International Journal of Progressive Education, Volume 16 Number 5, 2020

21st Century Skills: The Predictive Role of Attitudes Regarding STEM Education and Problem-Based Learning

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Abstract

The objective of this research is to determine the predictive situation of the proficiency perceptions of preschool teacher candidates' attitudes regarding STEM Education and Problem-Based Learning (PBL) towards 21st century skills. Within the scope of this objective, correlational survey design, one of the quantitative research methods, was used. The sample of the research consisted of a total of 284 teacher candidates studying in the Department of Preschool Education. In order to measure the 21st century skills of the teacher candidates according to their own perspective, the '21st Century Skills and Competences Scale' was used. To measure the attitudes of the teacher candidates towards STEM education, the 'STEM Education Attitude Scale'was used. In addition, the 'Problem-Based Learning Attitude Scale' was employed to identify the candidates' attitudes towards problem-based learning. Standard multiple linear regression analysis was performed while analyzing the data. As a result of the research, it was observed that the attitudes of the preschool teacher candidates regarding STEM education and PBL had a moderate and meaningful relationship with their proficiency perceptions towards 21st century skills. Additionally, it was found out that the candidates' attitudes towards STEM education and PBL explained 20% of their proficiency perceptions towards 21st century skills. In the light of the results obtained from the research, in order for preschool teacher candidates and teachers to design appropriate and qualified learning environments, it is suggested that they can be compared with enriched teaching practices that will be supported with different and innovative approaches, such as STEM and PBL, and structured in the focus of developing 21st century skills.

Keywords: 21st Century Skills, STEM Education, Problem-Based Learning, Preschool Teacher Candidates

DOI: 10.29329/ijpe.2020.277.27

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INTRODUCTION

In the digital age where information and technology are constantly changing, individuals are confronted with many problems. Individuals will need to be ready to solve problems related to issues that have not yet been created and technologies that have not yet been invented and to handle problems caused by unexpected situations (Garay & Quintana, 2019). Individuals must have a range of skills called 21st century skills in order to face these challenges.

Garay & Quintana (2019) have defined 21st century skills as a range of skills that are essential to interact with work and employment in today's world, especially in the technology management. In another definition, 21st century skills are defined as lifelong learning skills that allow students to familiarize with their changing life conditions and to become more responsive (OECD, 2005). Even though 21st century skills are known as a concept in which a wide range of knowledge, skills and talents are blended into individuals in today's world (Dede, 2010), there is no clear definition of which set of knowledge and skills it consists of (Sayın & Seferoğlu, 2016). The knowledge and skill areas required for individuals to adapt and succeed in the 21st Century's requirements are shown in Figure 1.

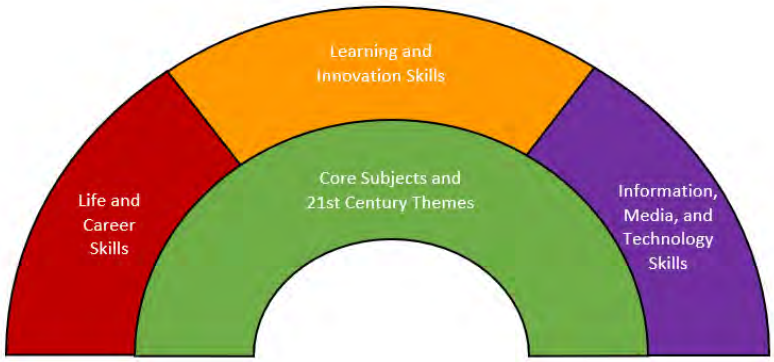

Figure 1. The 21st Century Knowledge and Skills Rainbow (Trilling & Fadel, 2009)

The structure and components of the rainbow in Figure 1 show a set of knowledge and skills that form 21st century skills. The basic skills recommended for individuals to acquire in the 21st century are life and career skills, learning and innovation skills, and knowledge, media and technology skills (Partnership for 21st Century Skills, 2019). 21st century skills are not actually new. What is new is the importance of possessing these skills for individual and social success (Rotherham & Willingham, 2010). When the concept is so important, the necessity of teaching the concept effectively and qualifiedly is necessary (Beswick & Fraser, 2019). With no doubt, education has a key role in the development of 21st century skills (Beswick & Fraser, 2019; Kay, 2010; Wan Husin et al., 2016).

In today's educational approach, it is crucial for educational systems to provide students with 21st century skills and qualifications (Beswick & Fraser, 2019). Beyond learning and spreading, what is expected of education is to help students prepare for a future that requires continuous learning and to actively use 21st century skills (Krskova, Wood, Breyer & Baumann, 2020; Mutiani & Faisal, 2020; Park & Suh, 2020).

The development of 21st century skills in students requires to determine new pedagogical and content-based goals in education (Voogt, Erstad, Dede & Mishra, 2013). Educating students with educational approaches according to the paradigms emerging in the century is very important for the development of 21st century skills. It is argued that an approach that integrates holistic and diverse fields such as science, technology, engineering and mathematics (STEM) education in the international arena will make it easier for 21st century skills to keep up with contemporary changes

and developments (Akgündüz, 2016; Beswick & Fraser, 2019; Karahan, 2019; McClure et al., 2017; Ünal & Aksüt, 2019; Yasar Ekici, Bardak & Yousef Zadeh, 2018).

In STEM Education, teachers always play the most critical role (Darling-Hammond, 2016). This is because teachers are responsible for the practice of various teaching methods and techniques, as well as preparing the environment in order to make children's scientific thinking real, giving them the ability to create concrete solutions using basic knowledge and skills for STEM areas (Günşen & Uyanık Balat, 2018; Mirzaie, Hamidi & Anaraki, 2009). However, the ability of teachers to carry out STEM Education in accordance with their purpose to bring the interdisciplinary perspective to all areas is closely related to their knowledge, experience and skills (Tippett & Milford, 2017). In this respect, it is thought that teachers should have sufficient knowledge of STEM subjects and application skills (Yaşar Ekici et al., 2018). From the results of different researches, it is understood that the biggest obstacle to teachers while revealing children's natural discovering ability is themselves (Toma & Greca, 2018; Uğraş & Genç 2018) and that teachers believe that they do not use STEM Education adequately (Yasar Ekici et al., 2018). However, a real and positive perception of STEM Education should be developed by teachers. Researches show that teachers' beliefs, self-perceptions and attitudes towards their qualifications and skills on STEM Education greatly affect STEM Education practices (Atiles, Jones & Anderson, 2013; Ong et al., 2016; Hedlin & Gunnarsson 2014; Park, Dimitrov, Patterson & Park, 2017). Teachers' attitude about the suitability of STEM Education affects the time, interest and even other decisions and behaviors they dedicate to these activities in their classrooms (Simoncini & Lasen, 2018).

Even though it is an important driving force of the 21st century skill agenda, giving STEM Education to students is not enough. In addition to STEM Education, it is also necessary for students to meet teaching strategies that will teach them real-world problem-solving skills (Beswick & Fraser, 2019; McCain, 2007). Problem-based Learning Approach (PBL) is one of them. In PBL, an effective method for combating teacher-centric teaching (Lapek, 2018), student-centric questioning is the most important learning time (Campbell, Jobling & Howitt, 2018). In this approach, students learn to use their own ideas in an original way to solve the faced problems (Lapek, 2018). In a PBL environment, STEM concepts can be included in the teaching process and used to improve the students' education quality (Asghar, Ellington, Rice, Johnson & Prime, 2012). Students can also be included in STEM activities and a foundation can be built to prepare students for future STEM careers (LaForce, Noble & Blackwell, 2017). Therefore, the PBL approach can actively be used as a teaching method that can improve students' 21st century skills (Savery, 2015; Tee & Lee, 2013; Yeo & Tan, 2014).

The sooner the mentioned information, competence and skills are acquired, the more effective it will be to deal with problems in the lives of individuals in a productive way (O'Neal, Gibson & Cotten, 2017; Tuğluk & Altın, 2018). Especially preschool education should be established on the development of these skills (Akgündüz, 2018). The child will be able to acquire the desired skills and grow up in a healthy manner with a qualified preschool education. In this respect, the need for future adults to develop their training programs in order to effectively teach 21st century skills should be revealed (Koh & Chapman, 2019; Park & Suh, 2020). However, it is noted that the preschool education program is particularly inadequate in terms of meeting 21st century skills (Tuğluk & Özkan, 2019; Yasar Ekici et al., 2018). It is possible to minimize this inadequacy by offering students new learning opportunities (Akgündüz & Akpınar, 2018; Larson & Miller, 2011). Additionally, students' involvement in innovative teaching strategies such as STEM and PBL will also play an effective role in developing students' 21st century skills (Koh & Chapman, 2019; Mutiani & Faisal, 2020). From this perspective, the importance of preservice period in which teachers' perceptions of 21st century skills are formed should be underlined (Gudmundsdottir & Hatlevik, 2018; Uyanık-Balat & Günşen, 2017). Especially determining the perceptions of preschool teachers for 21st century skills prior to service and demonstrating the predictive power of different methods and approaches such as STEM education and PBL are thought to be important for candidates to address their shortcomings on this matter (Harris, Lowery-Moore & Farrow, 2008; Uğraş & Genç, 2018).

Within the framework of the explanations mentioned above, it is thought that preschool teacher candidates' attitudes towards STEM education and PBL may be important variables in the process of predicting their proficiency perceptions towards 21st century skills.

The Purpose of the Research

The purpose of this research is to determine the predictive situation of the proficiency perceptions of preschool teacher candidates' attitudes regarding STEM Education and Problem-Based Learning (PBL) towards 21st century skills. For this purpose, the research problems of the research were created as follows:

1. What is the level of preschool teacher candidates' proficiency perceptions towards 21st century skills?

2. What are the attitudes of preschool teacher candidates towards STEM education and PBL?

3. Are teacher candidates' attitudes towards STEM education and its sub-dimensions a meaningful predictor of proficiency perceptions and sub-dimensions for 21st century skills?

4. Are teacher candidates' attitudes towards PBL a meaningful predictor of proficiency perceptions and sub-dimensions for 21st century skills?

5. Together with teacher candidates' attitudes towards STEM education and problem-based learning, do 21st century skills significantly predict proficiency perceptions?

METHOD

Research Design

Correlational survey design was used in this research. This model aims to determine the relationship between two or more variables, the degree of this relationship and to obtain clues about the cause and effect (Büyüköztürk, Çakmak, Akgün, Karadeniz & Demirel, 2016; Karasar, 2013).

Population-Sampling

The population of the research consists of teacher candidates who studied in the Faculty of Education at Çanakkale Onsekiz Mart University during the 2019-2020 academic year. A total of 284 teacher candidates studying in the Department of Primary Education Preschool constitute the sample group of the research. The purposive sampling method was employed in the selection of the samples. In special cases with certain criteria and characteristics, it is recommended to use this technique (Büyüköztürk et al., 2016). In this context, data collection tools were applied to preschool teacher candidates who continue their education at different grade levels, including 87 (30.6%) first-year, 90 (31.7%) second-year, 63 (22.2%) third-year and 44 (15.5%) senior students. It was determined that preschool teacher candidates did not take a compulsory or elective course for the variables (STEM, 21st century skills and PBL) during the study.

Data Collection Tools

In this research '21st Century Skills Proficiency and Competences Scale', 'STEM Education Attitude Scale'' and ' Problem-Based Learning Attitude Scale' were used. Information about the scales is included in the subheadings.

21st Century Skills and Competences Scale

In order to measure the teacher candidates' 21st century skills based on their own perspective, the '21st Century Skills and Competences Scale' developed by Anagün, Atalay, Kılıç and Yaşar (2016) was used. The 42-item scale focuses on three dimensions: Learning and Innovation Skills, Life and Career Skills, and Information and Media and Technology Skills.

In the relevant research, the Cronbach's alpha value of the scale was 0.889; and the Cronbach alpha coefficients of its subdimensions were 0,845 for Learning and Innovation Skills, 0,846 for Life and Career Skills and 0,810 for Information, Media and Technology Skills. In this research, the reliability coefficient of the scale was calculated as 0.907. For its subdimensions, the coefficient was 0,879 for Learning and Innovation Skills, 0,803 for Life and Career Skills and 0,848 for Information, Media and Technology Skills.

Attitudes towards STEM Education Scale

To measure the attitudes of the teacher candidates towards STEM education, the 'STEM Education Attitude Scale', which was developed by Berlin and White (2010) and adapted to Turkish by Derin, Aydın and Kırkıç (2017), was used. The 32-item scale has the Osgood-type scale structure and consists of two subdimensions: 'meaningfulness' and 'feasibility'.

The Osgood-type scale can measure attitudes and tendencies that are meant to be measured organizing the semantic differences of words excellently in a simple, understandable and time-saving way (Berlin & White, 2010). On this scale type, participants choose the word that feels closer to them from two antonyms (for example: boring __: __: __: __: __ exciting) (Erkuş, 2012). The scale is encoded as 1, 2, 3, 4 and 5 for each item, depending on where teacher candidates mark their attitudes and perceptions. In this coding, 5 expresses the highest attitudes and perceptions, while 1 refers to the lowest. The encodings in between were distributed as (1 2 3 4 5) or (5 4 3 2 1) to strengthen the internal consistency of the scale. However, some substances in the sub-dimension of feasibility are encoded as (1 3 5 4 2) to make the attitude and perception slightly more intense (e.g. simple __: __: __: __: __ complex) (Berlin & White, 2012). Similarly, for the (difficult __: __: __: __: __ easy) item, it was coded as (2 4 5 3 1) in order to make the "difficult" attitude and perception to be a bit more dominant (Derin et. al., 2017).

The entire scale's Cronbach alpha coefficient was calculated as 0.77 in the relevant research. While the Cronbach alpha value of 'meaningfulness'' was calculated as 0.92, this value for 'feasibility' was found to be 0.84. In this research, the scale's reliability coefficient was calculated as 0.710, and for its subdimensions, this value is 0.876 for 'meaningfulness', and 0.700 for 'feasibility'.

Attitude Scale Towards Problem Based Learning

In order to determine the attitudes of the teacher candidates towards problem-based learning, the 'Attitude Scale Towards Problem-Based Learning' developed by Turan and Demirel (2010) was used. The scale, rated in 5-Point Likert type, consists of 20 items, 10 of which are negative. The minimum score from the scale is 20, while the maximum score is 100. The Cronbach Alpha reliability coefficient calculated for the scale's reliability was 0.95. In this research, the reliability coefficient of the scale was calculated as 0.908.

Data Collection

The data of the research were collected in the spring semester of the 2019-2020 academic year. It was stated that filling the scales implemented by the researcher was voluntary and that the results would be used only for scientific purposes. Instructions were provided on how to fill each scale. Approximately 40 minutes of time was given to complete the scales.

Analysis of Data

SPSS 20.00 program was used to evaluate the research data. Standard multiple linear regression analysis was performed to solve research problems; however, in order to test the suitability of this test, the provided linearity; whether there was a missing data; and the proficiency of the number of the samples were checked along with the multi-variable normality (Palant, 2007). After the analysis, the data set of 67 students was excluded from the research.

Standard multiple linear regression analysis is used to determine how predictive two or more independent variables, which are thought to be related to the dependent variable, are, according to Büyüköztürk (2008). In this research, the predictive variable of the research is the attitude towards two sub-dimensions of STEM education and PBL, and the predicted variables are the perception of proficiency and sub-dimensions of 21st century skills.

In addition, the average scores in the research findings were graded as follows: 1-1.80 points is very low, 1.81-2.60 points is low, 2.61-3.40 points is medium, 3.41-4.20 points is high, and 4.20-5.00 points is very high. In the interpretation of Pearson Moments Multiplication Correlation Coefficients (r), the level of positive relationship correlation coefficients was taken as 'high' between 0.70-1.00; 'medium' between 0.70-0.30, and 'low' between 0.30-0.00 (Büyüköztürk, 2008).

FINDINGS

The numerical values depicting the sub-dimensions of the preschool teacher candidates' proficiency perceptions towards 21st century skills and attitudes towards the sub-dimensions of STEM education and PBL are included in Table 1.

Table 1. The description of the numerical values for the sub-dimensions of the preschool teacher candidates' proficiency perceptions towards 21st century skills and attitudes towards the sub-dimensions of STEM education and PBL

Variable	N	$\bar{x}$	SD
Learning and innovation skills	284	3.75	0.81
Life and career skills	284	4.15	0.72
Information, media and technology skills	284	4.28	0.70
STEM Meaningfulness	284	3.98	0.97
STEM Feasibility	284	3.31	0.99
PBL	284	4.13	0.67

In Table 1, it was found that the teacher candidates had a high level of learning and innovation skills ($\bar{x}$=3.75) and of life and career skills ($\bar{x}$=4.15) whereas they had a very high level of information, media and technology skills ($\bar{x}$=4.28), which are the sub-dimensions of their proficiency perceptions towards 21st century skills. Their STEM education attitudes were found to be high in meaningfulness ($\bar{x}$=3.98) and medium in feasibility ($\bar{x}$=3.31), while their PBL attitudes ($\bar{x}$=4.13) were found to be high.

The results of the multiple regression analysis of the teacher candidates' attitudes towards the sub-dimensions of STEM education and PBL in terms of predicting proficiency perceptions towards 21st century skills were given in Table 2.

Table 2. Multiple regression analysis results on the prediction of proficiency perceptions towards 21st century skills

Variables	B	Standard Error	B	T	P	Zero-order	Partial
Fixed	102.361	10.983	-	9.320	0.000	-	-
STEM	0.074	0.074	0.081	1.440	0.151	0.160	0.086
PBL	0.100	0.100	0.365	6.489	0.000	0.382	0.361
R=0.391 R^2=0.153 F (2,281)=25.293, p=0.000							

In Table 2, the teacher candidates' attitudes towards STEM education and PBL have a moderate and meaningful relationship with their proficiency perceptions towards 21st century skills, R=0.391, R^2=0.153, p<0.01. The two variables mentioned explain approximately 20% of the total variant. According to the standardized regression coefficient (β), the sequence of the relative importance of the predictive variables regarding proficiency perceptions towards 21st century skills are in the form of attitudes towards PBL and STEM education. As for the t-test results on the significance of the regression coefficient, it is seen that only the PBL variable is a significant predictor of proficiency towards 21st century skills. The teacher candidates' attitudes towards STEM education do not have a significant impact on their proficiency perceptions towards 21st century skills.

In addition, while examining the binary and partial correlations between the predictive variables and the dependent variable, it is observed that the teacher candidates have a positive and low level relationship between proficiency perceptions towards 21st century skills and attitude scores related to STEM education (r=0.160), [when the effect of other predictive variables is controlled (r=0.086)]. When looking at the binary correlation between proficiency perceptions towards 21st century skills and PBL-related attitude scores, a positive and moderate relationship (r=0.382) is observed [when the effect of other predictive variables is controlled (r=0.361)].

The results of the multiple regression analysis of the teacher candidates' attitudes towards the sub-dimensions of STEM education and PBL in terms of predicting 21st century learning and innovation skills were given in Table 3.

Table 3. Multiple regression analysis results on the prediction of learning and innovation skills

Variables	B	Standard Error	B	T	P	Zero-order	Partial
Fixed	34.630	6.465	-	5.357	0.000	-	-
STEM Meaningfulness	0.077	0.048	0.097	1.588	0.113	0.169	0.094
STEM Feasibility	-0.009	0.073	-0.007	-0.120	0.904	-0.046	-0.007
PBL	0.245	0.056	0.261	4.408	0.000	0.287	0.255
R=0.303 R^2=0.092 F (3,280)=10.176, p=0.000							

In Table 3, it is observed that the sub-dimensions of the teacher candidates' attitudes towards STEM education and PBL have a moderate and meaningful relationship with learning and innovation skills which are the sub-dimensions of 21st century skills, R=0.303, R^2=0.092, p<0.01. The two variables mentioned explain approximately 10% of the total variant. According to the standardized regression coefficient (β), the relative importance order of the predictive variables regarding learning and innovation skills is as follows: PBL, STEM Education meaningfulness sub-dimension and STEM Education feasibility sub-dimension. When the t-test results on the significance of the regression coefficient are examined, it is seen that only the PBL variable is a significant predictor of learning and innovation skills. The sub-dimensions of STEM education do not have a significant impact on learning and innovation skills.

In addition, when the binary and partial correlations between the predictive variables and the dependent variable are examined, it is observed that the teacher candidates have a positive and low level relationship between their proficiency perceptions towards learning and innovation skills and the meaningfulness sub-dimension scores of the STEM education attitude scale (r=0.169), [(r=0.09) when the effect of other predictive variables is controlled]. A negative and very weak level of binary

correlation value (r=-0.046), [(r=-0.007) when the effect of other predictive variables is controlled] was found between the candidates' proficiency perceptions towards learning and innovation skills and the feasibility sub-dimension scores of their attitudes towards STEM education. When looking at the binary correlation between the candidates' proficiency perceptions towards learning and innovation skills and the PBL attitude scale, a positive and weak relationship (r=0.287) [(r=0.255) when the effect of other predictive variables is controlled] is seen.

The results of the multiple regression analysis of the teacher candidates' attitudes towards the sub-dimensions of STEM education and PBL in terms of predicting 21st century life and career skills were given in Table 4.

Table 4. Multiple regression analysis results on the prediction of life and career skills

Variables	B	Standard Error	B	T	P	Zero-order	Partial
Fixed	50.767	5.158	-	9.843	0.000	-	-
STEM Meaningfulness	0.076	0.039	0.116	1.977	0.049	0.223	0.117
STEM Feasibility	-0.066	0.058	-0.065	-1.141	0.255	-0.112	-0.068
PBL	0.262	0.044	0.336	5.900	0.000	0.371	0.333
$R=0.397$ $R^2=0.158$							
$F(3,280)=17.473$, $p=0.000$							

In Table 4, it is seen that the sub-dimensions of the teacher candidates' attitudes towards STEM education and PBL have a moderate and meaningful relationship with life and career skills, $r=0.397$, $R^2=0.158$, $p<0.01$. The two variables mentioned explain approximately 16% of the total variant. According to the standardized regression coefficient (β), the relative importance order of the predictive variables regarding life and career skills is as follows: PBL, STEM Education meaningfulness sub-dimension and STEM Education feasibility sub-dimension. When the t-test results for the significance of the regression coefficient are examined, it is seen that the PBL and STEM education meaningfulness variables are significant predictors of their life and career skills. The feasibility sub-dimension of STEM education does not have a significant impact on life and career skills.

In addition, when the binary and partial correlations between the predictive variables and the dependent variables are examined, it is observed that the teacher candidates have a positive and low level relationship between their proficiency perceptions towards life and career skills and the feasibility sub-dimension of the STEM education attitude scale (r=0.223), [(r=0.117) when the effect of other predictive variables is controlled]. A negative and very weak level of bilateral correlation value (r=-0.112), [(r=-0.068) when the effect of other predictive variables is controlled] was found between the candidates' proficiency perceptions towards life and career skills and the feasibility sub-dimension scores of their STEM education attitudes. When looking at the binary correlation between the candidates' proficiency perceptions towards life and career skills and the PBL attitude scale, a positive and moderate relationship (r=0.371), [(r=0.333) when the effect of other predictive variables is controlled] is seen.

The results of the multiple regression analysis of the teacher candidates' attitudes towards the sub-dimensions of STEM education and PBL in terms of predicting 21st century information, media and technology skills were given in Table 5.

Table 5. Multiple regression analysis results on the prediction of information, media and technology skills

Variables	B	Standard Error	B	T	P	Zero-order	Partial
Fixed	21.768	3.301	-	6.594	0.000	-	-
STEM Meaningfulness	0.062	0.025	0.153	2.491	0.013	0.210	0.147
STEM Feasibility	-0.003	0.037	-0.005	-0.088	0.930	-0.055	-0.005
PBL	0.100	0.028	0.209	3.526	0.000	0.251	0.206
$R=0.291$ $R^2=0.085$							
$F(3,280)=8.648$, $p=0.000$							

In Table 5, it appears that the sub-dimensions of the teacher candidates' attitudes towards STEM education and PBL have a moderate and meaningful relationship with information, media and technology skills, R=0.291, R^2=0.085, p<0.01. The two variables mentioned explain approximately 9% of the total variant. According to the standardized regression coefficient (β), the relative order of the importance of the predictive variables on information, media and technology skills is as follows; PBL, STEM education meaningfulness sub-dimension and STEM Education feasibility sub-dimension. When the t-test results for the significance of the regression coefficient are examined, it is seen that the meaningfulness variables of PBL and STEM Education are significant predictors of information, media and technology skills. The feasibility sub-dimension of STEM education does not have a significant impact on information, media and technology skills.

In addition, when examining the bilateral and partial correlations between the predictive variables and dependent variables, it is observed that the teacher candidates have a positive and low level relationship between their proficiency perceptions towards information, media and technology skills and the meaningfulness sub-dimension of the STEM education attitude scale (r=0.210), [(r=0.147) when the effect of other predictive variables is controlled]. A negative and very weak level of binary correlation (r=-0.055), which was calculated between proficiency perceptions towards information, media and technology skills and the feasibility sub-dimension of STEM education, [(r=-0.005) when the effect of other predictive variables was controlled] was found. When looking at the binary correlation between the candidates' proficiency perceptions towards information, media and technology skills and the PBL attitude scale scores, a positive and low level relationship (r=0.251), [when the effect of other predictive variables is controlled (r=0.206)] is seen.

DISCUSSION, CONCLUSION AND RECOMMENDATIONS

This research was conducted to determine the predictive situation of the proficiency perceptions of preschool teacher candidates' attitudes regarding STEM Education and Problem-Based Learning (PBL) towards 21st century skills.

It was found that the preschool teacher candidates had high learning and innovation skills and life and career skills, which are the sub-dimensions of proficiency perceptions towards 21st century skills, and that they had very high knowledge, media and technology skills. Similarly, in the studies of Gökbulut (2020) and Kozikoğlu and Altınova (2018), it was found that teacher candidates had high scores in terms of their proficiency perceptions towards 21st century skills and its sub-dimensions. in the literature, it was also found that teacher candidates had above mid-level and moderate proficiency perceptions towards 21st century skills in the field (Anagün et al., 2016; Günüç, Odabaşı & Kuzu, 2013; Orhan Göksün & Kurt, 2017). Teacher candidates play an important role in transferring 21st century skills in schools (Valtonen et al., 2017). Therefore, it is significant that future teachers who will prepare individuals in the information community have high perceptions of 21st century skills (Karakoyun & Lindberg, 2020). It is also important that teachers who take care of children at the fastest time of change and development in all the areas of their development, such as preschool teaching, also think that they have these skills.

It is seen that the preschool teacher candidates have a moderate and meaningful relationship with their proficiency perceptions towards 21st century skills, STEM education and PBL. In addition, it was determined that the candidates' attitudes towards STEM education and PBL explain 20% of their proficiency perceptions towards 21st century skills. Every day, the need for creating a new way of improving students' 21st century skills is increasing (Beswick & Fraser, 2019). In line with this necessity, educations, trainings, approaches and strategies should be used to allow students to take an interest in different areas during their education and to lead them to interdisciplinary works (Acar, 2020). When STEM education is designed with PBL strategies, it is thought that students can have a well-developed set of 21st century skills. This result from the research can ultimately be cited as evidence.

The preschool teacher candidates were found to have a high attitude towards PBL. Teachers have important roles in helping their students acquire some skills, especially in early childhood

(Cansoy, 2018) because during this period, students' role models are teachers. The attitude of the teacher when facing problems is observed by students and taken as an example (Acar, 2020). Therefore, the teacher's attitude will also affect their behavior towards PBL. In this context, it is thought that individuals with high problem-solving skills will be raised in the future thanks to the high attitudes of preschool teacher candidates regarding PBL. However, it is another conclusion from the research that preschool teacher candidates' attitudes towards PBL are an important factor in predicting their proficiency perceptions related to 21st century skills. To understand problems in PBL environments, students implement the deduction and induction processes and analyze and find creative solutions to problems. In addition, they use their previous knowledge and new information to work intellectually in collaboration with their peers (Capraro, Capraro & Morgan, 2013). They even learn how to think and how to practice the information obtained as a result of their own experiences in real life (Larson & Miller, 2011; Morrison, Roth McDuffie & French, 2015). Therefore, PBL is a key to dealing with a complex world of students. It is thought that teacher candidates' attitudes towards PBL are an important predictive proficiency perception towards 21st century skills.

In the research, it was determined that the attitudes of the teacher candidates regarding STEM education did not have a significant impact on their proficiency perceptions towards 21st century skills. However, it was found that there was a positive and low-level relationship between proficiency perception levels and STEM education. By ensuring that students gain 21st century skills that they need to possess in our society, it is necessary to make them STEM-literate individuals (Karahan, 2019). Within the scope of the educational vision of the 21st century, all the aspects of the concepts mentioned in the educational system must be compatible with each other in order to produce positive and desired student outputs (Gelmez Burakgazi et al., 2019). Another conclusion from the research is that the attitudes of teacher candidates regarding STEM education are a significant predictor of life and career skills in the sub-dimension of meaningfulness. STEM education (MacDonald, Huser, Sikder & Danaia, 2020), where there is an increasing number of initiatives aiming the development of knowledge and skills, plays an important role in preparing students for their future careers and social challenges (Simoncini & Lasen, 2018). According to the results obtained from the research, it is considered that preschool teacher candidates have reached this level of awareness. In addition, the research found that the feasibility sub-dimension of the preschool teacher candidates' attitudes towards STEM education did not have a significant impact on their proficiency perceptions towards 21st century skills. This result from the research is similar to the studies carried out in the literature. Studies conducted in the literature revealed teacher candidates had an uncertainty about STEM content (Cohrssen & Page 2016) and were even scared (Hedlin & Gunnarsson, 2014). Aldemir & Kermani (2017) and Alexander, Knezek, Christensen, Tyler-Wood & Bull (2014) have demonstrated that preservice and in-service teachers' belief particularly in their qualifications and skills at STEM applications is also very low. This result from the research shows that preschool teacher candidates feel inadequate to turn these attitudes into skills even though they have a positive attitude towards STEM education.

Considering the results of this research as well as the importance of the undergraduate period for professional development, planned elective courses regarding the development of preschool teacher candidates in relation to 21st century skills should be supported by different and innovative approaches and added to the program. In addition to the theoretical knowledge of elective courses, it is thought that they should be supported by enriched teaching practices. Besides, preschool teacher candidates should be compared with practices based on interdisciplinary research. In addition, preschool teacher candidates should be encouraged to structure the learning environment necessary for 21st century skills in these courses and to design, plan, and solve problems in an organized way. Teachers can also be trained on the use of approaches and strategies, such as PBL and STEM, in order to design appropriate and quality learning environments for children. In future research, the power of different variables such as STEAM and scientific process skills to predict the 21st century skills competency perceptions can be addressed and the process can be handled comparatively with experimental research.

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APPENDIX A: 21ST CENTURY SKILLS AND COMPETENCES SCALE SUBSTANCES

Learning and Innovation Skills

I form unorthodox relationships between part and whole.

I use reasonable ways to solve the problems I face.

Life and Career Skills

I try to improve my skills.

I know that learning is a lifelong process.

Information, Media and Technology Skills

I use technological tools to access information.

I use media and technology effectively to communicate with others.

APPENDIX B: PROBLEM BASED LEARNING ATTITUDE SCALE SUBSTANCES

It reinforces what is learned.

It increases working efficiency.

It is a good educational experience for the student.

APPENDIX C: STEM EDUCATION ATTITUDE SCALE SUBSTANCES

Meaningfulness

Deep__: __: __: __: __: __ Superficial

Efficient__: __: __: __: __: __ Inefficient

Feasibility

Practical __: __: __: __: __: __ Theorical

Applicable __: __: __: __: __: __: __Inapplicable