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Analysis of Problem-Solving Skills in Vocational and Technical High Schools with Different School Vision

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Abstract

This study aims to analyze how two different vocational and technical high schools which have different visions but similar success requirements for admission, cultivate the problem-solving skills of the students. This descriptive research is conducted with freshman and senior students in two different vocational and technical high schools in Turkey. The data of the research were collected through scenario-based performance tasks and a semi-structured interview form. Quantitative data were analyzed by two-way ANOVA. The content analysis method was used in the analysis of qualitative data. Findings obtained from the quantitative data of the research show that the problem-solving scores of the students in both vocational and technical high schools do not differ significantly according to the grade level but differ significantly in favor of the school type (A and B). The qualitative data of this research also showed that the students in school B established for educating individuals who produce their energy and use energy efficiently, emphasized the richness of the learning experience related to the problem-solving process more than the school A one focused on being innovative, being a leader and having vocational education intertwined with the industry. Our findings have implications for how vocational and technical education foster problem solving capable workforce to address the dynamic demands of the modern world. This study.

Keywords: program evaluation, training policy, technical school, vocational school, problem solving skill.

Farklı Okul Vizyonuna Sahip Mesleki ve Teknik Liselerde Problem Çözme Becerilerinin İncelenmesi

Öz

Bu çalışma, farklı vizyonlara ancak kabul için benzer başarı koşullarına sahip iki farklı mesleki ve teknik lisenin öğrencilerin problem çözme becerilerini nasıl geliştirdiğini analiz etmeyi amaçlamaktadır. Tanımlayıcı nitelikteki bu araştırma, Türkiye'deki iki farklı mesleki ve teknik lisedeki birinci ve son sınıf öğrencileriyle gerçekleştirilmiştir. Araştırmanın verileri senaryo temelli performans görevleri ve yarı yapılandırılmış görüşme formu aracılığıyla toplanmıştır. Nicel veriler iki yönlü ANOVA ile analiz edilmiştir. Nitel verilerin analizinde içerik analizi yöntemi kullanılmıştır. Araştırmanın nicel verilerinden elde edilen bulgular her iki mesleki ve teknik lisede de öğrenim gören öğrencilerin problem çözme puanlarının sınıf düzeyine göre anlamlı bir farklılık göstermediğini ancak okul türü (A ve B) lehine anlamlı düzeyde farklılaştığını göstermektedir. Bu araştırmanın nitel verileri, enerji üreten ve enerjiyi verimli kullanan bireyler yetiştirmek için kurulan B okulundaki öğrencilerin, inovatif olma, liderlik yapma ve mesleki eğitimin sanayi ile iç içe geçmesi üzerine odaklanan A okulundaki öğrencilerden daha fazla, problem çözme süreci ile ilgili öğrenim deneyiminin zenginliğini vurguladığını gösterdi. Bulgularımız, mesleki ve teknik eğitimin, modern dünyanın dinamik taleplerini karşılamak için problem çözme yeteneğine sahip işgücünü nasıl teşvik ettiğine dair çıkarımlar içermektedir.

Anahtar kelimeler: program değerlendirme, eğitim politikası, teknik okul, meslek okulu, problem çözme becerisi.

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INTRODUCTION

In today's standards, the definition of qualified personnel includes different skills in each sector, but the common and most striking feature of all these definitions is that the higher-order thinking skills of the so-called qualified personnel are developed. The World Economic Forum (2016) listed the qualifications expected from individuals in business life and it has been observed that the ability to solve complex problems, is at the top of the list. Although problem-solving skill has been a sought-after qualification in business life for a long time (Carnevale, Garner, and Metzer, 1990; Soden,1994; Curtis and Denton, 2003; Toner,2011), it will continue to be a sought-after qualification in the following years (Suprapto and Basri, 2017; P21, 2019; U.S. Department of Labor, 2022).

Therefore, considering vocational and technical high school (VTHS) students play an important role in the economic development of countries, it is vital for them to have developed problem solving. Since future workers equipped with problem-solving skills, will have insight (Kohler, 2019) and work for making good designs before situations that endanger human life are happened (e.g. Developing systems to drain the water without causing flooding when the rain is heavy or designing the playgrounds that minimize the possibility of our children having an accident in playgrounds) and so they will have a positive impact at many points of lives and also sustainable future (Cortese, 2003).

To make future workers competent in problem solving, the curricula (Grabbe,1989) which enable teaching-learning environment support problem solving skills. Therefore, in this research we hypotheses that as students participated in the social and cultural level of activities that shape human thinking and learning (e.g. Problem solving) as Lev Vygotsky stated and the learning activities in changing existing social practices emphasized by the Paulo Freire and Yrjö Engeström (Ilkka,2018), they would have opportunities to make sense of different problems and try out problem solving process more and so they will be good problem solver.

Theoretical Framework

This study is grounded in the theoretical framework of problem-solving. To develop problem solving skills in any learning environment, educators should have knowledge about the concept of problem, types of problem with which they will make students be faced and the steps of problem solving. Therefore, we explained the different definitions, types of problems, and the problem-solving process under this heading.

The Concept of Problem

Individuals may encounter different obstacles and difficulties in different areas of their lives. When considered in the field of education, we may think of the problems we encounter in textbooks in the classical sense. Considering our social relations, the problems we experience with the people around us may come to mind. Technical problems that we encounter in our home life, such as the devices we use, can be thought of. This concept can be extended with many more examples like these. In this context, Dewey (1910) defines the concept of the problem as any situation that confuses the human mind and challenges the person, Bingham (1998) as the obstacle that a person gathers to reach the desired goal, and Morgan (2009) as an obstacle to the achievement of a goal. Based on all these definitions, it is possible to express the concept of the problem as a difficulty that confuses the mind, creates an obstacle to reaching a goal, and is desired to be solved.

Types of the Problems

There are different classifications of problems by different researchers in the literature. Heppner (1978) divided the problems into two groups according to the situations encountered in real life. According to this classification, Problems encountered during communication with other people in their social lives are “personal problems”. Greeno (1978), according to the mental functions required by the problems; structuring problems, transformation problems, and editing problems. Editing problems; These are the problems in which all the elements related to the problem are given and these elements need to be arranged to solve the problem. Conversion problems: Starting and target points are given, and these are problems that require the correct sequence of the transformation steps to be used to reach the target by the individual. Structuring problems: The rule required to reach the result is the problems that the individual finds by looking at the examples. Jonassen (1997) treated the problems in two groups well-structured and unstructured (ill-structured). Structured problems are problems in which the problem situation is clear, the information necessary for the solution has already been presented, a solution strategy specific to the given problem, and a limited or single solution. In structured problems, all the information required for the solution is presented with an appropriate algorithm that guarantees a correct solution.

Finding the area of a rectangle, drawing a diagram of a theorem, or applying a classical physics law are examples of structured problems (George, 1980).

Unstructured problems, on the other hand, are problems where the problem situation is not given directly, the problem situation must be determined by the person who encounters the problem, and the problem situation may vary according to the person. Information about the problem may also not always be presented. Unstructured problems are vaguely defined and include many goals, and the information presented to the individual about the problem situation may be unclear, incomplete, and unrelated (Wood, 1994). Unstructured problems may contain knowledge and skills from more than one domain. To solve the problem, the individual must have knowledge and skills in the field or areas required by the solution (Polya, 1957). Unstructured problems can be presented ambiguously. Often there is not enough information to come up with a solution, there is no algorithm that guarantees the correct answer, and there is no single correct answer (Simon, 1973). The general approach to finding solutions to unstructured problems is to use a heuristic. The creative problem-solving process is an intuitive process that proposes intermediate answers that lead the problem solver to a solution (George, 1980). In summary, solving unstructured problems requires different approaches than those used for structured problems.

Problem Solving Process

Problem-solving has been defined by many researchers in the field of educational sciences. According to Polya (1945), problem-solving is the process of creating and researching conscious steps to get rid of the difficulty and find the most appropriate way to reach the result. According to Krulik and Rudnick (1980), problem-solving is a process in which an individual synthesizes his previous knowledge, skills, and understanding to meet the demands of an unusual situation and uses it in a new and different situation. Woods (1987) defines problem-solving as the mental process used to arrive at the "best" answer to something unknown, subject to certain constraints, or in some decision-making situation. According to Jonassen (1997), problem-solving is the process of reaching a goal by using mental steps. Bingham (2004) defines problem-solving as a process that includes making efforts to eliminate the difficulties encountered to reach a certain goal. Problem-solving includes choosing and using both subject knowledge and appropriate cognitive strategies that will lead the individual to the goal (Senemoğlu, 2018). Based on the different definitions of problem-solving, problem-solving can be defined as the process of encountering an obstacle while moving toward the goal to be reached noticing this obstacle and removing it. In addition, many different problem-solving models are seen in the literature. The problem-solving model developed by George Polya is one of the first models and is still accepted as an appropriate approach. The problem-solving model of Polya (1945) consists of four stages. These stages are making sense of the problem and classifying data, planning, executing the plan and checking progress, checking, and evaluating the solution. In the literature, Dewey (1910;1997), Osbourne (1952), Newell and Simon (1972), Bransford and Stein (1984), Greeno (1978), Heppner and Krauskopf (1987), Kneeland (1999) defined problem-solving steps like Polya (1945). Experimenting with these problem-solving steps in different problem situations in educational environments has great importance in improving the problem-solving skills of individuals. The literature emphasizes that the development of problem-solving skills depends on the types of problems used in the classroom environment (Krulik and Rudnick, 1980; Polya,1986) and strategies, methods, and techniques used in learning environments (Chiang & Lee, 2016; Foster, 2000; Hidayati, & Wagiran, 2020; Hidayatullah et al.,2020; Mahan, 1963; Polya, 1986; Samani et al.,2019; Wulansari, & Nabawi, 2021). In addition, previous literature about problem-solving skills in the field of vocational and technical education points out the importance of the problem-solving skills of teachers (Bolner,2020), the knowledge that students have about problem-solving (Atabay, 2004), self-efficacy perceptions of students (Bolner, 2020; Gölgeleyen,2011) or perceived ability to learn and solve problems (Tews, Michel and Noe, 2011), the time students allocate to problem-solving and class level (Gölgeleyen, 2011) and school type (Bolner, 2020) that students. Therefore, schools should provide a learning environment for students to encounter qualified problems and so to practice the problem-solving process progressively. In this context, we aimed to search how A and B vocational and technical education which have similar school registration prerequisites in terms of the high school entrance exam scores but were established for different purposes, supports the problem-solving skills of students. Our central question was: How do education in A and B vocational and technical high schools cultivate the problem-solving skills of students? The sub-questions were: (1) Is there a significant difference between the problem-solving skill levels of freshman (9th grade) and senior (12th-grade) students in A and B schools according to grade level? (2) Is there a significant difference between the problem-solving skill levels of the students in A and B schools according to school type? (3) How do senior students explain the contribution of education in A and B schools to their problem-solving skills?

METHOD

Research Design

This study which aims to reveal how the education in A and B schools cultivates problem-solving skills, employed a mixed methods research design, an approach that combines both qualitative and quantitative research methods. According to Creswell (2014), mixed methods provide depth and diversity to research problems, helping to better understand research findings. Therefore, the quantitative data were collected through scenario-based performance tasks, an authentic way of assessment (Curtis and Denton, 2003), which included scenarios with real-life examples about agriculture, industry, and environment, as well as open-ended questions for assessing problem-solving skills with rubrics. In addition to quantitative data, qualitative data were collected from 12th-grade students to reveal the contribution of Vocational and Technical Education in A and B schools to problem-solving skills in depth.

Participants

The study group of the research consists of students of 9th and 12th grade levels in the 2021-2022 academic year in A and B Vocational and Technical High Schools in Turkey. The School A is established in an industrial zone which provides the students the opportunity to observe the production processes and get to know the sector and its representatives closely to improve the quality of vocational and technical education (Republic of Turkey, 2018). The school B was not established in an industrial zone, but it was established within the scope of a project for Increasing Energy Efficiency. While the vision of School A on its web page emphasizes "to be innovative, to be a leader and to have vocational education intertwined with the industry" the vision given on the website of school B is highlighted as "to educate individuals who produce their energy and use energy efficiently". Although schools have different visions, their school registration prerequisites in terms of the national high school entrance exam scores were similar. Because the VTHS is preferred by the students in a similar quantile (around % 6) in terms of success in this exam. A total of 239 students, including 9th grade (N:48) and 12th grade (N:44) students from school B, 9th grade (N:80) and 12th grade (N:67) students from school A, participated in the research.

Data Collection

The problem-solving skills of two VTHS's were investigated through scenario-based performance tasks consisting of scenarios and open-ended questions although the data related with problem solving skills were commonly collected with scales in previous research related with vocational and technical education (e.g., Atabay, 2004; Bolner, 2020; Efetevbia, 1996; Gölgeleyen; 2011). In addition, a problem-solving skills rubric that helps to evaluate the answers given to the questions in the scenario-based performance task, and a semi-structured interview form which was developed to understand how vocational and technical education cultivates problem-solving skills were used in this research.

Scenario-Based Performance Task and Rubric

First, the trial form of the scenario-based performance task was prepared. The trial version of the scenario-based performance task included nine scenarios, three for each topic of health, agriculture, and environment. Each scenario had five open-ended questions that presented unstructured problems (see appendix 1). The contents of the scenarios were determined according to common courses which are taught in both school A and school B, and the open-ended questions asked about the scenarios were prepared in a way that corresponds to the problem-solving steps. With these questions, the students were asked to identify the problem in the given scenario, present possible solutions, show evidence of the solutions they presented, identify the most appropriate solution, and make an evaluation regarding the solution. The scripts of scenarios and open-ended questions were written plainly and clearly to make not difficult for students to understand. For the content validity of the scenario-based performance task, first, the opinions of eight experts from the field of educational science were taken. Then the scenario-based performance task was applied to 30 students. The answers of the students for the scenario-based performance task with 9 scenarios were examined by researchers and 3 scenarios that were thought to provide the most data to the questions were selected for the final form of the scenario-based performance task. The contents of the three scenarios used in the study are as follows:

Scenario 1: In this scenario, a problem situation related to the decrease in the age of obesity and chronic diseases until childhood due to unhealthy diet and unconscious technology use is given.

Scenario 2: In this scenario, a problem situation related to food supply, which is likely to be experienced in the future because of the loss of attractiveness of agriculture and the decrease in agricultural lands, is given.

Scenario 3: In this scenario, a problem situation related to environmental pollution caused by people's ignorance about recycling and inadequate recycling collection stations is given.

In addition, a rubric was developed by the researcher to evaluate the answers given by the students to the open-ended questions. The rubric was prepared by the problem-solving steps The categories used in this rubric were identifying the problem, generating solutions for the problem, providing evidence of resolution, identifying, and evaluating the solution strategy, and implementing the solution. The evaluation key consisted of 5 categories and four levels: 0 (inadequate),1 (poor), 2 (moderate), and 3 (good). The minimum score that can be obtained from the evaluation key for the answers given for the three scenarios is 0 whereas the maximum score is 45.

Then the form of a scenario-based performance task with three scenarios and five open-ended questions was applied to 31 students and the collected data were scored with problem problem-solving skills rubric by two raters and then Inter-rater reliability was calculated by determining the agreement between the scores given by more than one rater. The inter-rater correlation coefficient is one of the many techniques used to determine inter-rater reliability (Jonsson and Svingby, 2007). According to this, to determine the reliability between raters in the study, the Pearson Correlation Coefficient was calculated with the scores given to the scenarios by both raters. Pearson Correlation Coefficient, which is a method frequently used in calculating inter-rater reliability, is defined as the consistency of the scoring of two raters. In other words, this coefficient indicates the linear relationship of the scores of the two raters; that is, it shows its change together (Güler and Taşdelen Teker, 2015; Tabachnick and Fidell, 2007). Therefore, in this research, the Pearson Correlation Coefficients showed that there was a positive, significant, and high-level correlation (Scenario 1:.774, Scenario 2: .765, and Scenario 3: .805) between the scores given by the raters for all three scenarios ($p < 05$). This showed that there is a positive, significant, and high correlation between the scores given by the raters for all three scenarios ($p < 05$). The literature emphasized that a correlation coefficient between 0.70-1.00 is high; between 0.70-0.30 is moderate; and between 0.30-0.00 can be defined as a low-level relationship (Büyüköztürk, 2020).

The Interview Form

Qualitative data of this research were collected with a semi-structured interview form developed by researchers. In order to ensure validity of the data obtained from the research, the opinions of two experts from the educational science department was taken for interview form. The interview form was rearranged in line with the opinions of the experts and applied to three students attending vocational and technical education for the comprehensibility of the questions. The trial version of the interview form was rearranged again and finalized in light of the information obtained from the interview with three VTHS students. The last version of the interview form was implemented for five 12th-grade students in School A and five 12th-grade students in School B as well. In order to ensure reliability (LeComplete and Preissle Goetz, 1982), questions were asked to all students by using similar approaches during the interview. For the transferability of the research, students were asked to explain their thoughts in detail and give examples during the interview.

Data Analysis

The Quantitative data were analyzed by two-way ANOVA which enables to control the effects of two factors together on a response variable. Before the quantitative data was analyzed with Two Way ANOVA, the assumptions of this test were checked. Firstly, the data set was prepared for the analysis since it was necessary to work with a qualified data set. The skewness and kurtosis coefficients of the research variables are presented in Table 1.

Table 1. Values About the Normality of the Data

Variable	Groups	Skewness	Kurtosis
School Type	A	.091	-.700
	B	.106	-.796
Class Level	9th grade	-.089	-.508
	12th grade	.216	-.758

The data distribution is considered normal if the kurtosis and skewness values are between +2 and –2 (George and Mallery; 2010). When Table 1 is examined, each of the subgroups of the categorical variables of the research is normally distributed. In addition, another assumption for two-way ANOVA is the homogeneous distribution of variances. For this, Levene's test was performed. According to Levene's test results, variances are distributed homogeneously ($p=.135 > .05$).

In addition, content analysis was used in the analysis of qualitative data. We used a deductive approach to read the interview transcripts and analyzed these texts to find meaningful semantic codes related to the main themes in interview questions. We aimed to build these codes around what participants say, mirroring their meanings (Willig and Stainton-Roger, 2017). In this context, meaningful units were found by examining the interview records, temporary coding was made. The themes and codes were re-examined and the relationships between the themes were checked. Then we calculated how many students emphasized the same codes. In addition, the qualitative data was coded by a second coder, and inter-coder reliability was calculated as 70%. That means the coding results of the two coders are in harmony and acceptable (Büyüköztürk et al., 2008; Miles and Huberman, 2015). Also, quotes are used to support our claims and illustrate students' ideas obviously and evoke emotion for the reader. The codes were given to each student participated in the interview and the letter "S" was used for students while qualitative data is presented.

FINDINGS

Findings Related to Research Question 1

In this research, we aimed to search whether there is a significant difference between the problem-solving skill levels of 9th and 12th-grade students in schools A and B according to grade level and school type. For this purpose, Two-way ANOVA was used. In Table 2, the descriptive statistics about the problem-solving levels of 9th and 12th-grade students in School A and School B are first given and In Table 3, ANOVA results are presented.

Table 2. Descriptive Statistics about the Problem-Solving Levels of 9 and 12th-Grade Students in School A and B

	9th Grade			12th Grade			Total		
	N	$\bar{x}$	SD	N	$\bar{x}$	SD	N	$\bar{x}$	SD
School A	80	22.86	9.49	67	20.27	9.18	167	21.51	9.39
School B	48	24.06	7.71	44	24.07	9.53	92	24.07	8.58

When Table 2 is examined, 80 people participated in the research at the 9th grade level

in School A, while 67 people participated in the 12th grade. In the school B, there are 48 students in the 9th grade, while there are 44 students in the 12th grade. While the problem-solving average of 9th-grade students in School A is 22.86, the problem-solving average of same graders in School B is 24.06. Also, the problem-solving average of 12th-grade students in School A is 20.27, the problem-solving average of same graders in School B is 24.07. In total, 167 people participated in the research in School A, while 92 people participated in School B. However, the mean is 21.51 and the standard deviation value is 9.39 for School A, while the mean is 24.07 and the standard deviation value is 8.58 for School B. Also, The ANOVA results are given in Table 3.

Table 3. The ANOVA Results About the Problem-Solving Skills Levels According to Class Level and School Type

Source	SS	df	MS	F	p	η^2
Class Level	98.655	1	98.655	1.194	.276	.005
School Type	370.541	1	370.541	4.484	.035*	.017
Class Level* School Type	101.277	1	101.277	1.226	.269	.005
Error	151962.750	259	82.641			
Total	21742.456	258				

Table 3 shows that the problem-solving scores of VTHS students do not differ significantly according to grade level (F (1-259) =.276; p>0.05). On the other hand, Tablo 3 shows that there is a significant difference between the problem-solving skill levels of 9th and 12th-grade students according to the school type that students attended (F (1-259) =.035; p<0.05). For this purpose, when Table 2 and Table 3 are examined together, problem-solving scores of students who attended school B are significantly higher than students who attended school A but the effect size is small (η^2 =.017) When Table 3 is examined, it is observed that the school type and grade level variables together do not have a significant effect on the problem-solving skill levels of VTHS students (F (1-259) =.269; p>0.05).

Findings Related to Research Question 2

Within the scope of the qualitative data of the research, interviews were conducted with the senior students in school A and B about the contribution of the education they received in high school to their problem-solving skills. The results of the interviews provide important findings in terms of explaining the reasons for the difference between the problem-solving skill levels of the students in school A and B. The school A students explained the contribution of the school to their problem-solving skills by bringing them in "comprehensive perspective(f=4), learning the different ways of reaching knowledge (f=3), foresight (f=1), conscious about the steps of the problem (f=1)". A student explained how the school supported them to have a comprehensive perspective in the following sentences:

"...Social situations are all intertwined issues, and a part of each chain affects us all. That's why the vocational training I received as a perspective on such problems. He contributed a lot to me, as I just mentioned. the ability to look at events from different perspectives, to have a comprehensive perspective to offer more competent solution suggestions, and to implement them..." S4

One of the remarkable findings of the research is that one of the students explained that the education they received gave them "learning the different ways of reaching knowledge" even though it did not provide them with problem-solving skills:

"...Well, it gives perspective. In other words, although it does not provide any skills, you know where you learn from and where you can get the information because it teaches you the pith of the matter at some points. You realize that this is very important in engineering. After a point, you use the internet much more effectively, you know, if you don't know something, you learn the steps you need to take to reach that information. Vocational education has such a benefit, it teaches technical thinking...." S1

Another student stated that the school gained "foresight into the results of the problem" with the following sentences:

"...Yes, it has given you the ability to predict how different actions you can take, this may have more than one solution to a problem, and some of these solutions aim to eliminate, reset, or disrupt that problem instead of solving it. Since we can foresee them, we can approach the problems more healthily..." S3

Another student stated that school provides "conscious about the steps of the problem" and she learned to focus on the cause of the problem at school, in other words, she learned to look at problem-solving processes from a different perspective:

"...When I encounter a problem, I focus directly on the solution beforehand, but I realized that the main thing I need to do is to realize what the problem is caused by. When I come to school, a problem I encounter is first I look at why, and then I go through how to edit it, and when I understand why, most things are easier...." S3

School A students (f=2) explained the contribution of vocational and technical education about problems related to health, agriculture, and environmental issues as "awareness" of these subjects. They exemplified this awareness as that their schools mostly focus on the problems that the companies in the industrial region are looking for solutions to:

"...When you study at a technical school, something like this happens, of course, you start to be interested in the solutions that the companies around you, are looking for, or you participate in various competitions. When you come to the point of developing your skills, you see a lot of demand for these issues in the environment, agriculture, and industry, so even if you are not interested in the subject, if there is a problem, you start searching these issues to identify the problem and find a solution for that problem, so it raises your awareness at this point…" S1

The interview data obtained from students in School A shows that their schools do not focus directly on the activities related to problem-solving or the whole process of problem-solving. They focus on some pre- or sub-skills related to problem solving such as foresight, and consciousness about the steps of the problem. Also, the opinions of students show that their schools focus on the problems of the companies around them.

On the other hand, the school B students explained the school's contribution to problem-solving skills by including "various problem-solving activities (f=5)" in their schools. Students exemplified how school B focused on the problem-solving process by focusing on inventions and innovations in their schools, giving projects to students, and teachers coming to their classes with a problem they expect students to solve:

"...It influenced me a lot, I think it has improved a lot because, in our school, many inventions and innovations are made. We already identified the problem and are going after it. We are investigating the reason for this. So, there is a benefit." S2

"In other words, the projects given to us at school, the tasks given to us, the things that enable us to be more self-confident and to solve our problems and find new solutions, I think, influence this issue, given by the teachers. Because I wasn't like this before I came to this school. I was more passive. After coming here, I started to think more and realize that you can solve anything" S1

"...In vocational education at school, our teachers always give us a problem and proceed with a solution to it. So, they never give the answers. For example, there is broken material or something. they don't directly say anything by giving it to us. He wants us to solve the problem ourselves. Since vocational education is in this way, I can say that vocational education has contributed to me a lot about problem-solving..." S3

When the students' quotations above are examined, it is seen that the practices related to problem-solving in their schools are done in various ways and in a way that positively affects the students' self-efficacy beliefs about problem-solving.

In addition, School B students (f=3) explained the contribution of vocational and technical education about problems related to health, agriculture, and environmental issues as "awareness" of these subjects. In this context, they emphasized that education in their school focuses on environmental issues such as recycling and renewable energy which is emphasized in the school B vision:

"...Consciousness. For example, we have very good work on recycling. That's why I think they have already given me consciousness ..." S2

"... I am taking vocational training in the energy department. Solar energy, environmental pollution, etc. is a big problem for us. From that point of view, how can I say, Vocational education has made a great impact on problems such as environmental pollution." S3

When the views of 12th-grade students in school A and B are examined in general, it is remarkable that 12th-grade students in school B are more focused on basic problem-solving processes rather than sub-skills or different skills related to problem-solving compared to 12th-grade students in School A.

DISCUSSION & CONCLUSION

In this research, we examined how the VTHS in both school A and B supports problem-solving skills. This research showed that the problem-solving skill levels of school A and B students did not differ according to the grade level. Likewise, some of the research (e.g., Atabay, 2004; Efetevbia, 1996; Sağ, 2010) shows that there is no difference in terms of grade levels of students in VTHS. This study also showed that the problem-solving skill levels of school A and B differ according to the school type in favor of school B. Similarly, Bolner (2020) examined the problem-solving skills of students in traditional vocational high schools and technical high schools which their focus was different, and it was found that the Problem-Solving Self-Efficacy Perceptions of students in technical high schools compared to those in traditional vocational high schools were higher, they avoided problem-solving less, and they were able to control better while solving problems.

Supportively, the findings obtained from the qualitative data of our research reveal the crucial clues for the difference in problem-solving skills between the school A and B. This data asserts that the difference in problem-solving skills between the two schools is due to the richness of the learning environments which support experience in the problem-solving process. In addition, the priorities of the school stated in the vision of school B focused problem-solving process more. Previous research also mentioned the importance of content and the teaching-learning process for developing problem-solving skills (Chiang & Lee, 2016; Foster, 2000; Hidayati, & Wagiran, 2020; Hidayatullah et al.,2020; Krulik and Rudnick, 1980; Mahan, 1963; Polya, 1986; Samani et al.,2019; Wulansari, & Nabawi, 2021).

The results of this research showed that the problem-solving skills of the students in a VTHS, which was established to solve problems such as increasing energy efficiency and offers a rich learning environment in this regard, are more developed than the VTHS students who prioritize on innovation, leadership, and vocational education intertwined with the industry. At this point, curricula and school visions of VTHS can be updated to increase students' problem-solving skills in Vocational Education. Therefore, learning experiences in lessons or internships can be designed for the students to encounter different problems and use the problem-solving steps effectively. The problem-solving skills of students in different VTHSs around Turkey can be examined and schools who have students or graduates with high problem-solving skills can be determined and the learning experiences

in these schools can be applied to other schools. Also, in-service training about cultivating problem solving skills. can be given to the teachers worked in VTHS who have students with low problem-solving skills.

Limitations

This research has also some limitations. Firstly, the data is obtained from two vocational high school students. The findings of the study cannot be generalized to other vocational and technical high schools throughout the country. Also, a cross-sectional evaluation based on the snapshot of the problem-solving skills of the freshman such as the 9th grade and senior such as 12th grade, was made in this study. To see how the development of problem-solving skills of the students attended to A and B vocational and technical high school, longitudinal studies that examine the development of problem-solving skills should be done. In this study, problem solving skills of students were determined through three scenarios prepared for daily life considering the general subjects taught in VTHS. The problem-solving skills of VTHS students can be determined through more content specific scenarios in which examine their field knowledge. Data on students' problem-solving skills can be collected by using different measurement tools. Students' problem-solving skills can be analyzed through data sources including teachers' and parents' opinions and in-class researcher observations.

Statements of Publication Ethics

The ethical principles of the publication process were rigorously followed in this study, ensuring integrity, transparency, and compliance with all relevant ethical standards throughout the research and publication. All authors have disclosed potential conflicts of interest and upheld the highest standards of research ethics. Ethics Committee Approval was taken from Hacettepe University with the issue number 43A19999-F43E-

Researchers' Contribution Rate

Authors	Literature review	Method	Data Collection	Data Analysis	Results	Conclusion
Author 1	☒	☒	☒	☒	☒	☒
Author 2	☒	☒	☒	☒	☒	☒

Conflict of Interest

All authors certify that they have no affiliations with or involvement in any organization or entity with any financial interest or non-financial interest in the subject matter or materials discussed in this manuscript. The authors have no financial or proprietary interests in any material discussed in this article.

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