ability on electrical competence. The results of such analysis can be seen in the figure below.

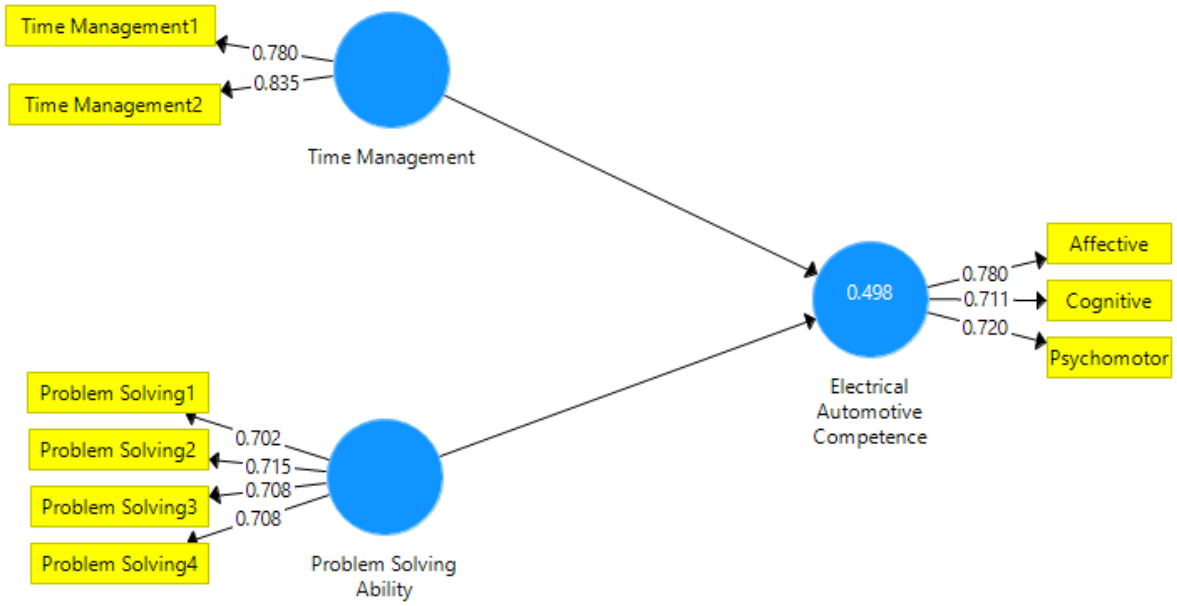

Figure 2. Data Analysis Results

1. Effect of Time Management (X1) on Electrical Competence (Y)

Based on table 6, it is found that Time Management (X1) does not affect electrical competence. The P value is 0.088, where a deal above 0.05 means time management does not impact competence.

Table 6. Values of Effect X1 on Y

	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (|O/STDEV|)	P Values
Time Management -> Electrical Automotive Competence	0.101	0.104	0.069	1.709	0.088

2. Effect of Problem-Solving Ability (X2) on Electrical Competence (Y)

Table 7 shows that Problem Solving Ability (X2) has a positive influence of 0.654 on automotive electrical competence (Y). The P value of 0.000 or less than 0.05 has the meaning of being hypothesized. From this interpretation, it can be concluded that the ability to solve problems positively and significantly influences the competence of Mechanical Engineering Education students.

Table 7. Values of Effect of X2 on Y

	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (|O/STDEV|)	P Values
Problem-Solving Ability -> Electrical Automotive Competence	0.683	0.688	0.045	15.194	0.000

Understanding problems is the highest indicator owned by Mechanical Engineering Education students. The lowest indicator is the ability to solve problems. This low ability is due to doubts about making quick and appropriate decisions.

Discussion

Knowledge, skills, and attitudes can measure competence during the student's work/assignment. Knowledge is the ability that students acquire theoretically, both formally and informally. Agility is the ability of a person to perform tasks more efficiently and accurately. At the same time, an attitude is a state of one's self that encourages one to act on specific emotions or engage in social activities when responding to objects, situations, or environmental conditions.

A student's competence can be influenced by several factors, namely internal and external factors. Internal factors are those caused by himself. At the same time, external factors arise outside the individual. This research is more focused on internal factors. Internal factors include time management and problem-solving ability.

Time management is a form of decision-making used by individuals to structure, protect, and adapt their time to changing conditions (Aeon & Aguinis, 2017). A student's success depends on his ability to manipulate time well and efficiently. Therefore, students must learn to manage their time in such a way that they can apply the same efficiency in their chosen profession after completing their education. Time management is an essential skill that mechanical engineering education students must learn during their academic life to improve their skills and quality of service.

The learning method must follow the length of learning. Learning without planning means an ineffective, organized, and balanced day; therefore, planning is essential to achieve the goal. Time management has several functions, namely 1) assisting individuals in determining priorities, 2) helping to reduce the tendency to postpone work to be completed, 3) it can prevent clashes when working on two or more jobs at the same time, 4) helping the evaluation process on individual work results.

From some of the explanations above, we can conclude that good management will help facilitate activities. Similarly, if while studying, if we manage study time with social or other interests, it will not be disturbed by the student's academic field. Some studies suggest that good student time management positively impacts learning outcomes [(Aeon et al., 2021; Nadinloyi et al., 2013).

The research resulted in time management not affecting electrical competence. These results are different from some previous studies. Most likely, students' competence is more

influenced by other internal factors. Several researchers' studies include that time management does not affect learning outcomes (Saputra, 2022; Triansyah & M Fitri Ramadhana, 2018).

The ability to solve problems using their cognitive strategies is the ability to solve them (Chiou et al., 2009). There are four processes involved in problem-solving, namely understanding, formulation, and implementation, and the last one is evaluation. Before completing a given task, the student must understand the meaning of the problem. Understanding the phases of a problem is about understanding the system and the problems it solves (Mirel, 2004). The student's question comprehension process must be able to determine the keywords of the question. This keyword limits the student's answer from deviating from the question's context. Students who can understand the problem indicate that they have basic skills related to the material given in the assignment. Understanding the problem makes it easier to solve the problem.

After the student understands the problem, the next step is to formulate measures to solve the problem. The student must identify the activities and strategies necessary to solve a particular problem. Students can do this in the following ways: (1) guessing, (2) developing models, (3) sketching diagrams, (4) simple tasks, (5) recognizing patterns, (6) creating tables, (7) experimenting and simulating, (8) working in reverse, (9) testing all possibilities, (10) identifying partial goals, (11) making analogies and (12) sorting data/information. Formulate students' problem-solving skills to think critically. Critical-thinking students solve problems efficiently. The ability to think critically also positively impacts students' academic performance [(Bellaera et al., 2021; Ren et al., 2020). Students must also have sufficient understanding. Student understanding helps to find different solutions to solve problems. A quick and precise solution is chosen from several solutions.

Once you have formulated and provided the right solution to solve the problem, the next step is to have the student solve the problem. Troubleshooting actions should be consistent with the plan that has been drawn up. What is done depends on what was planned in advance and also includes the following: (1) interpreting the information provided in the form of calculations; and (2) the application of strategies during the process and calculations. Generally, the student must stick to his chosen plan at this stage. Students can choose a different method or procedure if the program cannot be implemented. Whenever a student takes a step/action, they must be careful with their actions. A misstep in the troubleshooting process results in an error at the end of the process. When solving problems in the automotive industry, students work step by step according to the usual procedure.

After the troubleshooting procedure is completed, the next step is to evaluate the work results. The following considerations should be taken into account when reviewing previous efforts to resolve the issue, namely: (1) reviewing all identified material information; (2) reviewing all included calculations; (3) considering whether the solution is logical; (4) seek other alternative solutions; and (5) re-read the question and ask yourself if it was answered.

If the student performs the troubleshooting steps well, it will help solve the problem. Our research showed that problem-solving ability has a 68.3% positive impact on competency. That is, if the problem-solving ability increases, then the know-how in the automotive industry also increases. Based on this research, it has been proven that students are often trained to develop problem-solving skills.

Conclusion

The results of the research that has been carried out to answer the hypotheses tested on each construct can be concluded as follows:

1. Time management does not affect automotive electrical competence
2. The problem solving ablility has a direct positive and significant effect on the competence of automotive electricity. The power of students to solve unwittingly will increase competence since, in the face of problems, they must apply the knowledge they have gained to determine the methods and make decisions to solve problems
3. Improve automotive electrical competence and it can be done by increasing students' ability to solve problems

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