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# Preservice Science Teachers' Views of a Web-Based Intelligent Tutoring System

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## Abstract

Due to the COVID-19 epidemic, courses are carried out online in undergraduate programs and in this study, Web-Based Intelligent Tutoring System (WBITS) was used for online lessons. The aim of the study is to determine the opinions of 144 pre-service science teachers, who have used WBITS in three different undergraduate courses, about the system. Opinions about whether they are happy to use WBITS, whether the system serves the purpose of the courses (validity), whether the system is an alternative to face-to-face education (reliability) and whether the system is sufficient in pedagogical aspects (pedagogical qualification) were collected. The majority of the candidates stated that they are happy to use the system, that the system can be used to achieve the course objectives, and that the system is pedagogically sufficient and it can be used instead of the traditional classes. The most positive opinions were that the lesson could be used to achieve the course objectives. Negative opinions about the use of the system were mostly related to being unhappy with using the system. The system can be adapted for different courses and can be used in distance learning processes or to support in-class education. The system can be effective in overcoming the limitations of distance education.

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## Introduction

The technological developments witnessed over recent years have generated radical changes to lifestyle as well as to all fields of life, including education, where the importance of technology's role can be clearly seen today. The use of technology in educational processes has created new opportunities for educational institutions, teachers, and students. In the case of educational institutions, technology has enabled education to be delivered to a higher number of students at a lower cost and with smaller workforces, teachers have greater access to information and ease of ability to transfer this information, and students can access enriched course content without space and time limitations. Advancements in the fields of computer software and communication have led to important changes in distance educational activities, such as the introduction of computer- and internet-based tutoring, distance education, and online learning. Furthermore, the development of sophisticated artificial intelligence programs has led to the emergence of internet-based artificial intelligent tutoring systems.

Through the aid of computers and the internet, in-class educational activities are supported with written, audio,

and visual materials. PowerPoint presentations, digital cameras, and smartboards greatly contribute to the enrichment of visual instruction and educational processes. Educational activities that are carried out via the internet offer students the opportunity to access a wide variety of enriched information without space and time limitations. Today's advancements in internet technology and computer software have diversified online education processes and have made online education an important aspect of education. The developmental process of distance education has occurred in parallel with that of communication technologies. After first starting with written correspondence, distance education has come a long way and now features internet/web-based educational processes.

Internet-based distance education is carried out in one of two ways, synchronous and asynchronous. Courses that are delivered interactively through the internet are mostly synchronic, while educational processes that are not interactive but are independent of time and place are unsynchronized. Web-based education, an internet-based form of distance education, refers to a process of learning and instruction of topics via the internet. Web-based education environments are in effect artificial learning environments that facilitate communication with different parts of the world. Web-based tutoring presents knowledge to learners using the internet (French, 1999).

## **Web-Based Education**

In web-based education, webpages are designed in HTML (a scripting language used to create a webpage on the internet) format and online access is administered by internet service providers. The subject content and information that learners access on the web can be presented in plain text, GIFs, or videos and be synchronous or asynchronous. The internet provides learners the benefit of accessing enriched course content at any time or location, an advantage that forms the basis for an ideal educational model (Carswell & Venkatesh, 2002).

As the use of the internet and computers in educational processes eliminates the space and time problem (Anderson & Ellumi, 2002), students, teachers, organizations, and institutions alike benefit from the conduct of educational processes through the internet. The elimination of the time and space problem has been shown to have a positive effect on learning performance (Demirel, Seferoğlu, & Yağcı, 2001). Flexible learning processes, a smaller workforce, ease of accessibility, sharing and updating, and performance feedback are the main advantages offered by web-based education.

## **Web-Based Intelligent Tutoring System**

A web-based intelligent tutoring system (WBITS) is an educational platform that uses an internet-based intelligent tutoring system (ITS) unrestricted by time and space. As seen in Figure 1, a WBITS involves the integration of an adaptive hypermedia system and ITS (Brusilovsky & Peylo 2003). The ITS component of the WBITS functions to provide learners with lectures, figures, formulas, animations, examples, activities, links to external sources, and different problems. The course content provided by the ITS is designed separately for each lesson. Educational processes and the pedagogical dimensions of educational technologies are considered when

designing this content. If the pedagogical dimension and the advantages and disadvantages of technology are overlooked when designing web-based educational processes, then the effort, time, and resources, and freedom and flexibility offered by the web-based process will be wasted (Kinshuk & Palel 1997).

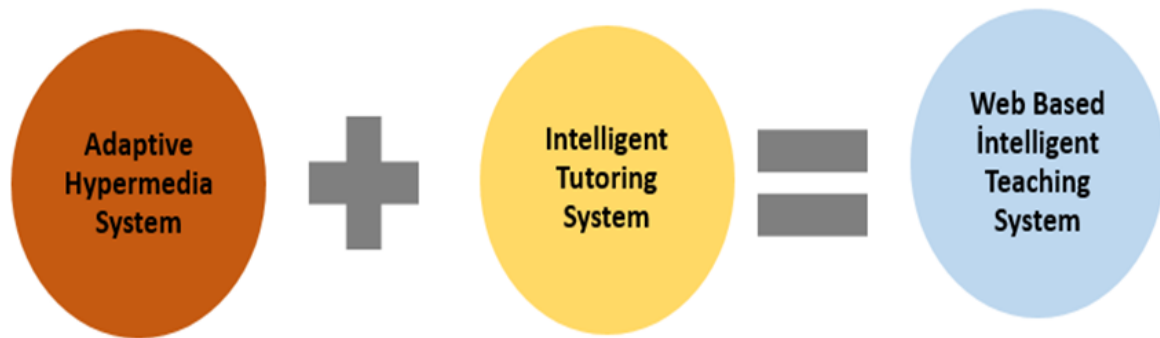


Figure 1. Components of Web-Based Intelligent Tutoring System (Brusilovsky & Peylo, 2003)

For an internet-based ITS to be effective, system users should be involved in its development process (Yum & Crawford, 1996), as ITSs offer course content according to the level of learners. ITSs are computer systems that can adapt educational environments to the knowledge and ability levels of learners (Rosic, Galavinic, & Stankov 2005). Intelligent teaching systems are computer-based teaching systems that determine what and how to teach by modeling teaching content and teaching strategies (Murray, 1999). ITSs offer learners the opportunity to learn from their mistakes by providing them with constructive feedback (Merceron & Yacef, 2005).

ITSs include the features of artificial intelligence (information demonstration, reasoning, expert systems, hardware, and learning), computer systems (programming techniques and computer-human interaction), and tutoring (pedagogy, cognitive sciences, psychology, and instruction sciences) (Jerinic, 2013). Like computer systems, ITSs are suited to perform operations developed by artificial intelligence and the human mind and to apply learning and tutoring techniques (Akkoyunlu, 1998) that simulate the teacher-student interaction in an educational process. The student-ITS interaction is realized through artificial intelligence (Self, 1990).

### **Related Works**

The first intelligent tutoring system is considered to be SCHOLAR, which was developed by Carbonell in the 1970s to provide education on ITS in the southern part of America (Carbonell, 1970). Later, with the development of Internet and computer technologies, Internet-based intelligent tutoring systems have been used for teaching and learning. This led to the development and use of educational activities with distant intelligent tutoring systems in various fields. Web-based education has many advantages such as ease of taking lessons without leaving the workplace or home, and low cost (Berz, Erdelyi, & Hoefkens, 1999), which provides significant opportunities for educational institutions, teachers and students. In recent studies, it has been proven to be useful in artificial intelligence personnel training, knowledge renewal, professional development and skills

training (Kavitha & Lohani, 2019). In addition, an intelligent tutoring system that adjusts the tutor's behavior and creates maps during the lesson according to the student's navigation among the educational content (de Carvalho, de Melo, Flôres, Pires, and Loja, 2020).

Web-based intelligent tutoring systems have been developed and employed with the transfer of intelligent tutoring systems to the Internet. Works on some of the ITSs that were developed and implemented can be found in the references section (Alpert, Sing-ley, & Fairweather 1999; Ritter, 1997; Eliot, Neiman, & Lamar, 1997; Peylo, Thelen, Rollinger, & Gust, 2000; Keleş, 2009; Arıçlı, Karacı, 2013; Erdemir , 2015; Aslantürk, 2002; Özen & Kahraman, 2001; Muangprathub, Boonjing & Chamnongthai, 2020). The ease of accessing information and using it effectively has increased the interest for learning processes employing ITSs on the Internet. Studies on Internet-based ITSs conducted between 1998-2019 focused on system development and implementation, and the number of studies has increased day by day (Tang, Chang & Hwang 2021). In the ITS studies computer programs such as neural networks, expert systems, deep learning, symbolic machine learning, speech recognition, image recognition, natural language processing, and statistical analysis have been used (Lu, Li, Chen, Kim & Serikawa, 2018).

Internet-based ITSs are used in different fields. Internet-based ITSs in studies conducted between 1998-2019 were used in diverse areas including computer science, software engineering, education and scientific disciplines, experimental psychology, telecommunications, automation control systems, engineering, computer hardware architecture, healthcare, library, linguistics and medical communication (Tang, Chang & Hwang 2021). 32 studies on Internet-based ITSs conducted after 2000 were investigated in a meta-analysis study, and it was found that the studies were designed for a wide variety of fields such as information technologies, mathematics, science, medicine and foreign language education (Erümit & Çetin 2020; Troussas, Chrysafiadi, and Virvou, 2019; Karacı 2019). In the meta-analysis study, it was stated that the effectiveness of ITSs were statistically significant in terms of attitude and success in web-based Science Education courses (Orhan & Men 2018). In the last decade, a lot of research has been conducted in the field of ITS. These studies addressed fuzzy logic-based, dialogue-based, language education and intelligent tutoring systems that adapt to the students. WBITS developed by Karacı (2013) was used in this study. The system consists of an active domain knowledge module, a student module, a pedagogical module and a communication interface.

The student model module is an overlay student model. The teaching system has a general content management system and can be used in different domains. The system was used by Erdemir (2015) in Physics teaching and with the transition to distance education due to pandemic in 2020; the system was updated and used in the delivery of the Science Education program courses. The perceptions of the Science teacher candidates about using the system were determined with their answers to the 4 “Yes/No” questions about the system. Perceptions focus on the students’ enjoyment of using WBITS for learning, their thoughts about the usefulness of the system for achieving the course objectives, its and pedagogical suitability and potential for replacing in-class education. Despite the fact that there are studies on the development and employment of the ITS in the literature, there are not enough studies on the satisfaction of the users of the developed teaching systems, compliance to course objectives, potential for replacing face-to-face education and pedagogical suitability. The current study aims to

fill this gap.

In the present study, a sample of preservice science teachers who were taking their undergraduate courses online using a WBITS was asked to provide yes or no responses to the four questions listed below.

- 1-Did the use of WBITS in the course process make you happy?
- 2-Do you think that using the WBITS in the course process contributed to fulfilling the course objectives?
- 3-Do you think the WBITS can be a suitable alternative to in-class teaching?
- 4-Did you find that the overall experience of using WBITS to meet the course objectives was positive?

## **Method**

In March 2020, due to the COVID-19 pandemic, education-training processes were largely transferred to online platforms. From this date on, Faculty of Education Science Education students started to take their courses with distance education. Turkish Education History (TEH), Fundamentals of Physics (FoP) and Earth Science (ES) lessons, which consist of 2 lessons per week each in Science Education, were carried out using WBITS. The teacher candidates took the lessons only on WBITS until the end of the spring semester, and no other lesson materials such as live lectures and lecture videos were used. The teacher candidates were engaged in a self-paced learning and training process on WBITS and they also took online midterm and final exams on the ITS at the end of this semester.

## **Significance of the Study**

Using WBITS in distance courses is important in terms of contributing to increasing the efficiency of the teaching and learning process. By leveraging the technological developments and artificial neural networks in online courses, limitations of distance education processes can be reduced. The fact that WBITS is Internet-based can provide teachers and educational institutions with flexibility in terms of time and place. WBITS is important in terms of facilitating the interaction between the learner and the computer, providing feedback, evaluating performance, individual learning situations, time saving, offering rich, more interactive course and personalized content. The WBITS employed in the study was used for three different courses, TEH, FoP and ES, and importantly, it can be adapted to different courses.

## **Aim of the Study**

The aim of the study is to contribute to the efforts towards increasing the effectiveness of technological developments in distance education processes. In this context, the study aims to determine the advantages and disadvantages of the system in the light of participants' opinions about the validity of the system, the reliability of the system and its pedagogical dimension by capturing what the teacher candidates feel about the WBITS which they used in the distance lessons. The study also aims to contribute to the future studies and the formation

of the new infrastructure for restructuring based on the opinions of the teacher candidates.

### **The Scope of the Study**

The study consists of pre-service teachers who are studying at the Faculty of Education Science Education program in the spring semester of the 2019-2020 academic year. It consists of 144 pre-service teachers in total, 19 taking the TEH course, 77 taking the FoP course, and 48 taking the ES course. They utilized WBITS throughout their learning process. After completing the topics on the system, their opinions about the system were collected.

### **Limitations of the Study**

The study was limited by the opinions of pre-service teachers who took 3 courses in the Science Education bachelor degree program. Due to the required preparations of Internet-based course content, the lack of sufficient contribution of some field experts for each course, technical support and communication difficulty due to COVID-19 pandemic restrictions, the study was limited to 3 courses. This restricted the possible number of lessons and students. The pre-service teachers did not have any in-class lessons, and there was no opportunity to compare face-to-face lessons and lessons using WBITS. Therefore, the teachers gave their opinions by referring to their past experiences and distance education-teaching methods used in other lessons.

### **Research Model**

The Study is a case study which aims to investigate one or more situations in depth. In this model, factors related to case studies (environment, individuals, processes, events, etc.) are investigated and reported with a holistic approach (Yıldırım & Şimşek, 2008). Adaptive WBITS was created according to the overlay student model by providing links to illustrations, activities, examples, problems, animations and related topics. Course contents created by field experts were presented to the students taking the courses on the Internet at [www.zekifizik.com](http://www.zekifizik.com). The opinions of teacher candidates about WBITS were collected.

#### *The WBITS Used in the Study*

Intelligent Tutoring Systems (ITSs) are internet-based (web-based) and computer-based platforms. ITS course content that is accessible via the internet is described as web-based ITS (WBITS). A person with expertise both in the related subject field and in designing web-based course content prepares the course content. After completion of this stage, the course content developed is uploaded to the ITS through the host connected to the domain. The course content in the present study, which was prepared in line with the program of the department and in-class educational activities, included enriched course materials, like lecture texts, lecture videos, virtual experiments, examples, activities, links to related websites, or links to virtual courses. Preparation of the course content took approximately one month, and the transference of the content to the WBITS was completed in the middle of April, 2020. Worksheets for each topic were converted to a web-format and added to the WBITS.

After transferring the course content to the system, the system was opened to the preservice teachers who were registered to the system.

To follow the courses delivered on the WBITS, the preservice teachers had to sign up on the website, [www.zekifizik.com](http://www.zekifizik.com), by providing the necessary information (name-surname, username, school number, the course attended, password, and email). The admin of the website confirmed the information of each preservice teacher. Once their information was confirmed, the preservice teachers were able to log in to the system with their username and password and gain access to the course content and start their learning process. The learning process was carried out according to the method of programmed instruction. With the programmed instruction method, the teacher role was realized on the WBITS through artificial intelligence, computer systems, and science education (pedagogy). This role involved teacher behaviors, such as decision-making, supervision, providing feedback, and assessment. The stages of the WBITS learning process are presented in Figure 2.

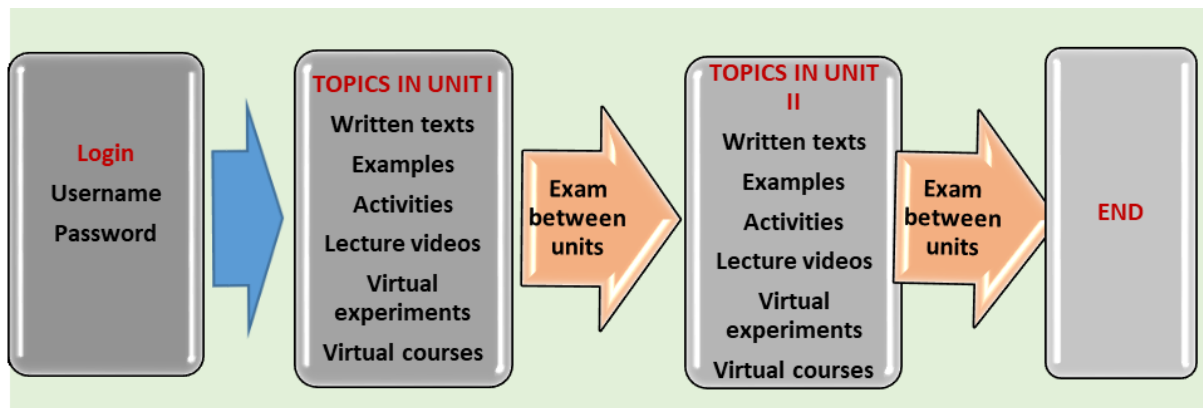


Figure 2. Stages of the WBITS Learning Process Involving Two Units

As seen in Figure 2, the preservice teachers log in to the system with their username and password on their computers or smartphones via an internet connection. Each preservice teacher experienced a personalized learning process. Once they logged in to the system with their username and password, the system recognized them and directed them to the page they were previously on when they logged out of the system. At the beginning of the course, when the preservice teachers first logged in to the WBITS, the first topic of the first unit was opened for them to study. The course content consists of either a single or multiple-page website. The preservice teachers were only able to study the topic pages that the system assigned to them and could not study the other pages. As seen in Figure 2, each topic included written texts, lecture videos, virtual experiments, links to the related websites, examples, activities, and links to virtual classes. The field expert set a time for each topic, and the preservice teachers were supposed to complete the studying of the course content within that time limit. During this period, the system did not allow the preservice teachers to study another topic. That is, it was not possible to access the content of the next topic without first completing the first topic assigned. Written texts (figures, graphs, tables, or pictures), related examples, and activities were included on the webpage corresponding to a given topic. The activities related to each topic were designed as fill-in-the-blanks, comparisons, and true/false concepts or questions. At the end of each topic, prompt feedback was provided to the preservice teachers' responses to the activities and examples. The system did not allow the preservice



teachers to start studying the next topic without first completing the activities and examples of the current topic. In addition to the content, the preservice teachers were also able to access lecture videos, virtual experiments, and virtual courses using the links presented at the end of each topic. Each external source in the WBITS was examined by a field expert (teacher), and upon the confirmation of the field expert, the links to the external sources were provided.

After completing Unit I, the preservice teachers needed to meet or exceed the score determined by the field expert on the first exam between units to pass on to Unit II. If a preservice teacher failed to meet that criterion on the exam, the WBITS directed the preservice teacher to revisit the topics to which he or she provided incorrect answers on the exam. Exams between the units consisted of problems, fill-in-the-blank, true/false, and multiple-choice questions related to the topics addressed in the unit just completed. Each exam question was linked to one or more topic webpages or topics in Unit I. Therefore, in cases where the preservice teacher provided an incorrect answer to an exam question, the topic related to the learning deficiency was shown to the preservice teacher, and the result was also sent to them as feedback. In other words, if the results were below the criterion determined by the field expert—which indicates that the learning level is not sufficient—then the preservice teacher was directed to revisit those topics. After being provided a designated period of time to restudy these topics, the preservice teacher was entitled to take the exam again. The system did not allow preservice teachers to take the exam without first restudying the topics assigned to them. If the preservice teacher succeeded in the exam, the Unit II topics were opened. The process depicted above was repeated for each unit until each preservice teacher achieved the level determined by the teacher. The learning process was completed by following the process for each unit.

The intelligence feature of the WBITS used in the present study is summarized below:

- 1- The system prevents a preservice teacher from going to the next page without first completing the current one.
- 2- The system detects once a preservice teacher finishes studying all topics to allow the preservice teacher to take the exam.
- 3- The system determines the pages that are viewed, allowed to be viewed, and not allowed to be viewed.
- 4- The system keeps track of the number of times the preservice teacher views a page and the time they spend on the page. The system allows the teacher to see the preservice teachers' answers to the activity questions. The system marks preservice teachers' wrong answers in red and sends them to the preservice teachers as feedback.
- 5- The system determines the level at which preservice teachers view the worksheet webpage (level of studying), the number of times they logged on to the website, and the amount of time they spent using artificial neural networks. The system prevents access to the exams between units for preservice teachers whose level of studying the pages is not at the desired level and directs them to these pages for revising.
- 6- The system informs preservice teachers about their results on the exams between units and their level of learning by using statements like “definitely does not know”, “quite likely does not know”, “possibly does not know”, “possibly knows”, “probably knows”, “quite likely knows”, and “definitely knows”. The system lists the topic or topics about which the preservice teachers have deficient knowledge and directs

them to these pages.

7-The system prevents preservice teachers who fail to achieve the desired level on the exams between units from studying the next topic.

8- The system enables preservice teachers and the teacher to monitor the answers provided to the exams between units and shares the preservice teachers' incorrect answers with the teacher.

9- The system directs the preservice teachers to the section they last left off at when they logged out of or closed the browser.

## **Data Collection**

In the present study, a total of 144 preservice teachers who were taking the TEH, FoP, and ES courses stated their views regarding the system they used. Their views on the WBITS were collected through a simple Yes/No question format. The four questions on the use of the WBITS were posed to them after they completed their learning processes using the system.

## **Data Analysis**

The preservice teachers' views regarding the WBITS were analyzed using the descriptive analysis technique, a type of qualitative analysis. Frequencies and percentages of the yes/no responses made to the four questions by the preservice teachers who had completed the TEH (19), FoP (77), and ES (48) course were calculated, and the results are given in Table 1 below. The responses were collected under four headings: happiness with using the system, the validity of the system, reliability of the system, and pedagogical sufficiency of the system.

As can be seen in Table 1, the first question is about whether the preservice teachers were happy with using the system, the second question is about their views on whether using the system contributed to realizing the course objectives, the third question is about whether the system can be used in place of in-class education, and the fourth question is about whether using the system positively affected the attainment of course objectives:

1. Did realizing the course process using the WBITS make you happy?
2. Do you think that using the WBITS in the course process contributes to fulfilling the course objectives? The level at which the WBITS was able to serve the intended purpose is a measure of its validity. The key point in measuring validity is to determine the degree to which an instrument accurately measures its supposed target, without mixing it with other situations (Tekin 1997).
3. Do you think that the WBITS could be a reliable alternative to the in-class education process? By using the system in in-class educational processes, its reliability was able to be determined. An instrument is said to be reliable if it yields similar results when applied over an extended period of time. The reliability of a measurement tool is determined by applying repeated measurements under the same circumstances (Carey 1988; Öncü 1994).
4. Did you find that the experience of using the WBITS had a positive impact on attaining course objectives? This question was posed to understand the preservice teachers' views on the WBITS as they related to pedagogy, which refers to the teaching practices and strategies applied to transfer knowledge.

In brief, the questions addressed the ideas of happiness with and validity, reliability and pedagogy of the WBITS according to the preservice teachers who used the system.

Table 1. Frequencies and Percentages of the Views Expressed by the Preservice Teachers who used the WBITS in the TEH, FoP, and ES Courses

	Turkish Educational History (n=19)				Fundamentals of Physics (n=77)				Earth Sciences (n=48)			
	Yes		No		Yes		No		Yes		No	
	f	%	f	%	f	%	f	%	f	%	f	%
Did completing the course process using the WBITS make you happy?	14	73.68	5	26.32	62	80.51	15	19.49	34	70.83	14	29.17
Do you think that using the WBITS in the course process contributed to fulfilling the course objectives?	18	94.73	1	5.27	68	88.31	9	11.69	44	91.66	4	8.34
Do you think that the WBITS can be a reliable alternative to the in-class education process?	16	84.21	3	15.79	67	87.01	10	12.99	43	89.58	5	10.42
Did you find the experience of using the WBITS to have a positive impact on attaining course objectives?	17	89.47	2	10.53	65	84.41	12	15.59	39	81.25	9	18.75

## Results and Discussion

The findings of the present study were derived from an analysis of the preservice teachers' responses to the yes/no questions on the happiness they had using the system, the validity and reliability of the system, and its

pedagogical sufficiency after using the WBITS to complete their respective courses. Separate findings were gathered for each course. The results are presented in percentages (%) and frequencies (f) in Table 1. The findings of the study were framed under the headings of being happy, being valid, being reliable, and being pedagogical.

### The Views on the WBITS of the Preservice Teachers who used the System to take the Turkish Educational History (TEH) Course

The percentages corresponding to the yes/no responses made by the 19 preservice teachers who took the TEH course using the WBITS are presented in bar graph form in Figure 1.

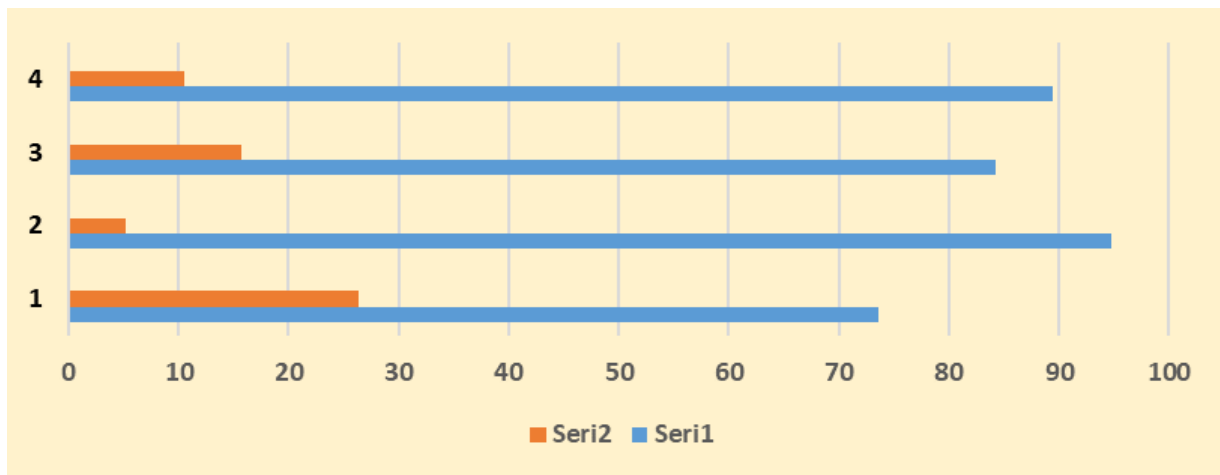


Figure 1. Views of the Preservice Teachers who took the TEH Course using the WBITS

As can be seen in Graph 1, of the 19 preservice teachers who took the TEH course using the WBITS, 73.68% stated that they were happy using it, while the remaining 26.32% stated that they were not happy, 94.73% stated that the system was valid and contributed to achieving the course objectives, whereas the remaining 5.27% stated that it did not contribute to achieving the course objectives, 84.21% stated that the system was reliable and could be used as an alternative to in-class education for the TEH course, while the remaining 15.79% stated that it could not be used an alternative, and finally, 89.47% found that using the WBITS in the TEH course was pedagogically positive, while the remaining 10.53% found it to be pedagogically negative.

The most positive views expressed by the preservice teachers were related to the question of the WBIT being valid (94.73%), which indicates that the system contributed to achieving the course objectives. The most negative views expressed were related to the preservice teachers' unhappiness with using the system (26.32%).

### The Views on the WBITS of the Preservice Teachers who used the System to take the Fundamentals of Physics (FoP) Course

The percentages corresponding to the yes/no responses made by the 77 preservice teachers who took the FoP course using the WBITS are presented in bar graph form in Figure 2.

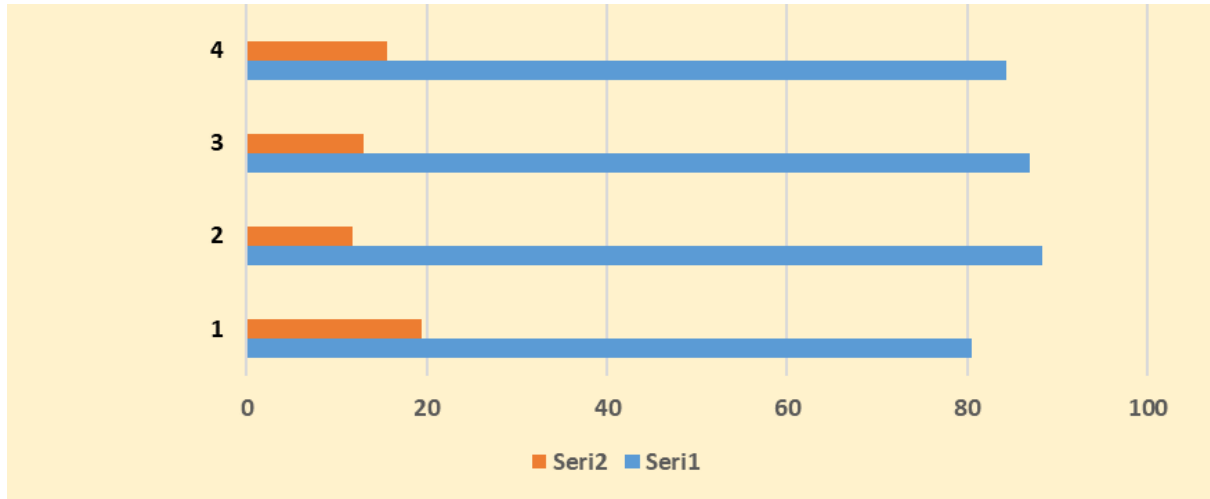


Figure 2. Views of the Preservice Teachers who took the FoP Course using the WBITS

As can be seen in Graph 2, of the 77 preservice teachers who took the FoP course using the WBITS, 80.51% stated that they were happy using it, while the remaining 19.49% stated that they were not happy, 88.31% stated that the system was valid and contributed to achieving the course objectives, whereas the remaining 11.69% stated that it did not contribute to achieving the course objectives, 87.01% stated that the system was reliable and could be used as an alternative to in-class education for the FoP course, whereas the remaining 12.99% stated that it could not be used as an alternative, and finally, 84.41% found that using the WBITS in the TEH course was pedagogically positive, while the remaining 15.59% found it to be pedagogically negative.

The most positive views expressed by the preservice teachers were related to the questions of the WBITS's validity and reliability (88.31% and 87.01%, respectively), which indicates that the system was dependable and could contribute to achieving the course objectives. The most negative views expressed by the preservice teachers were related to their unhappiness with using the system (19.49%).

### **The Views on the WBITS of the Preservice Teachers who used the System to take the Earth Sciences (ES) Course**

The percentages corresponding to the yes/no responses made by the 48 preservice teachers who took the ES course using the WBITS are presented in bar graph form in Figure 3. As can be seen in Figure 3, of the 48 preservice teachers who took the ES course using the WBITS, 70.83% stated that they were happy using it, while the remaining 29.17% stated that they are not happy, 91.66% stated that the system was valid and contributed to achieving the course objectives, whereas the remaining 8.34% stated that it did not contribute to achieving the course objectives, 89.58% stated that the system was reliable and could be used as an alternative to in-class education for the ES course, whereas the remaining 10.42% stated that it could not be used as an alternative, and finally, 81.25% found that using the WBITS in the ES course was pedagogically positive, while the remaining 18.75% found it to be pedagogically negative.

The most positive views expressed by the preservice teachers were related to the questions of the WBITS's

validity and reliability (91.66% and 89.58%, respectively), which indicates that the system was dependable and could contribute to achieving the course objectives. The most negative views expressed by the preservice teachers were related to their unhappiness with using the system (29.17%).

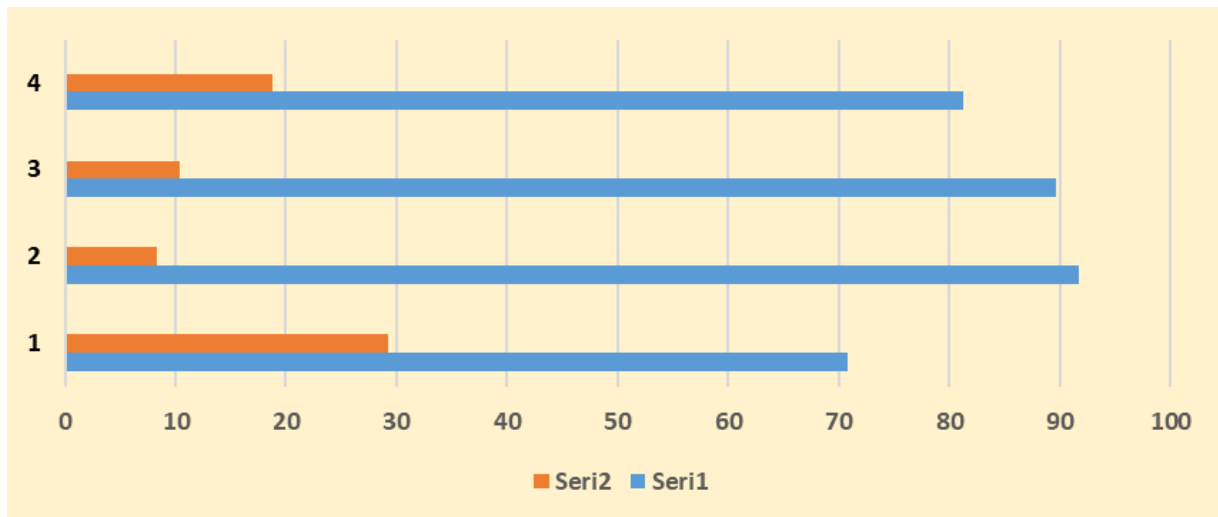


Figure 3. Views of the Preservice Teachers who took the ES Course using the WBITS

A total of 144 preservice teachers, 19 in the TEH course, 77 in the FoP course, and 48 in the ES course, participated in the present study. The findings related to the preservice teachers' views were presented separately for each course. In the Discussion section that follows, the findings are examined under four headings: Being happy with using the system (feeling good), (system) being valid, (system) being reliable, and (system) being pedagogically sufficient.

#### Preservice Teachers' Views on whether they were Happy with Using the WBITS in Courses

Table 2 was formed using the percentages corresponding to the preservice teachers' views on the use of WBITS in the TEH, FoP, and ES courses, as shown in Figure 1, Figure 2, and Figure 3, respectively. Table 2 presents the percentages of the preservice teachers' views on whether or not they were happy with using the WBITS in courses. The opinions of the teacher candidates conducting the lessons on the system about being happy about using the system were found as FoP (80.51%), TEH (73.68%) and ES (70.83%) (see Table 2).

The highest percentage of positive views on feeling happy to use the system was seen in the preservice teachers who took the FoP course (80.51%), followed by the preservice teachers who took the TEH and ES courses (73.68% and 70.83%, respectively). This relatively high rate of happiness with the WBITS could be interpreted to mean that the preservice teachers enjoyed the enriched course materials and the absence of time and place restrictions offered by the system. The visuals which are able to be used in an ITS are much more effective than those used in traditional (in-class) education (Steenbergen-Hu & Cooper, 2014; Van-lehn, 2011), and the use of the internet and computers to access knowledge eliminates time and space problems (Anderson & Ellumi, 2002). Students who use the intelligent tutoring system stated that although they are not very happy to use the system, it is easy and helpful to use the system in teaching and learning (Karacı, Piri, Akyüz & Bilgici 2018).

Table 2. Preservice Teachers' Views on Being Happy with Using the WBITS in Courses

	Turkish Educational History		Fundamentals of Physics		Earth Sciences	
	Yes (%)	No (%)	Yes (%)	No (%)	Yes (%)	No (%)
	Being happy	73.68	26.32	80.51	19.49	70.83

The percentages of the preservice teachers who stated that they were not happy with using the system for the ES, TEH, and FoP were 29.17%, 26.32%, and 19.49%, respectively (see Table 2). The preservice teachers who took the FoP course expressed more positive views, compared to those of their peers who took the TEH and ES courses, regarding the use of the system. The use of the WBITS in physics course largely involved problem-solving and experiments, which were enhanced with virtual experiments and many examples, activities, and problems from different sources, features that likely contributed to making the preservice teachers in the FoP course feel happier. The predominantly verbal content of TEH and ES courses do not call for rich course materials in lectures. This made participants to feel unhappy with using the system. Another reason for the unhappiness was the limitations of their distance education.

This difference in results, or less happiness, could also stem from the limitations of distance education, which include the lack of student-teacher communication and socialization. This lack of communication and socialization is a challenging issue for distance education (Rovai, 2002) and is one of the main limitations of distance education (Van-lehn 2011; Vygotsky 1995). Moreover, the lack of teacher-student communication can result in students feeling unsure of themselves (Chyung, Winiceki, & Fenner 1998), an issue that could have been responsible for some of the preservice teachers in the present study feeling unhappy with the distance education process.

### Preservice Teachers' Views on the Validity of Using the WBITS in Courses

Table 3 was created by using validity percentage values in Graph 1, Graph 2 and Graph 3. In Table 3, prospective teachers stated with a high rate that WBITS will be effective in achieving the course objectives. The opinions of the preservice teachers on achieving the course objectives are listed as TEH (94.73%), ES (91.66%) and FoP (88.31%) (see Table 3).

Table 3. Preservice Teachers' Views on whether Using the WBITS in Courses was Valid

	Turkish Educational History		Fundamentals of Physics		Earth Sciences	
	Yes (%)	No (%)	Yes (%)	No (%)	Yes (%)	No (%)
	Being valid	94.73	5.27	88.31	11.49	91.66

The concept of validity refers to how well a measuring tool measures what it intends to measure. Validity in courses refers to the quality of learning and teaching (Kember & Leung 2008). As can be seen in Table 3, most of the preservice teachers stated that the WBITS was valid, and that the use of the system in the educational

process served the purposes of the process. The enriched course materials and the feedback provided could explain this finding. Van-lehn (2011) indicated that ITSs provide enriched stimuli and feedback, which makes the course presentation provided by ITSs more effective. As academic achievement is one of the main goals of a course, ITSs are effective tools for increasing academic achievement levels (Ma, Adesope, Nesbit, & Liu 2014). The links to external sources and adjustable navigator offered by WBITS could have contributed to the positive views regarding the validity of the WBITS.

As seen in Table 3, 5.27%, 11.49%, and 8.34% of the preservice teachers in the TEH, FoP, and ES courses, respectively, expressed negative views regarding the validity of the WBITS. The percentages of negative views are considerably lower than the percentages of positive views, meaning that it is quite clear that few of the preservice teachers felt that the WBITS system was not effective in fulfilling the course objectives.

**Preservice Teachers’ Views on the Reliability of Using the WBITS in Courses**

Table 4 was formed using the percentages corresponding to the preservice teachers’ views on whether the use of the WBITS in the TEH, FoP, and ES was reliable or not, as also shown in Graph 1, Graph 2, and Graph 3, respectively. The preservice teachers mostly expressed positive views about the use of the WBITS being capable of replacing in-class education, as demonstrated by the high percentages of those who responded ‘yes’ to this question (84.21% in the TEH course, 87.01% in the FoP course, and 88.31% in the ES course).

Table 4. Preservice Teachers’ Views on the Reliability of Using the WBITS in Courses

	Turkish Educational		Fundamentals of		Earth Sciences	
	History		Physics			
	Yes (%)	No (%)	Yes (%)	No (%)	Yes (%)	No (%)
Being reliable	84.21	15.79	87.01	12.99	89.58	10.42

The preservice teachers stated that it would be appropriate to use WBITS instead of the lessons in the classroom. This shows that the system is consistent and it would be reliable to use it instead of classroom education. As seen in Table 4, the preservice teachers who used the WBITS indicated that the use of the WBITS was better able to help achieve objectives than that of in-class education. The WBITS is a computer and internet-based education system that simulates teachers’ behaviors, a feature that could have played a key role in achieving the course objectives.

ITSs are flexible teaching tools that can provide individual learning and feedback (Moundridou & Virvou, 2000). Compared to in-class learning, the WBITS’s ability to provide more individualized, flexible learning based on the level of learners likely contributed to the preservice teachers’ views that the WBITS could be used as an alternative to in-class education. As the system monitors and realizes learning stages, the preservice teachers were only able to pass on to the next learning stage when they met certain criteria.



With its intelligence feature, the system was able to simulate teacher behaviors in a classroom, a factor likely responsible for the preservice teachers' feeling that the WBITS could be used as an alternative to in-class educational practices. As seen in Table 4, 15.79%, 12.99%, and 10.42% of the preservice teachers in the TEH, FoP, and ES courses, respectively, expressed that the WBITS could not be used as an alternative to in-class education, as was not reliable. They further felt that the learning outcomes achieved using WBITS could not live up to those able to be achieved in in-class education processes.

### Preservice Teachers' Views on the Pedagogical Sufficiency of Using the WBITS in Courses

Table 5 was formed using the percentages corresponding to the preservice teachers' views on whether the use of the WBITS in the TEH, FoP, and ES was pedagogically sufficient or not, as also shown in Graph 1, Graph 2, and Graph 3. The pedagogical dimension includes all educational behaviors that should be used in an educational process. Teachers exhibit these behaviors in teaching processes using different methods and techniques. Pedagogy refers to the science of education, the teaching profession, and the art of guidance (Ada & Baysal 2013; Akyüz, 1991).

Table 5. Views on the Pedagogical Sufficiency of the WBITS in Courses

	Turkish Educational History		Fundamentals of Physics		Earth Sciences	
	Yes (%)	No (%)	Yes (%)	No (%)	Yes (%)	No (%)
Being pedagogical	89.47	10.53	84.41	15.59	81.25	18.75

Teacher candidates participating in the study take lessons on what, how and when to learn within the context of pedagogy lessons. They apply their knowledge by going to schools under the control of expert instructors. As can be seen in Table 5, most of the preservice teachers found the WBITS to be pedagogically sufficient in the TEH, FoP, and ES courses (89.74%, 84.41%, and 81.25%, respectively). The system delivered a programmed education and could monitor learning stages with its intelligence feature. This was effective in the learning process examined in the present study.

Most of the preservice teachers indicated that the system was positive in terms of science education and could carry out teacher behaviors observed in in-class education. The intelligence feature of the WBITS was specifically designed to simulate teacher behaviors. Intelligent teaching systems are computer-based teaching systems that determine what and how to teach by modeling teaching content and teaching strategies (Murray, 1999). The preservice teachers' positive views on this subject could stem from the fact that the WBITS provided enriched course materials and made it easier to use teaching methods. Can (2010) reported that the use of technology in learning environments positively affects learning.

As seen in Table 5, 10.53%, 15.59%, and 18.75% of the preservice teachers in the TEH, FoP, and ES courses, respectively, stated that the use of the WBITS was not pedagogically effective, a finding that could be attributed to the preservice teachers feeling more accustomed to in-class education, and the lack of socialization and

communication provided by the WBITS:

1-The 80.5% of the pre-service teachers who took the FoP course expressed a positive opinion of being happy to use WBITS in the lessons. The participants who revealed a negative opinion were mostly the candidates who took the ES course by 29.17%.

2- Of participants who took the TEH course, 94.73% of the pre-service teachers agreed that the use of WBITS in the courses served to reach the course objectives. Preservice teachers who took the FoP course disagreed with this statement by 11.49%.

3- The positive opinion of using WBITS instead of in-class lessons came mostly from the pre-service teachers who conducted the ES course with a rate of 89.58%. The candidates who disagree with replacing face-to-face lessons with WBITS were mostly those who took the TEH course with 15.79%.

4- According to % 89,47 of students who took the TEH course, WBITS was sufficient in pedagogical aspects. On the other hand, 18.75% of the candidates who took the ES course expressed a negative opinion in this respect.

## **Recommendations**

A high percentage of the preservice teachers expressed positive views on the use of WBITS in courses in terms of their happiness with using the system, the ability of the system to fulfill the purposes of the course, the use of the system as an alternative to in-class education, and the pedagogical sufficiency of the system. It is important to note that these findings may have been influenced by the comparison the preservice teachers made between the WBITS and other systems used for educational practices in distance courses. Furthermore, the preservice teachers' views may have been biased in a positive direction due to the fact the COVID-19 pandemic had caused disruption to the usual educational process, and therefore, it was a welcome opportunity to use the WBITS to complete their respective courses online.

WBITSs can be used as efficient tools for administering distance education. These systems should, however, be modeled according to the objectives of courses to eliminate problems. Moreover, they can be used either as a separate, stand-alone educational method or as a support tool for in-class education. The fundamentals of a topic can be addressed through WBITSs to save time for more advanced topics in in-class education.

## **Notes**

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