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Pre-Service Teachers' Skills in Analysing Achievements in Regard to the Revised Bloom's Taxonomy

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Abstract

This study examined the development of pre-service teachers' skills in analysing the achievements of secondary school sixth grade Information Technologies and Software Course curriculum in regard to the revised Bloom's taxonomy at a western Anatolian university in Turkey. A single group pre-test, post-test experimental design was used, and 99 pre-service teachers participated in the study. The sample was determined according to the purposive sampling method. The pre-test presented achievements for the pre-service teachers to analyse in regard to the revised Bloom's taxonomy, after which the revised Bloom's taxonomy's analysis was taught. The achievements were given as the post-test for pre-service teachers to re-analyse. The pre-service teachers' total scores were calculated based on their accuracy. The pre- and post-test total scores were compared, and the total scores of the post-test were higher than those of the pre-test. Suggestions were made regarding future research on the revised Bloom's taxonomy and achievements analysis teaching.

Keywords: Revised Bloom's Taxonomy, Information Technologies and Software Course, Curriculum, Achievements, Pre-Service Teachers

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INTRODUCTION

Teaching is defined as the process of planned and programmed activities occurring under the guidance of teachers in a determined environment and aiming to provide effective learning for the individual (Orhaner & Tunç, 2003; Taşpınar, 2005). In an environment in which students, teachers, subjects, objectives, methods, and equipment coexist, these elements' cooperation toward coherent teaching depends on teachers as most important element. To bring these elements into harmony, teachers should be familiar with their students and subjects, determine the objectives, and organise the teaching environment (Orhaner & Tunç, 2003; Riedler & Eryaman, 2016). It is vital for teachers to determine the qualifications of the objectives (Akbulut Taş & Karabay, 2019; Altıntaş & Yanpar Yelken, 2016; Kocakaya & Kotluk, 2016; Näsström, 2009). Although these teaching factors are universal, their terminology is not; because of this study's western Anatolia setting, we have adopted the term preferred in the new curriculum in Turkey, "achievement", instead of "objective". Correct handling of the achievements is crucial for designing other elements in harmony with them (Beyreli & Sönmez, 2017; Bümen 2006; Näsström, 2009; Näsström, & Henriksson, 2008). Among the taxonomies prepared to determine the qualifications of the achievements, that prepared by Bloom, Engelhart, Furst, Hill, and Krathwohl (1956) is essential (Beyreli & Sönmez, 2017). This taxonomy covers cognitive, affective, and psychomotor domains (Bloom et al., 1956). The cognitive domain addresses objectives related to the recognition of information and development of intellectual skills, and the objectives are expressed as the clearest definition of students' behaviour. In the affective domain, objectives regarding students' changes in interests, attitudes and values, and objectives defining their development of appreciation and sufficient adaptation are considered (Bloom et al., 1956). The psychomotor domain includes objectives related to physically observable behaviours (Taşpınar, 2005). To achieve the objectives in the affective and psychomotor domains, it is important to define and achieve the cognitive domain's objectives (Bloom et al., 1956).

The taxonomy that was created to classify students' behaviours indicating the achievements in the cognitive domain is sometimes known as "Bloom's original taxonomy" (Krathwohl, 2002). This taxonomy is based on a hierarchical classification of instructional objectives and is unidimensional. In the taxonomy of the cognitive domain, instructional objectives are discussed in six categories: "knowledge", "comprehension", "application", "analysis", "synthesis", and "evaluation". These categories are ordered from simple to complex and from concrete to abstract, demonstrating a cumulative hierarchy; that is, competence in the simpler category is a prerequisite for competence in the following, more complex category (Krathwohl, 2002). The taxonomy has been used in many institutions to classify program objectives and test items (Anderson et al., 2001; Krathwohl, 2002; Arı, 2008).

Bloom's original taxonomy (1956) was reorganised as a two-dimensional revised taxonomy model by Anderson et al. (2001) to address the problems with its bidirectional knowledge categories. This was called "the revised Bloom's taxonomy", and the learning outcomes are defined as the explanation of subjects' content (Krathwohl, 2002). Target expressions consist of a noun or noun phrase (subject content) and a verb or verb phrase (cognitive process), forming the revised unidimensional taxonomy, and encompass the "knowledge" and "cognitive process" dimensions (Krathwohl, 2002). In the revised Bloom's taxonomy, the knowledge dimension is divided into sub-categories of Bloom's original taxonomy's "knowledge" category. The added "metacognitive knowledge" sub-category includes knowledge and awareness about one's own cognition (Anderson et al., 2001; Krathwohl, 2002). Although the six original categories remained largely the same in the "cognitive process" dimension of the revised Bloom's taxonomy, three categories were completely renamed, the names of three categories changed from noun to verb form, and the order of two categories was revised. "Knowledge" was changed to "remember", "comprehension" became "understand", and "synthesis" was changed to "create". The names of the categories "application", "analysis", and "evaluation" are expressed as verb forms: "apply", "analyse", and "evaluate". The order of the "synthesis" and "evaluation" categories also changed (Krathwohl, 2002). The revised Bloom's taxonomy dimensions are given in Table 1 as the "cognitive process" dimension on the horizontal axis and the "knowledge" dimension on the vertical axis (Anderson et al., 2001; Krathwohl, 2002).

Table 1. The revised Bloom's taxonomy dimensions (Anderson et al. 2001; Krathwohl 2002)

	The cognitive process dimension					
The knowledge dimension	1. Remember	2. Understand	3. Apply	4. Analyse	5. Evaluate	6. Create
A. Factual knowledge						
B. Conceptual knowledge						
C. Procedural knowledge						
D. Metacognitive knowledge						

As seen in Table 1, in the revised Bloom's taxonomy, the "knowledge" dimension consists of four categories: "factual knowledge", "conceptual knowledge", "procedural knowledge", and "metacognitive knowledge". The "cognitive process" dimension includes six categories: "remember", "understand", "apply", "analyse", "evaluate", and "create". The "factual knowledge" that is the category of "knowledge" dimension is explained as "the basic elements that students need to know to learn about a scientific field or solve problems in that field", and consists of two sub-categories: "knowledge of terms" and "knowledge of special elements and details" in the structure of the revised Bloom's taxonomy (Anderson et al., 2001; Krathwohl, 2002). The "conceptual knowledge" is described as "the relationships between key elements within a larger structure that enable them to work together", and includes three sub-categories: "knowledge of categories and classifications", "knowledge of generalisations and principles" and "knowledge of structures, models, and theories". The "procedural knowledge" is defined as "how to do something; research methods and criteria for using techniques, algorithms, skills, and methods", and has three sub-categories: "knowledge of subject-specific algorithms and skills", "knowledge of specific methods and techniques" and "knowledge of criteria about when and how to use appropriate methods". The "metacognitive knowledge" is explained as "awareness and knowledge of one's own cognition as well as cognitive knowledge in general", and consists of three sub-categories: "strategic knowledge", "knowledge of cognitive tasks including appropriate context and conditions" and "self-knowledge (recognition of strengths and weaknesses of cognition and learning)" (Anderson et al., 2001; Krathwohl, 2002).

The "remember" that is the category of the cognitive dimension is defined as "retrieve relevant information from long-term memory", and has two sub-categories: "recognise" and "recall" in the structure of the revised Bloom's taxonomy (Anderson et al., 2001; Krathwohl, 2002). The "understand" is explained as "decide the meaning of instructional messages, including written, graphical, and oral communication", and consists of seven sub-categories: "interpret", "exemplify", "classify", "summarise", "infer", "compare" and "explain". The "apply" is described as "apply or use a method in a given case", and includes two sub-categories: "perform" and "apply". The "analyse" is defined as "divide the material into its components and determine how the parts relate to each other and to the overall structure or purpose", and has three sub-categories: "dissociate", "organise" and "qualify, attribute". The "evaluate" is explained as "judgment based on standards and criteria", and consists of two sub-categories: "check" and "criticise". The "create" is described as "create an original product or bring together items to create a new, harmonious whole", and includes three sub-categories: "create", "plan" and "produce" (Anderson et al., 2001; Krathwohl, 2002).

Examining the literature about the revised Bloom's taxonomy reveals that studies have mostly evaluated various course programs' achievements in regard to it (Aktan, 2020; Bekdemir & Selim, 2008; Bozdemir, Ezberci Çevik, Kurnaz, & Yaz, 2019; Çelik, Kul, & Çalık Uzun, 2018; Doğan & Burak, 2018; Durmuş, 2017; Efe & Efe, 2018; Eke, 2015; Gezer, Şahin, Öner Sünkür, & Meral, 2014; İlhan & Gülersoy, 2019; Kablan, Baran, & Hazer, 2013; Özdemir, Altıok, & Baki, 2015; Vick & Garvey, 2011; Altıntaş & Yanpar Yelken, 2016; Zorluoğlu, Güven, & Korkmaz, 2017; Zorluoğlu & Kızılaslan, 2019; Zorluoğlu, Kızılaslan, & Sözbilir, 2016). In addition to the studies in which the contents and questions of textbooks have been examined in regard to the revised Bloom's taxonomy (Avşar & Mete, 2018; Eroğlu & Sarar Kuzu, 2014; Mizbani & Chalak, 2017; Rahpeyma &

Khoshnood, 2015; Uğur, 2019), other studies used the taxonomy to evaluate the questions on examinations held at the national level in Turkey (Ayvacı, Yamak, & Duru, 2018; Başol, Balgalmış, Karlı, & Öz, 2016; Kala & Çakır, 2016; Kara, 2016; Keleş & Hacısalihoğlu Karadeniz, 2015; Korkmaz & Ünsal, 2016; Özer Keskin & Aydın, 2011; Zorluoğlu, Bağrıyanık, & Şahintürk, 2019). Additionally, studies have examined teachers' or pre-service teachers' planning, teaching, or questioning skills based on this taxonomy (Arseven, Şimşek, & Güden, 2016; Ayvacı & Türkdoğan, 2010; Bümen, 2007; Çalık & Aksu, 2018; Çintaş Yıldız, 2015; Erdoğan, 2017; Kara, Karakoç, Yıldırım, & Bay, 2017; Motlhabane, 2017; Şanlı & Pınar, 2017; Tanık & Saraçoğlu, 2011), and still other studies have used it to analyse pre-service teachers' knowledge and skills (Başbay, 2007; Kurtuluş & Ada, 2017; Nkhoma, Lam, Sriratanaviriyakul, Richardson, Kam, & Lau, 2017; Ruggiero & Mong, 2013). Few studies have examined in- or pre-service teachers' skills in analysing achievements or objectives in regard to the revised Bloom's taxonomy (Akbulut Taş & Karabay, 2019; Altıntaş & Yanpar Yelken, 2016; Kocakaya & Kotluk, 2016; Näsström, 2009). In the study by Akbulut Taş and Karabay (2019), examining the pre-service teachers' analysis skills (N=130) in the cognitive domain objectives in regard to revised Bloom's taxonomy was aimed. The results indicated that pre-service teachers' mean scores in the knowledge dimension was quite low, and their mean scores in the cognitive process dimension were higher than the knowledge dimension. Also, the participants' mean scores in the knowledge dimension demonstrated significant differences in favour of the participants who prepare instructional plan (Akbulut Taş & Karabay, 2019). Altıntaş and Yanpar Yelken (2016) aimed to analyse the achievements of the secondary school eighth grade mathematics course curriculum in regard to revised Bloom's taxonomy, and to determine undergraduate and graduate students' skills in analysing the achievements in regard to revised Bloom's taxonomy. The findings revealed that the achievements were not in the high level cognitive processes in regard to revised Bloom's taxonomy, and the participants' skills in analysing the achievements in regard to revised Bloom's taxonomy were in the low level. Kocakaya and Kotluk (2016) aimed to examine the eight pre-service physics teachers' and the eight in-service physics teachers' skills in analysing the high school tenth grade physics course curriculum's objectives (mentioned as standards in the study) (N=45) in regard to revised Bloom's taxonomy. In the study, each participant analysed the objectives individually and with their groups. The analysis made by the individuals and by the groups comprised of four and eight people, and the analysis made by the pre- and in-service teachers groups were compared and the differences and similarities in the analysing scores were examined. The findings revealed that the agreement level for the objectives (for 43 of 45 objectives) was quite low. The high agreement level was observed for the only two achievements in the study. The researchers claimed that the reason for the low agreement level may be the objectives had vague meanings (Kocakaya & Kotluk, 2016). In the study by Näsström (2009), examining four teachers' and four assessment experts' analysis of mathematics course objectives (N = 35) (mentioned as standards, and 20 standards named as goals and 15 standards named as grading criteria in the study) in terms of revised Bloom's taxonomy was aimed. The participants examined the objectives at two different times, both intra- and inter-agreement consistency were reported in the study. Both the teachers and assessment experts analysed all objectives, and while the teachers used the dimensions and categories in the revised Bloom's taxonomy to large extent, the assessment experts used to lesser extent. Also, the assessment experts had higher levels of inter- and intra-agreement consistency than the teachers. Näsström (2009) concluded that the reason for the low levels of inter- and intra-agreement consistency were too broad and vague objectives. Kocakaya and Kotluk (2016), and Näsström (2009) claimed that the revised Bloom's taxonomy were a useful tool for analysing the objectives of the mathematics and physics course curriculums and the taxonomy was applicable. No experimental studies on the development of pre-service teachers' skills in analysing the objectives of their curricula in regard to the revised Bloom's taxonomy have been found.

Accordingly, this study will contribute to the above literature as pre-service teachers should know the revised Bloom's taxonomy to determine the characteristics of their subjects' objectives and should gain the ability to analyse the achievements of their curricula. This study was conducted to investigate the skill development of pre-service teachers studying at a western Anatolian university's Department of Computer Education and Instructional Technology in analysing the achievements of the secondary school sixth grade Information Technologies and Software Course [ITSC] curriculum (Ministry of National Education [MoNE], 2018) in regard to the revised Bloom's taxonomy. For this purpose, the sub-problems of the study were determined as follows:

(1) What is the development process of pre-service teachers' skills in analysing the secondary school sixth grade ITSC curriculum's achievements in regard to the revised Bloom's taxonomy?

(2) Do the differences between pre- and post-test scores of pre-service teachers differ with respect to independent variables (gender and year of university education)?

In the following section, the research design, participants, data collection, data analysis, and validity and reliability of the study are explained.

METHOD

Research Design

The study was conducted according to a single-group pre- and post-test experimental design, a quantitative research method. In a single-group pre-test, post-test experimental design, a pre-test is applied to a group, instruction is performed, and then a post-test is administered. In this design, whether the pre- and post-test scores differ significantly from each other is examined (Büyüköztürk, Kılıç Çakmak, Akgün, Karadeniz, & Demirel, 2014; Fraenkel & Wallen, 2012). The reason for choosing a single group experimental design is that performing achievement analysis in regard to the revised Bloom's taxonomy is not traditionally taught to pre-service teachers.

Participants

The participants of the study were 99 pre-service teachers studying in the Department of Computer Education and Instructional Technology at a university in western Anatolia. Participants were determined according to the purposive sampling method, in which researchers determine the sample according to the purpose of the research by using their previous knowledge about individuals in the universe (Fraenkel & Wallen, 2012). In this study, the participants were third- and fourth-year pre-service teachers studying at the Department of Computer Education and Instructional Technology. All participants took Special Teaching Methods 1 or Special Teaching Methods 2 courses in the summer, fall, and spring semesters. Bloom's cognitive domain taxonomy (original Bloom's taxonomy) was introduced to the courses' participants, and it was ensured that the participants knew of the original Bloom's taxonomy. The demographic characteristics of the participants are given in Table 2.

Table 2. Demographic characteristics of the participants

		Gender		
		Female	Male	Total
Year of university education	3	16	17	33
	4	18	48	66
Total		34	65	99

Data Collection

As the pre-test, the achievements of the sixth grade ITSC Curriculum (total=77) were given to pre-service teachers who were asked to determine the level of achievements in regard to the cognitive process and knowledge dimensions of the revised Bloom's taxonomy. After collecting the pre-test data, a four-hour session instructed on how to analyse the achievements of the fifth grade ITSC curriculum (total=75) in regard to the cognitive process and knowledge dimensions of the revised

Bloom's taxonomy. The achievements were individually discussed, and the pre-service teachers assessed the level of each achievement in regard to the cognitive process and knowledge dimensions and explained their reasoning. After collecting participants' scores, the actual levels of the achievements were explained based on the study of the descriptive analysis for the achievements explained in the validity and reliability section.

After this instruction, the achievements of the sixth grade ITSC curriculum were presented to the pre-service teachers again with a document instructing how to analyse achievements in regard to the revised Bloom's taxonomy. The achievements were tabulated with the unit and the subject names; three columns were added to the right side of the table to write down the level of achievement in regard to the cognitive process and knowledge dimensions. Depending on their surety about the correctness of the determined level, the pre-service teachers were asked to write in the first, second, and third columns "Code if you are sure", "Code if you are not sure", and "Mark if you have no idea", respectively.

Data Analysis

When examining the determined levels of the pre-service teachers' pre- and post-tests, only the responses in the "Code if you are sure" column were considered, while the other responses were excluded (Crocker & Algina, 2008; Taşlıdere & Eryılmaz, 2015). The levels determined by the pre-service teachers in the cognitive process and knowledge dimensions for each achievement were compared with the levels determined by the descriptive analysis for the achievements. Correct coding was awarded 1 point, and 0 points were given for incorrect coding. The pre- and post-test total scores were calculated by adding the scores of the pre-service teachers. Descriptive statistics of the total scores of the pre-test and post-test were calculated, and their normality was examined. In addition, the differences between the scores of the pre- and post-tests were calculated; the scores' descriptive statistics were calculated, and the normality was examined with respect to gender and year of university education variables.

The skewness and kurtosis values were calculated, and histogram, box-line, Q-Q, and detrended graphs were examined to determine whether the data demonstrated normal distribution (Alpar, 2016; Aminu & Shariff, 2014; Çokluk, Şekercioğlu, & Büyüköztürk, 2014; Razali & Wah, 2011). The skewness and kurtosis values are shown in Table 3.

Table 3. The skewness and kurtosis values

					Skewness		Kurtosis	
Measurement	Dimension	Variables		N	Value	SE	Value	SE
Pre-test	Knowledge			99	-.124	.243	-.801	.481
	Cognitive process			99	-.294	.243	-.570	.481
	Both			99	-.364	.243	-.570	.481
Post-test	Knowledge			99	-.641	.243	-.311	.481
	Cognitive process			99	-.013	.243	-.885	.481
	Both			99	-.213	.243	-.657	.481
Difference	Knowledge	Gender	Female	34	-.154	.403	-.422	.788
			Male	65	-.080	.297	-.722	.586
		Year of university education	3	33	-.317	.409	-.888	.798
			4	66	-.011	.295	-486	.582
	Cognitive process	Gender	Female	34	-.719	.403	.223	.788
			Male	65	.080	.297	-.582	.586
		Year of university education	3	33	-.221	.409	.682	.798
			4	66	-.055	.295	-.859	.582
	Both	Gender	Female	34	-.396	.403	.489	.788
			Male	65	-.167	.297	-.634	.586
		Year of university education	3	33	.046	.409	-.509	.798
			4	66	.097	.295	-.585	.582

Note. SE: standard error

Table 3 reveals that the skewness and the kurtosis values were in the range of -1 to +1 for all groups. Skewness and kurtosis values should fall within the range of -1 to +1 to avoid a significant deviation from the normal distribution (Çokluk et al., 2014), and if the skewness and kurtosis values are greater than +3 and +10, respectively in large samples, there is a normality problem (Aminu & Shariff 2014). The histogram, box-line, Q-Q, and detrended graphs also demonstrated that the data had normal distribution (Alpar, 2016).

A paired sample t-test was used to determine whether the total scores of the pre- and post-tests differed significantly. An independent samples t-test was used to determine whether the difference in scores between the pre- and post-tests differed with respect to independent variables (gender and year of university education).

Validity and reliability

The level of the achievements of the fifth and sixth grade ITSC curricula was analysed using descriptive analysis (Yıldırım & Şimşek, 2006) in regard to the cognitive process and knowledge dimensions of the revised Bloom's taxonomy, and validity and reliability analysis was conducted. For reliability, the achievements were coded and analysed in regard to the dimensions in the revised Bloom's taxonomy independently by two different researchers. Intercoder reliability (Miles & Huberman, 1996) was calculated as between 0.84 and 0.95 with respect to the main themes and grade levels. Expert opinion was heeded for the validity of the coding.

Alpar (2016) stated that the scale used to determine the scores of individuals' knowledge or attitudes was based on total scores possible. The reliability of a two-category test administered once is predicted by the Kuder Richardson-20 (KR-20) formula (Alpar, 2016). In the two-category tests that are in the form of 0 and 1, as in this study, the KR-20 and Cronbach's Alpha coefficient are the same. Cronbach's Alpha reliability coefficients were calculated for 1 and 0 points assigned to pre-service teachers. The reliability coefficients are given in Table 4.

Table 4. Cronbach's Alpha reliability coefficients

Measurement	Dimension	N of Cases	N of items	Cronbach's Alpha
Pre-test	Knowledge			.869
	Cognitive process	99	77	.883
	Both			.928
Post-test	Knowledge			.820
	Cognitive process	99	77	.873
	Both			.913

Table 4 reveals that Cronbach's Alpha reliability coefficients were higher than 0.80. As values of 0.80 and above indicate that the reliability of the test or scale is high (Alpar, 2016), this means that the pre-service teachers' responses in the pre- and post-tests were interpreted as highly consistent.

RESULTS

To answer the first sub-problem of the study, "What is the development of pre-service teachers' skills in analysing the achievements of the secondary school sixth grade ITSC curriculum in regard to the revised Bloom's taxonomy?", the pre- and post-tests' total scores were calculated by adding the points given for the accuracy of pre-service teachers' responses. Descriptive statistics regarding the total scores are given in Table 5.

Table 5. Descriptive statistics regarding total analysis scores

Measurement	Dimension	N	Minimum	Maximum	x	SD
Pre-test	Knowledge		0	41	22.26	10.210
	Cognitive process	99	0	46	24.08	10.688
	Both		0	82	46.34	19.424
Post-test	Knowledge		10	46	33.09	8.864
	Cognitive process	99	17	59	38.25	10.342
	Both		34	105	71.34	17.854

Note. x: mean; SD: standard deviation; df: degree of freedom

Table 5 reveals that the pre-serv ce teachers' pre-test total scores (x=22.26 and x=24.08) were low, whereas the r post-test total scores (x=33.09 and x=38.25) were h gher n the cogn t ve process and knowledge d mens ons. When the d mens ons were scored together, there were s m lar results for the pre-test (x=46.34) and the post-test (x=71.34). To test the s gn f cance of the mean d fference scores, the paired sample t-test was used. The results are provided in Table 6.

Table 6. T-test results of the total scores of the pre-test and post-test

Measurement	Dimension	N	x	SD	df	t	p	η^2
Pre-test	Knowledge	99	22.26	10.210	98	8.518	.000	.155
Post-test		99	33.09	8.864				
Pre-test	Cognitive process	99	24.08	10.688	98	10.792	.000	.227
Post-test		99	38.25	10.342				
Pre-test	Both	99	46.34	19.424	98	10.512	.000	.218
Post-test		99	71.34	17.854				

Note. x: mean; SD: standard deviation; df: degree of freedom

According to Table 6, pre-service teachers' skills in analysing the achievements of the sixth grade ITSC curriculum in the knowledge dimension in regard to the revised Bloom's taxonomy improved with instruction ($t(98)=8.518$, $p<.05$, $\eta^2=.155$). Cohen's d was also calculated by using the correlation value of the related samples with the group mean scores and the standard deviation values (d=1.084). A Cohen's d value greater than 0.8 is considered a large effect size (Cohen, 1988; Lenhard & Lenhard, 2016). The calculated eta square (η^2) and Cohen's d values indicate that the instruction had a great effect on the pre-service teachers' skills in analysing the achievements in the knowledge dimension. Similarly, pre-service teachers' skills in analysing achievements in the cognitive process dimension improved with instruction ($t(98)=10.792$, $p<.05$, $\eta^2=.227$). Cohen's d value was found to be high (d=1.084) for the cognitive process dimension findings. Thus, the eta square (η^2) and Cohen's d values indicate that the effect of the instruction on the development of the analysis skills in the cognitive process dimension was significant.

To evaluate the analysis in the cognitive process and knowledge dimensions of the revised Bloom's taxonomy together, their total scores were added. Table 6 provides the findings related to these combined scores, showing that the post-test total mean scores were significantly higher than those from the pre-test ($t(98)=10.512$, $p<.05$, $\eta^2=.218$). Cohen's d value is also high (d=1.057). The eta square (η^2) and Cohen's d values indicated that instruction had a strong effect on the development of analysis skills in regard to the revised Bloom's taxonomy.

To answer the second sub-problem of the study, "Do the differences between pre- and post-test scores of pre-service teachers differ with respect to independent variables (gender and year of university education)?", first the distributions of their total pre- and the post-tests' scores with respect to gender were found (Table 7).

Table 7. Distribution of the total scores of the pre-test and post-test analysis according to gender

Measurement	Dimension	Gender	N	Minimum	Maximum	x	SD
Pre-test	Knowledge	Female	34	0	35	20.53	10.106
		Male	65	5	41	23.17	10.223
	Cognitive process	Female	34	0	41	23.76	11.755
		Male	65	3	46	24.25	10.178
	Both	Female	34	0	73	44.29	21.228
		Male	65	10	82	47.42	18.493
Post-test	Knowledge	Female	34	14	46	34.82	8.017
		Male	65	10	46	32.18	9.206
	Cognitive process	Female	34	20	55	41.68	9.184
		Male	65	17	59	36.46	10.527
	Both	Female	34	34	100	76.50	15.490
		Male	65	35	105	68.65	18.517

Note. x: mean; SD: standard deviation

Table 7 reveals that the pre-service teachers' total mean scores differed by gender. To determine whether these differences were significant, the differences between the pre- and post-tests' scores were calculated for each dimension, and the independent samples t-test was performed with respect to gender. The results of the t-tests are presented in Table 8.

Table 8. T-test results of the difference scores with respect to gender

Measurement	Dimension	Gender	N	x	SD	df	t	p	η^2
Difference	Knowledge	Female	34	14.29	11.025	97	2.002	.048	.0428
		Male	65	9.02	13.137				
	Cognitive process	Female	34	17.91	10.650	97	2.095	.039	.0468
		Male	65	12.22	13.842				
	Both	Female	34	32.21	19.623	97	2.236	.028	.0530
		Male	65	21.23	24.827				

Note. x: mean; SD: standard deviation; df: degree of freedom

The difference between the pre- and post-test scores in the cognitive process and knowledge dimensions differed significantly with respect to the pre-service teachers' gender ($t(97)=2.002$, $p<.05$, $\eta^2=.0428$ and $t(97)=2.095$, $p<.05$, $\eta^2=.0468$). Considering the dimensions together revealed a similar finding $t(97)=2.002$, $p<.05$, $\eta^2=.0428$). The mean d fferences between the scores of female pre-serv ce teachers (x=14.29 and x=17.91) were h gher than those of males (x=9.02 and x=12.22). Cohen's d values were also calculated using group means, standard deviation, and sample size values obtained from the t-test (d=.423 and d=.443). The d value of 0.4 is interpreted as a small effect size (Cohen, 1988; Lenhard & Lenhard, 2016). The calculated eta square (η^2) value indicated that approximately 4% of the variance in the mean difference scores was due to gender. A similar interpretation could be made when the cognitive process and knowledge dimension scores were taken together (d=.473).

Second, to further address the second sub-problem of the study, the distributions of the variable of pre-service teachers' total pre- and post-test scores with respect to their year of university education were found (Table 9).

Table 9. Distribution of the pre-test and post-test analysis total scores with respect to years of university education

Measurement	Dimension	Year	N	Minimum	Maximum	x	SD
Pre-test	Knowledge	3	33	0	40	18.82	9.986
		4	66	0	41	23.98	9.951
	Cognitive process	3	33	0	46	22.18	10.780
		4	66	0	44	25.03	10.596
	Both	3	33	0	82	41.00	19.489
		4	66	0	80	49.02	18.977
Post-test	Knowledge	3	33	15	46	36.55	8.614
		4	66	10	46	31.36	8.535
	Cognitive process	3	33	24	59	43.79	9.539
		4	66	17	54	35.48	9.651
	Both	3	33	51	105	80.33	16.885
		4	66	34	100	66.85	16.695

Note. x: mean; SD: standard deviation

Table 9 demonstrates that the distribution of pre-service teachers' pre- and post-test scores differed with respect to their year of university education. The difference between the pre- and post-test scores was calculated for each dimension and an independent samples t-test was performed for pre-service teachers' year of university education to determine the significance of the differences. Table 10 presents the t-test results.

Table 10. T-test results of the difference scores with respect to year of university education

Measurement	Dimension	Year	N	x	SD	df	t	p	η^2
Difference	Knowledge	3	33	17.73	10.357	97	4.142	.000	.1631
		4	66	7.38	12.335				
	Cognitive process	3	33	21.61	10.509	97	4.355	.000	.1775
		4	66	10.45	12.686				
	Dimensions together	3	33	39.33	18.560	97	4.697	.000	.2003
		4	66	17.83	22.765				

Note. x: mean; SD: standard deviation; df: degree of freedom

The difference between the pre- and post-test scores in the cognitive process and knowledge dimensions differed significantly with respect to year of university education (t(97)=4.142, p<.05, η^2=.1631 and t(97)=4.355, p<.05, η^2=.1775). Considering the dimensions together produced a similar finding (t(97)=4.697, p<.05, η^2=.2003). The mean d fference scores of the pre-serv ce teachers n the r th rd year of un vers ty educat on (x=17.73 and x=21.61) were found to be h gher than the scores of those n the r fourth year (x=7.38 and x=10.45). The Cohen's d values calculated from the scores were found to be d=.883 and d=.929, which are interpreted as a large effect size (Cohen, 1988; Lenhard & Lenhard, 2016). According to the calculated eta square (η^2) value, approximately 16% and 17% of the variance of the difference scores in the cognitive process and knowledge dimensions is due to the participants' year of university education. A similar interpretation could be made when the dimensions were taken together (d=1.001).

DISCUSSION, CONCLUSIONS, AND SUGGESTIONS

This study evaluated the development of pre-service teachers' skills in analysing the achievements of the secondary school sixth grade ITSC curriculum in regard to the revised Bloom's taxonomy after instruction. Reviewing the literature revealed that few studies have investigated in- or pre-service teachers' skills in analysing achievements of curricula in regard to the revised Bloom's taxonomy (Akbulut Taş & Karabay, 2019; Altıntaş & Yanpar Yelken, 2016; Kocakaya & Kotluk, 2016; Näsström, 2009), and no experimental study investigating the issue has been found. Pre-service teachers should gain necessary skills in analysing the achievements of their curriculum by familiarizing themselves with the revised Bloom's taxonomy. Also, the revised Bloom's taxonomy could be a useful tool for analysing the achievements and the taxonomy could be found applicable to the curriculum by the pre-service teachers.

The results of the pre-test demonstrated that the pre-service teachers' analysis skills were low in both the cognitive process and knowledge dimensions, aligning with past studies (Akbulut Taş & Karabay, 2019; Altıntaş & Yanpar Yelken, 2016). A probable reason for pre-service teachers' low-level analysis skills using the revised Bloom's taxonomy is that the taxonomy is not sufficiently introduced in teacher instruction programs. Pre-service teachers' mean scores in the cognitive process dimension were higher than those in the knowledge dimension, also aligning with previous findings (Akbulut Taş & Karabay, 2019). The likely reason for this is that the categories in the cognitive process dimension in the revised Bloom's taxonomy and the categories in the original taxonomy are similar, and the pre-service teachers are likely already familiar with the categories of the original Bloom's taxonomy. Accordingly, the revised Bloom's taxonomy should be included in teacher education curricula. In their study investigating the harmony between in- and pre-service teachers' analysis of physics lesson achievements in regard to the revised Bloom's taxonomy, Kocakaya and Kotluk (2016) concluded that the rate of harmony was low due to the comprehensive and uncertain achievements and stated that this situation may negatively affect the teaching process. Násström (2009) had also a similar conclusion made by Kocakaya and Kotluk (2016). The uncertainty of the achievement expressions is one of the reasons for pre-service teachers' low scores in analysing achievements in regard to the revised Bloom's taxonomy. In this study, the high number of achievements may have caused pre-service teachers to become distracted while performing the analysis, resulting in low scores. In future studies, fewer achievements may be selected to be representative of categories in the revised Bloom's taxonomy to determine if the quantity affects pre-service teachers' results.

The findings from the post-instruction test demonstrated that pre-service teachers' skills in analysing the achievements in regard to the cognitive process and knowledge dimensions of the revised Bloom's taxonomy increased, and instruction allowed for their development. Pre-service teachers should be familiar with the revised Bloom's taxonomy to determine the qualifications of the achievements related to the subjects they will teach. Within the scope of this study, the revised Bloom's taxonomy was introduced to the pre-service teachers, but no application of the analysis was performed regarding the planning, implementation, and measurement or evaluation of teaching during the instruction. Future studies should attempt such applications. This instruction should also be included in other teacher education programs.

In this study, the pre-service teachers' skills in analysing the achievements were examined with respect to gender and year of university education variables. When the cognitive process and knowledge dimensions were evaluated separately and together, the total scores differed in favour of female pre-service teachers. The reason for the significant difference in favour of females after the instruction could be investigated by future studies, as previous studies have also not addressed this (Akbulut Taş & Karabay, 2019; Altıntaş & Yanpar Yelken, 2016; Kocakaya & Kotluk, 2016). Future studies that examine pre-service teachers' skills in analysing the achievements in regard to the revised Bloom's taxonomy with gender as a variable are recommended.

The results of the study revealed that the pre-service teachers' scores in analysing the achievements in regard to the revised Bloom's taxonomy differed in terms of the year of university education. Before the instruction, the total scores of the fourth-year pre-service teachers were higher than those of the third-year teachers. This may be because the pre-service teachers in their fourth year had already learned the original Bloom's taxonomy within their teacher education program. After instruction, the total scores of the pre-service teachers in their third year were higher than those of the fourth-year teachers in both the knowledge and the cognitive process dimensions. Accordingly, it could be concluded that the instruction was more effective for the third-year pre-service teachers. This may be because the pre-service teachers in the third year were not familiar with the original Bloom's taxonomy at the beginning and they therefore learned about the taxonomy solely through the study's instruction.

This study was conducted within the scope of the achievements of the secondary school sixth grade ITSC curriculum with pre-service teachers studying in the Computer Education and Instructional Technologies department. In future studies, the skills of pre-service teachers studying in different departments of the faculties of education in analysing the achievements in different curricula could be developed. Similar studies can be carried out with in-service teachers as well.

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