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Teachers' opinions on the effectiveness of digital technology in the realization of cognitive objectives[1]

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Abstract. Educational technologies are used as an effective tool in achieving educational objectives. In this research, it is aimed to examine teachers' opinions about the effectiveness level of digital technology in acquiring cognitive objectives. The research was conducted as the sequential explanatory mixed research design. "A questionnaire of technology beliefs for cognitive objectives" and semi-structured interview form developed by the researchers were applied. At the end of the research, it was concluded that teachers' views about the effectiveness of digital technologies in achieving cognitive objectives were generally high. The teachers think that smart boards and Web 2.0 are the most effective tools. Respectively computer, tablet pc, smartphone and Web 1.0 come next in that list. It has been seen that smart board and Web 2.0 technologies play an effective role in the acquisition of cognitive objectives by enabling the development of different parameters.

Keywords: Cognitive taxonomy, educational objectives, technology

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INTRODUCTION

The systematic and programmable structure of education (Akpınar, 2003) obliges dynamic relationships affecting one another among the elements/components of curriculum (objectives, content, teaching and learning process and evaluation). The objective element in this context has an essential basis (Bümen, 2006). Objective is a desired qualification statement that can be acquired via education and seen as favourable qualifications for those who are named as 'learners' (Ertürk, 1972). Defining the objectives in formal education procedures is essential in terms of the functionality of educational efforts (Bloom, 1956). For this reason, the level of knowledge, skills and attitudes that are thought to be gained to the student should be revealed. This situation makes it obligatory to determine and classify the objectives according to the quality of the student (Arı, 2013).

In the process of teaching, observing that the objectives are realized clearly and in a visible way provide benefits for observing the expected behavioural change. This has led to the development of classification objectives in education (Tekin, 2009). In the classification of objectives hierarchically, the most common ones are those, which are practised by Bloom, Engelhart, Furst, Hill & Krathwohl (Demirel, 2015). In these classifications, behaviours are gathered in three main chapters; cognitive behaviours, affective behaviours and psychomotor behaviours according to the learning domains (Bloom, 1956). The conceptual background regarding cognitive classification, which constituted the study, is presented below.

Relationship between Education and Technology

It is important to use tools that can enable students' access, use, produce and transfer information in education (Akkoyunlu, 2002). These tools are named as educational technology. These tools used in education process, such as practising the defined objectives, in solutions of

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possible problems regarding teaching and learning process and in supporting this process are approached as technological procedures (Lever-Dufy & Mcdonald, 2008; Newby, Stepich, Lehman & Russell, 2006; Roblyer, 2006; Seels & Richey 1994). It can be seen that dynamism in the perpetuity of the usage of technology is regarded as functional as well as different technologies are preferred in education in the scope of educational implementations from past to the year 2020. Computer, smart board, web technologies and mobile technologies are among the commonly used educational technology in the teaching/learning process. Teachers who are the most significant practitioner of the system of education and to use these technologies are highly responsible for planning educational activities.

In order to effectively utilize the technologies in education, teachers need to support the teaching-learning process with technology, choose the appropriate ones and plan the instructional strategies according to the technology they use (Lever-Dufy & Mcdonald, 2008). This enables teachers to integrate technology to the classes and create an effective class environment (Kuşçu & Arslan, 2015).

Political and educational attempts regarding the use of digital technologies in education has been increasing and getting widespread (www.worldbank.org). Countries actively integrate technology into educational practices. Many countries such as Korea, Malesia, England, Indonesia, Thailand have attempted digital technology-based education (Trucano & Dykes, 2017). In technology-based teaching practices; where particularly, flipped classrooms, blended teaching have become prominent, smart phones, Web 2.0 devices also become important (learningportal.iiep.unesco.org). In digital world where concepts like technological equipment, software, networks and access have become significant; there exists a different educational dynamism opposite of traditional education. Accordingly, a new reality where multi-media materials are included in education, teacher training are integrated with technology, concept of online school becomes prominent and education and digital technology are rebuilt together shows up (Haddad & Draxler, 2002). With FATIH Project, step of education and technology integration have been carried out in Turkey. When statistics of the project are analyzed, frequency and preferences of practices like smart boards usage in education, computer, use of internet are seen to increase (Çoban, Saray & Ulutan, 2017).

When tendencies regarding the use of technology in education are considered, teachers' consciousness and awareness level in the aim of integrating technology with education is significant. Teacher's analysis, which is involved as discussions of Clark (1983, 1994) and Kozma (1991, 1994) in literature- whether educational technologies are instrument or teaching strategy has addressed the functionality of curriculum. When scientific body of literature is examined, in 2000' specially, as a result of developments in information and communication technologies, computer technologies and its extensions can be told to affect teaching strategies meaningfully (Clark, Tanner-Smith & Killingsworth, 2016; Hasting & Tracey, 2005). Web 2.0 particularly as well as being functional, is also an effective method for learning and teaching (Gleason & Heath, 2019).

In order for teachers to make the best use of educational technologies, educational technologies should be used in a planned and efficient manner in accordance with the goals and behaviors they want to achieve. While planning the educational technologies, it is necessary to appeal more senses, to motivate and consequently to provide more qualified learning processes (İşman, 2015).

Bloom's Taxonomy and Critiques for Bloom's Taxonomy

In 1956, Bloom, Engelhart, Furst, Hill and Krathwohl formed a taxonomy for cognitive domain for examination of the classification of education objectives hierarchically (Bloom, 1956). This taxonomy named as 'Bloom's Taxonomy' comprises of six main levels; knowledge, comprehension, application, analysis, synthesis, and evaluation. Among these main levels, there are also sublevels except the 'application' step in these steps. At the same time, in this taxonomy, while lower order thinking skills are stated as knowledge, comprehension, and application, higher order thinking skills are stated as analysis, synthesis, and evaluation (Arı, 2011; Bloom, 1956; Çepni, Ayas, Johnson & Turgut, 1997; Forehand, 2010; Krathwohl, 2002; Şahinel, 2002).

Bloom's taxonomy which consists of six levels in general, usually requires to use various cognitive process at each step (Büyükalan, 2007).

The levels in Bloom's taxonomy include one –dimension frame which are ordered from simple to complex and from concrete to abstract. In this case, it was thought that knowledge and comprehension levels were more complex than the other abstract levels- synthesis and evaluation levels. However, in taxonomy, sometimes, there are possible cases where lower-level objectives are likely to be more complex than higher-order levels. Similarly, synthesis level is likely to contain 'the evaluation level' which is higher level than synthesis (Amer, 2006; Anderson et al., 2014; Krathwohl, 2002). This fact has shown that taxonomy conflicts with its structure sometimes each objective may not be ordered from simple to complex, and according to the circumstances an objective which is seen as simple in any level is likely to become more complicated than any objective in any level which is seen as complicated in higher levels.

Bloom's Taxonomy presents a hierarchical framework where low-levels are prerequisite to higher-levels' competence (Anderson, 2005; Bloom 1956; Sönmez, 2004). In fact, some behaviours can also occur without acting the behaviours needed for that level (Senemoğlu, 2007). For instance, in a synthesis level, one can make evaluations for a theorem with internal and external standards without presenting a new theorem (Berkdemir & Selim, 2008). Another criticism is about the subject area. Fairbrother (1975, as cited in Senemoğlu, 2007) states that all objectives in subject areas are impossible to be classified gradually. Specially in the classes such as music and physical education which require kinesthetic intelligence, it is hardly possible to use this taxonomy (Berkdemir & Selim, 2008). One other criticism for Bloom's taxonomy is that the knowledge step's two-dimensional structure which includes both noun and verbal qualification. Noun or subject area element, are stated widely in sublevels of 'knowledge'. The verb form, on the other hand requires learner's to remember the knowledge or recognize. This case which is not seen in any other levels of taxonomy creates a conflict by including knowledge level's two-dimensions to express with one dimension (Anderson et al., 2001; Krathwhol, 2002).

Since the date Bloom's taxonomy was published, many new theories and approaches have taken place in literature in the light of the studies in education and psychology. Theories and approaches such as constructivist approach, effect of self-regulated learning with metacognitive skills in education process, supporting autonomous learning and the cognitive and perceptual necessity of being responsible for the learning have revealed the need for revising the taxonomy The deficiencies in taxonomy and the need to make the structure suitable for learner-centered have drawn attention (Amer, 2006). As a result, it is necessary to review and update the taxonomy due to the fact that students have more knowledge in education compared to the past and the knowledge accumulation has increased as the development, change and learning of the students, teachers' practices, and the quality of the educational environment have changed.

Bloom's Revised Taxonomy

Resulting from the lacks and criticisms directed at Bloom's taxonomy, Anderson, Krathwohl, Airasian, Cruikshank, Mayer, Pintrich, Raths and Wittrock (2001) discussed the taxonomy and published Bloom's revised taxonomy by updating it.

In the revised Bloom's taxonomy, the conflict of two-dimensional frame in the original taxonomy was corrected by separating 'noun' and 'verb' case. A new, two different dimensional frameworks that is; two 'noun based' structure showing content and 'verb based' structure showing how to carry out the content has come into use. Thus; a chance to be able to evaluate the objective or learning in terms of both knowledge and process became possible (Anderson et al., 2001; Krathwhol, 2002). Within the sub-step "knowledge dimension" Bloom's Taxonomy; in addition to the three categories, which are described as factual knowledge, conceptual knowledge, and procedural knowledge; "metacognitive knowledge", which is defined as "it includes information about cognition as well as that the individual knows and is aware of his own cognitive knowledge" is the fourth category. Thus, The Revised Bloom's Taxonomy was formed by four categories in the knowledge dimension (Amer, 2006; Anderson, 2005; Kratwohl, 2002). This categorical classification within the knowledge level ensured all subject area, class

level and school level to become applicable. Thus, the criticisms for the original taxonomy which suggest 'not applicable to every learning area' lost validity (Berkdemir & Selim, 2008).

In the cognitive level, on the other hand, 'the knowledge level' in the original taxonomy was named as 'remembering', 'comprehension' was named as 'understanding' and 'analysis' was named as 'analyzing'. 'Synthesis' was named as 'creating' and replaced 'evaluating'. In the process of naming primary and lower-steps, verb version was used completely (Amer, 2006; Anderson 2005; Bümen, 2006; Krathwhol, 2002). Just like in the original taxonomy, in The Revised Bloom's Taxonomy, first three steps are remembering and application steps are lower-steps and last three steps are analysis, evaluation and creating levels which are metacognitive skills (Arseven, Şimşek & Güden, 2016; Kaya & Karamustafaoğlu, 2015; Soleimani & Kheiri, 2016; Tikkanen & Aksela, 2012).

Another change in Revised Bloom's Taxonomy is to ease hierarchical framework of the original one. Though hierarchy qualification appears in the revised one as is the original, it is not that rigid (Anderson, 2005; Bümen, 2006). So this, resolved the prerequisite principle to mastery of the next higher levels. For example, 'understanding is no longer prerequisite of the 'application'. One can 'apply' partially without needing to understand a unit of an objective or learning area (Anderson, 2005; Berkdemir & Selim, 2008).

To summarize the alterations in the revised taxonomy, we can gather them in three chapters; the levels of taxonomy converted from noun to verb and some of them were renamed –terminological change, transition from one-dimensional to two-dimensional- structural change and purposeful change which aims to reach more people (Forehand, 2010). Consequently, revised taxonomy did not wipe off the original one. It was updated to keep up with time and was corrected at some critical points in general. With this revised one, Bloom's taxonomy has a very strong basis in terms of usability within cognitive area classifications.

Problem Status

Objectives in subject area are aimed to teach by determining cognitive, psychomotor and affective domains. Specifically, cognitive objectives a great deal of importance in education process. The attainment level of cognitive skills in any education system makes a great deal contribution to see the success of the system. In this framework, the results of the assessment and evaluation test's both as international and national context, are interpreted as an indicator regarding Turkish Education System's reaching cognitive objectives.

With one of the international examinations, PISA (Programme for International Student Assessment) students are evaluated with science, maths and reading skills (OECD, 2016). When examinations that took place in 2006, 2009, 2012 and 2015 are evaluated, Turkey fell behind with science and maths literacy both as country average and OECD countries' average. In reading skills area, on the other hand; though ranked as above average of all countries' except the year 2015, Turkey fell behind in all OECD countries again (Taş, Arıcı, Ozarkan & Özgürlük, 2016). Also, according to each domain's determined competence level, when taken into consideration, with regard to the result of 2015 examination in Turkey, it can be seen that while percentage of lower competence increases, upper competence percentage decreases in the science, maths and reading skills (OECD, 2016). According to one other evaluation examination - TIMMS (Trends in International Mathematics and Science Study) results, when 4th and 8th graders' maths and science levels are reviewed in 2011 and 2015, Turkey's average score can be seen under TIMSS scale. In these examinations, Turkey can be seen in lower and mid-level and could not reach upper and advanced level (Yıldırım, Özgürlük, Parlak, Gönen & Polat, 2016).

Examinations at the national level also take place in Turkey. In exam for transition high school (TEOG), from 2014-2015 to 2018, except common results of second terms of 2016-2017, foreign language course (English only) and maths & sciences courses are below the mean or slightly above (MEB, 2017, 2016a, 2016b, 2015). When undergraduate placement test (LYS) which is one of the phase of university admission test is examined, it is seen that those who took the exam have nearly less than half of the total points for each subject (OSYM, 2017). Similarly, 2018 (Turkish 16,17 mean of 40 questions; social science 6,00 mean of 20 questions; basic maths 5,64 mean of 40 questions; science 2,82 mean of 20 questions) and 2019 (Turkish 14,67

mean of 40 questions; social science 6,68 mean of 20 questions; science 2,24 mean of 20 questions; basic maths 5,67 mean of 40 questions) Basic Proficiency Test (TYT) is examined in terms of all applicants, similar results exist (OSYM, 2018; OSYM, 2019).

Turkey's national (LYS, TYT, TEOG) and international (PISA, TIMSS) evaluation results show us the fact that; desired levels of cognitive objectives have not been reached in education and there are some limits to reach those objectives. Students not being at desired level for expected cognitive objectives even with formal education programs and despite supporting them professionally, is seen as a huge and basic problem. It is known that achieving success in the realization of cognitive objectives is influenced by many parameters (psychological, sociological, economic, linguistic, technological, etc.). Among these parameters; technology (specially digital technology), is a subject of study and also taken into consideration to improve and apply curricula.

To be able to reach at desired level for cognitive objectives, digital technologies have been seen as a significant tool. Especially, in the areas such as students to improve academically, and objectives to be reached, digital-technology-reinforced teaching and learning, some examinations have been made. When literature is reviewed, as a consequence of technology use, students increase their success (Çakır & Tan, 2017; Lopez, 2010; Özabacı & Olgun, 2011; Özenç & Özmen, 2014; Sakız, Özden, Aksu & Şimşek, 2014; Tienken & Wilson, 2007; Xin & Sutman, 2011), supports and makes their learning easy, increases their performance and their learning approach is affected positively (Chen, Chiang & Lin, 2013; Enriquez, 2010; Gorgievski, Stroud, Truxaw & DeFranco, 2005; Jang, 2010), some metacognitive skills such as critical thinking, problem solving, reflective thinking are developed (Arkün Kocadere & Aşkar, 2013; Bagdasarov, Luo & Wu, 2017; Gök, 2012; Kershner, Mercer, Warwick & Kleine, 2010; Kıcı & Dilmen, 2014; Koehler & Ertmer, 2016). At the same time, this improves cooperative learning and increases the communication among students (Bonastre, Penalver & Belmonte, 2006; Cheng, Chan, Kong & Leung, 2016; Fallon, 2015; Lin, Liu & Niramitranon, 2008;). This shows educational purpose of digital technology use has a success potential to minimize disadvantages when experienced while reaching cognitive objectives.

With different approaches such as distance education, hybrid education, blended learning, computer-assisted learning, it is seen that technology has been employed in terms of achieving and increasing success in the education process. However, changes in technology might cause some concerns regarding adapting those changes in education process. Especially, some tools using these technologies like smart-phones, tablet computers and Web 2.0 devices are basis for the concern. These technologies; in terms of building academic and social autonomy which support carrying out educational approaches with adapting basic philosophy of education can cause problems such as supporting undesirable behaviours and unacceptable latent learning in the process of carrying out defined objectives in the era of info pollution. In this context, here appears a question whether digital technologies in learning and teaching settings is an opportunity or a limitation in carrying out cognitive objectives. Within this research questions, it is wise enough to consult with teachers who are one of the most important and executive part of education system. In this study, teachers' ideas upon efficiency are examined in terms of their using/ability of using these devices (computer, smart boards, tablet computers, smart phones, Web 1.0, Web 2.0) for cognitive educational objectives. With this basic aim, questions below are expected to be answered.

1. Which digital technologies (computer, smart board, tablet pc / smartphone, Web 1.0, Web 2.0) stand out in terms of their effectiveness in achieving cognitive objectives according to the opinions of teachers?

2. What are the reasons why digital technologies, which are the most effective in achieving cognitive objectives, have this effect?

METHODS

The research was conducted as a mixed method. In this research, with reference to findings from quantitative research, "The Explanatory Sequential Design Model" (Creswell, 2017) is applied in which detailed answers are sought with qualitative research.

In the quantitative part of the research, the descriptive survey research design, in which the existing situation was defined within its own conditions (Karasar, 2006), was carried out. In the qualitative part of the research, "explanatory case study", which explains the causal connections of complex situations (Yin, 2009), is used from case studies, where an event is examined in depth based on how and why questions (Yıldırım & Şimşek, 2016). The first research question of the research is solved with quantitative method and the efficiency levels of technological devices in study scope (computer, smart board, tablet computer, smart phone, Web 1.0, Web 2.0) regarding reaching cognitive objectives according to teachers' ideas is examined. The second research question is solved with qualitative method and, the reasons of efficiency of the first research question's findings are examined. In this context, examining the second research question is done by Web 2.0 and smart board technologies which are the most effective devices in cognitive taxonomy. Particularly Web 2.0 and Web 1.0 and other devices are explained to the teachers in data collection process. Participants' answering the questions within the scope of explanations is cared.

Population and sample in quantitative pattern and study group in qualitative pattern of the study are presented separately.

Population and Sample

The research population is consist of teachers of Turkish, English, Religious Culture and Moral Knowledge, Maths, Science and Social Studies who are teach in Çanakkale province. The sample of the research is determined by proportional sampling method (5% error margin) and 267 teachers answered the survey which makes 88 % of total. The fact that response rate's being above 70-80% provides healthy interpretation (Büyüköztürk et al., 2012). Teacher's demographical qualifications that participated in the quantitative part of the research (survey) is given in Table 1;

Table 1. *Demographic features of teachers in quantitative research*

		f	%
Gender	Female	162	60,7
	Male	105	39,3
	Total	267	100,0
Branch	Maths	53	19,9
	Science	50	18,7
	Social Studies	39	14,6
	English	45	16,9
	Turkish	54	20,2
	Religious Culture and Moral Knowledge	26	9,7
	Total	267	100,0

According to Table 1, teachers from elementary mathematics branch 53 (19,9%), from science branch 50 (18,7%), from social sciences 39 (14,6%), from English branch 45 (16,9%), from Turkish branch 54 (20,2%), from Religious Culture and Moral Knowledge branch 26 (9,7%) participated in the study. Teachers were teaching in middle schools. 60 percent of participants are female and the other 39,3 percent are male.

Study Group

Focus groups and individual interviews are formed according to maximum variety of purposed sampling techniques in the qualitative part of the study. In maximum variety sampling process,

without generalization concern, defining the problem from a broader view to find out common or distinctive patterns in consistently defined situations is aimed (Büyüköztürk et al., 2012).

One teacher from the branches of quantitative examination of the research participated and two focus studies were done in total. Teacher's demographical qualifications that participated in the qualitative part of the survey is given in Table 2.;

Table 2. *Demographic features of teachers in qualitative research*

		Individual interview (n)	Focus group interview (n)	Total
Gender	Female	6	7	13
	Male	4	5	9
	Total	10	12	22
Branch	Maths	2	2	4
	Science	2	2	4
	Social Studies	1	2	3
	English	2	2	4
	Turkish	2	2	4
	Religious Culture and Moral Knowledge	1	2	3
	Total	10	12	22

According to Table 2, 10 teachers were chosen providing at least one teacher participating individual interviews. 12 teachers participated in focus group and 10 teachers in individual interviews, which makes 22 in total. There are some other ideas, which suggest focus group interviews should be formed with 6-8 (Yıldırım & Şimşek 2016), 4-6 (Büyüköztürk et al., 2012) and 6-10 (Ersin & Bayyurt, 2015) participants. Focus group formed from 6 participants has been functional enough for this study.

Data Collection Instrument

As a data collection instrument of quantitative part of the research, the survey of '*Technological Beliefs Regarding Obtaining Cognitive Objectives Questionnaire*' was used which consists of 48 items. Content validity of the questionnaire is carried out with 6 academicians who are specialists in "Curriculum and Instruction" and "Assessment and Evaluation in Education". For the reliability of the instrument, split half test reliability technique was realized. Consistency of the questionnaire' test score is high enough and this shows that the questionnaire is reliable (lowest item r= .579 and highest r= .896). In the questionnaire, 5 ratings from "I don't believe at all" to "I believe completely"' whether technological devices used in educational setting are effective in terms of cognitive objectives were used. Teachers from different branches expressed their opinions by considering cognitive objectives regarding their own classes.

In the qualitative part of the research, to be able to examine quantitative findings deeply, semi-structured interview form was prepared by the researcher. Expert opinion regarding the validity of the interview form was received; a pilot interview was held with a teacher regarding reliability.

Data Analysis

Arithmetic mean results were calculated with SPSS 21.0 program for descriptive comparisons. In data scoring, opinions concerning the effect of technology in obtaining objectives are interpreted as; 1.00-1.50 'too low', 1.51-2.50 'low, 2.51-3.50 'mid', 3.51-4.50 'high', and 4.51-5.00 advanced level. In defining these rating score intervals, criteria that participants took into consideration became a basis. Participants, when they did not know which one to choose, for example; I believe/ high (4 points) or I believe completely /advanced (5 points), they round it mathematically. That is, like in the related example, when they are between 4 and 5, the point that helps them to decide is 4.50. In the circumstances where opinion or tendency is like above 4.50, it becomes 5, and if it is below 4.50, then it becomes 4. In order not to manipulate

participant's opinions statistically, score intervals served as a contact in evaluations as stated above. Also in different studies, similar scoring system can be seen (Alston & Miller, 2002; Bringula et al., 2012).

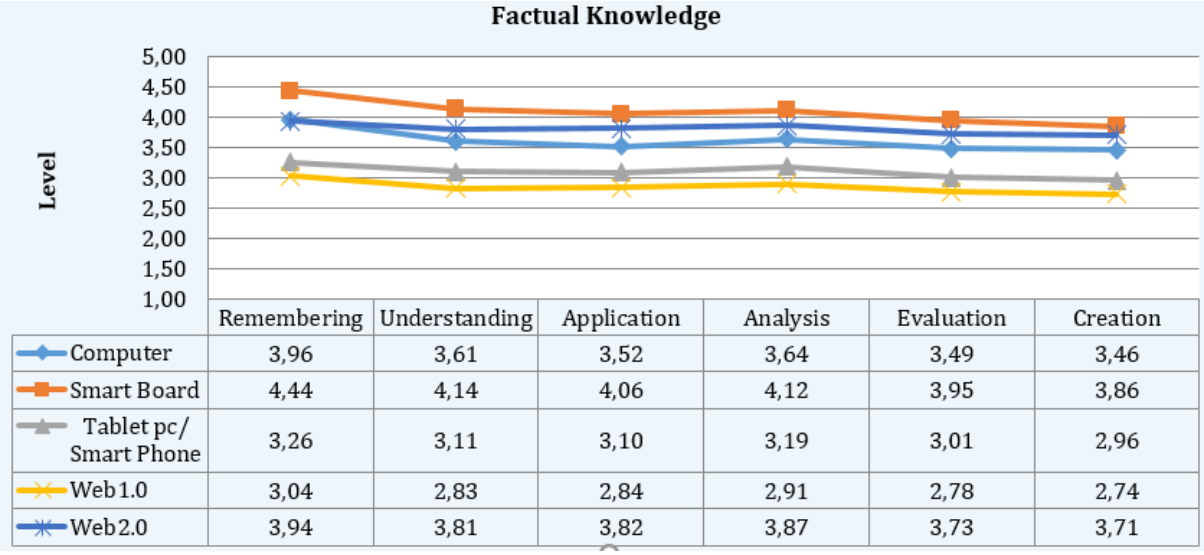
In the process of analysing teachers' opinions, semi-structured focus group interviews and individual interviews took place. Focus group interviews lasted 1 hour and 45 minutes, individual interviews lasted minimum 30 minutes and maximum 1 hour in average. Data, on the other hand, was recorded with tape recorder and transferred to MS Word. Transcripts of focus group are formed with 6240 words, and, individual interviews are formed with 5210 words. In data coding process, "content analysis" was performed which is one of the qualitative data analysis. Reliability calculation of the coding procedure in content analysis was made with the formula of Miles and Huberman (1994) "Reliability = Consensus/ (agreement + disagreement) x 100". At the end of the calculation procedure, concordance between two coders was found as 87%. Calculations of reliability's being above 70 percent is accepted as reliable for a research (Miles and Huberman, 1994). At the end of the content analysis theme, how many participants focused the same theme has been indicated by frequency value. "I-f" code for individual interview frequency and "FG-f" code for focus group interview frequency are used in themes.

RESULTS

Analysis results regarding the research questions of the research are presented here. First, examinations of technology efficiency in obtaining objectives, then findings and comments related with academic base of these comments are presented.

Analysis Regarding Teachers' Opinions in Effectiveness Level of Digital Technology in The Process Obtaining Factual, Conceptual, Procedural and Meta-Cognitive Knowledge (remembering, understanding, application, analysis, evaluation, creation)

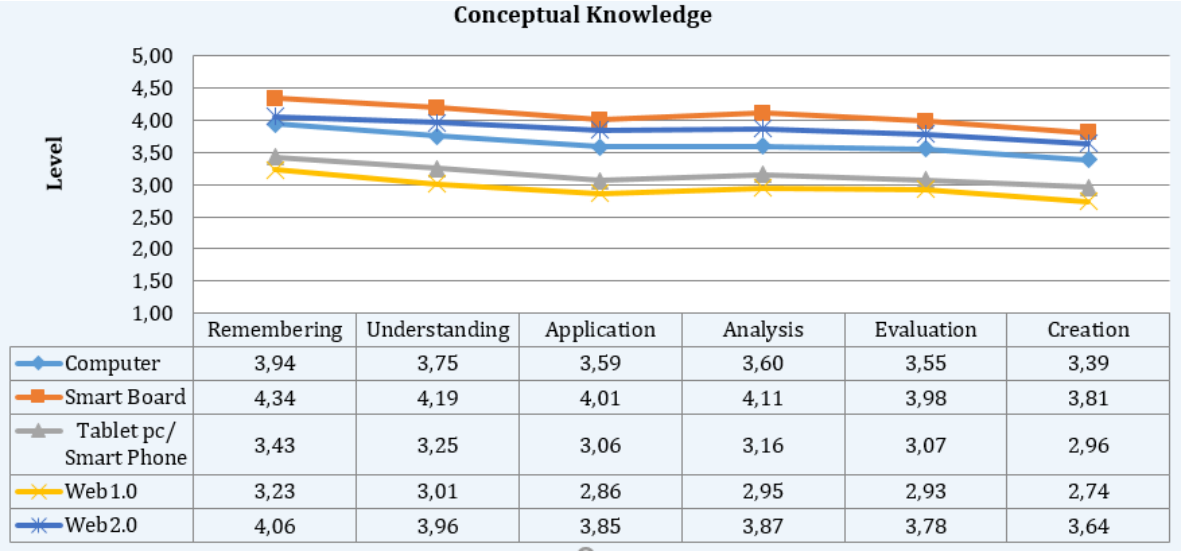
Teachers' opinions on the effectiveness of technology in achieving cognitive objectives are presented in Graph1.



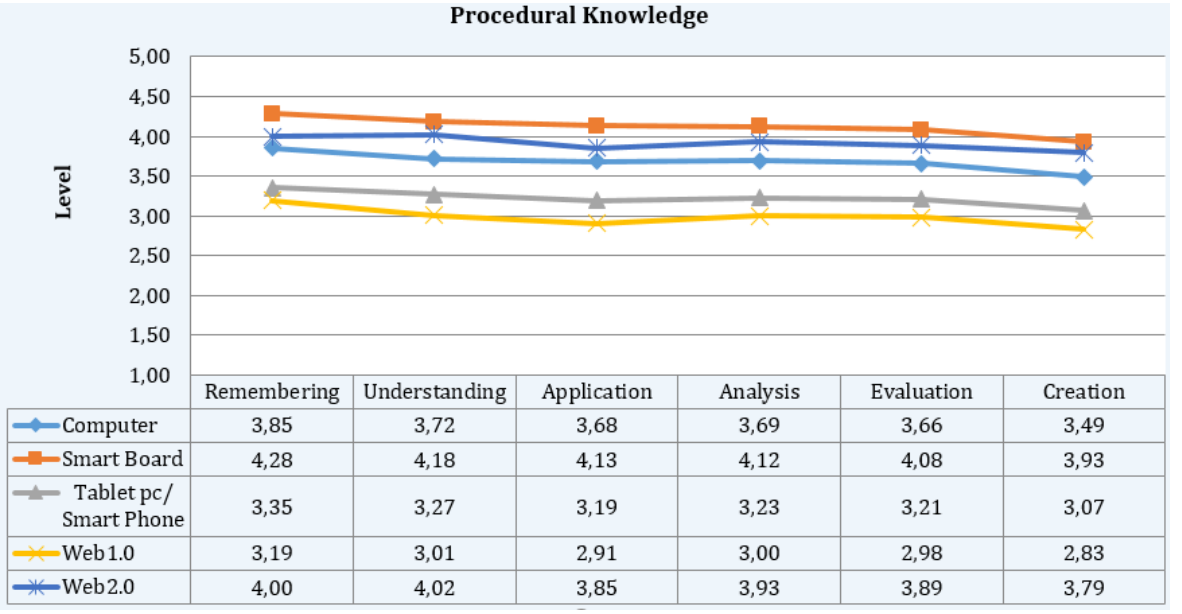
	Remembering	Understanding	Application	Analysis	Evaluation	Creation
Computer	3,96	3,61	3,52	3,64	3,49	3,46
Smart Board	4,44	4,14	4,06	4,12	3,95	3,86
Tablet pc/ Smart Phone	3,26	3,11	3,10	3,19	3,01	2,96
Web1.0	3,04	2,83	2,84	2,91	2,78	2,74
Web2.0	3,94	3,81	3,82	3,87	3,73	3,71

GRAPH 1. *Teachers' opinions on the effectiveness of technology in achieving cognitive objectives*

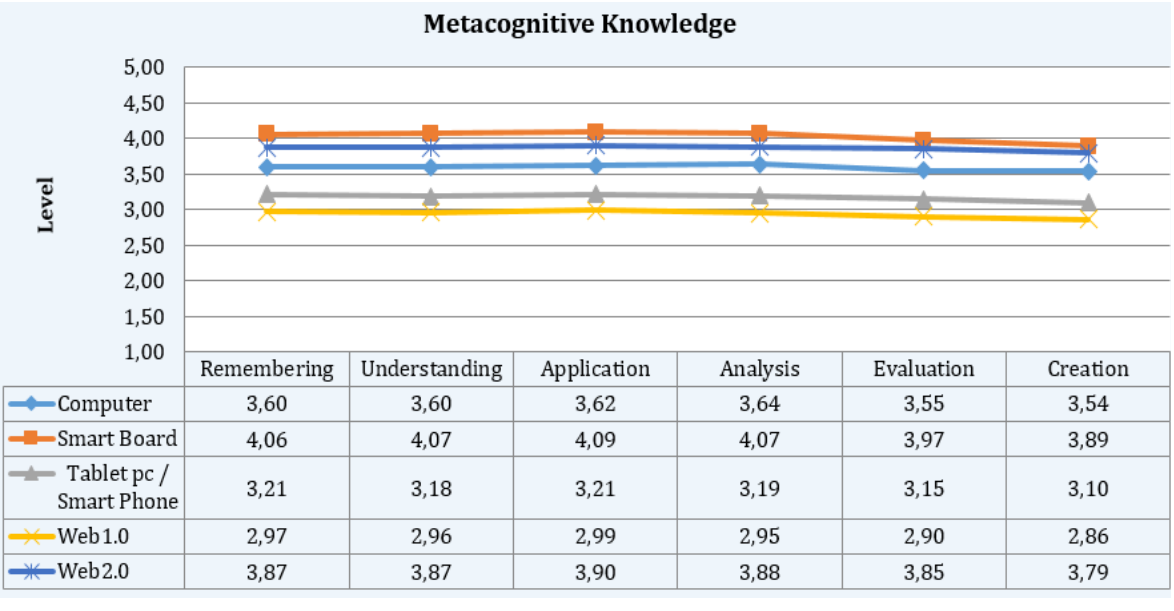
Graph 1. *Continued …*



	Remembering	Understanding	Application	Analysis	Evaluation	Creation
Computer	3,94	3,75	3,59	3,60	3,55	3,39
Smart Board	4,34	4,19	4,01	4,11	3,98	3,81
Tablet pc/ Smart Phone	3,43	3,25	3,06	3,16	3,07	2,96
Web 1.0	3,23	3,01	2,86	2,95	2,93	2,74
Web 2.0	4,06	3,96	3,85	3,87	3,78	3,64



	Remembering	Understanding	Application	Analysis	Evaluation	Creation
Computer	3,85	3,72	3,68	3,69	3,66	3,49
Smart Board	4,28	4,18	4,13	4,12	4,08	3,93
Tablet pc/ Smart Phone	3,35	3,27	3,19	3,23	3,21	3,07
Web 1.0	3,19	3,01	2,91	3,00	2,98	2,83
Web 2.0	4,00	4,02	3,85	3,93	3,89	3,79



	Remembering	Understanding	Application	Analysis	Evaluation	Creation
Computer	3,60	3,60	3,62	3,64	3,55	3,54
Smart Board	4,06	4,07	4,09	4,07	3,97	3,89
Tablet pc / Smart Phone	3,21	3,18	3,21	3,19	3,15	3,10
Web 1.0	2,97	2,96	2,99	2,95	2,90	2,86
Web 2.0	3,87	3,87	3,90	3,88	3,85	3,79

When Graph 1 is examined, teachers' opinions regarding the efficiency of technology in the cognitive processes of factual knowledge, conceptual knowledge, procedural and meta-cognitive knowledge is high in general. This shows us that teachers find technology useful and they have a great deal of ideas which devices are more effective than the others and how to benefit from them in educational process.

Graph 1, except remembering level of the factual knowledge in cognitive process of all knowledge levels, when arithmetic mean of opinions regarding technology effect is seen, smart board comes first and followed by Web 2.0, computer, tablet/smart phone and Web 1.0. 'Computer' is in second rank only in 'remembering step' of the factual knowledge.

The Reasons for the Effectiveness of Digital Technologies That Are Most Effective in Achieving Cognitive Educational Objectives

According to teachers' views, in terms of efficiency level, smart board and Web 2.0 step forward and this can be seen in Graph 1. Following the analysis of first research question, 'the case' which forms second research question is a set of reasons regarding the effectiveness of smart board and Web 2.0 in achieving cognitive objectives. The results are shown in Figure 1 and 2. Teachers' views related with efficiency of cognitive taxonomy in knowledge dimension are reflected.

Analysis of smart board effectiveness in educational objectives of cognitive taxonomy

In the research, the coding was done at the end of the interviews conducted to determine the reasons for the effect of the smart board on the realization of the educational objectives in the factual, conceptual, procedural and metacognitive knowledge dimensions of cognitive taxonomy and shown in Figure 1.

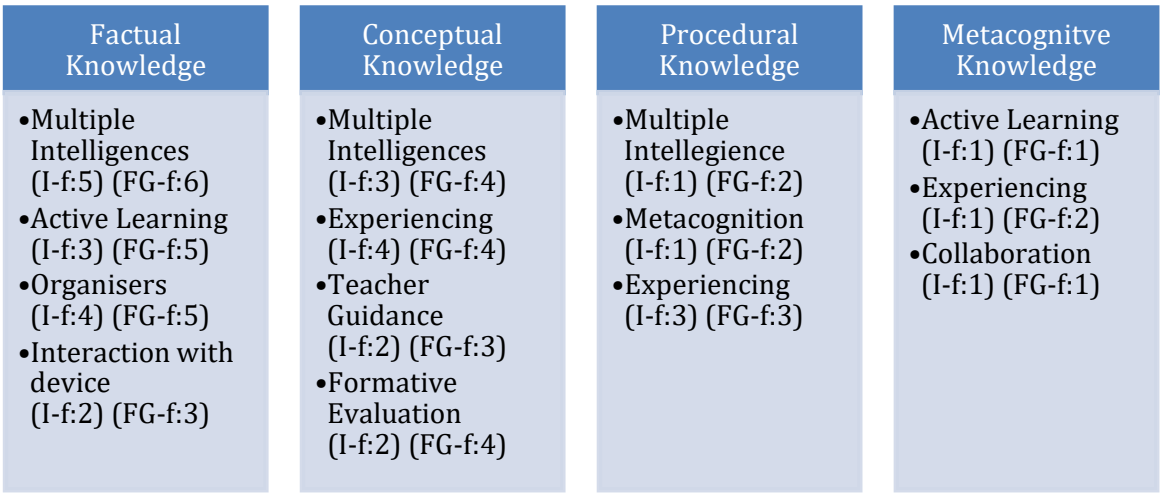


FIGURE 1. *Interview results regarding effectiveness of smart boards in achieving cognitive taxonomy objectives*

Figure 1 shows the parameters that emerged as a result of interviews with teachers. This reveals that in the knowledge dimension of cognitive objectives, smart boards develop different parameters in itself. When considered from this point of view; in each knowledge category, findings regarding smart board are;

In factual knowledge, smart boards appeal to different intelligence types and ensures objectives to come true. Smart board, besides appealing to different senses, addresses tactual sense and provides student to learn by doing and by this way, becomes very influential. By this way, it enables learning by doing and experience and creates student- centered environment. So, smart boards help knowledge to be permanent and meaningful by providing usage of organizers in complex subjects. Teachers' views regarding with this are;

> T18 coded teacher; .... smart board is very important in terms of students' interaction with notions that they can learn or we want them to learn. With the help of smart board, teacher

becomes an observer and has a chance to allow student to be the knowledge. So, a learning area is created where the students are involved. The student hears and sees as visually, and learning become more permanent if she can intervene by touching as this appeals to more senses.

T16 coded teacher; some notions might be abstract for some students, so smart board is an important tool as it concretizes abstract notions and presents visually.

In the conceptual knowledge, smart board appealing to different intelligence types, helps permanent learning and increases learning by ensuring students to experience different applications. Smart board makes a great deal of contributions as it presents the knowledge that students get via teacher guidance and evaluates the solutions of problems via instant feedbacks. Teachers' views regarding with this are;

T11 coded teacher; ... topics we want to teach and structures/principles of these topics can be easily given with the usable applications of smart board. Students have the chance of practicing the topics with teacher guidance and presenting them. It is possible for students to solve questions in smart boards while practicing with teacher's suggestions, instructions, and feedbacks. As they practice in front of the class, other students can give solution offerings and evaluate whether correct or not. Activities of smart board makes the learning process permanent for students.

In procedural knowledge, smart board increases the permanency of knowledge by means of appealing to different intelligence types and providing distinctive interpretation and codings. Applications in smart board gives students opportunity to experience sub-process levels of topic. Teachers' views regarding with this are;

T22 code teacher; We use animations and simulations of smart boards to concretize the info and make them more meaningful. Thus, students find given numeric values by practicing and evaluating, decide what/how to do and how to proceed. Also these enable them to decide which one is correct.

In meta-cognitive knowledge, applications in smart board help students experience them, solve problems collaboratively, and learn by doing. Teachers' views as follows;

T15 coded teacher; .... I help students to practice and work in collaboration by forming groups for simulations that we use before doing an experiment. Then, by practising the data we have found, we get the chance of performing the experiment on smart board with the info we have and we witness the results together. Different data help each group perform the experiment on smart board, see the results, and participate in learning process.

T3 coded teacher; "With the help of applications on smart board, students are ensured to transmit the info they have just learnt. At this point, students are asked to follow the lesson carefully via smart board to make them gain a broader view with the applications/visuals. To exemplify, when I show the area of parallel calculation, students can calculate triangle area as floor area x height. But they can see that dividing the parallel edge brings us two triangles so they become aware of dividing the number. This helps them notice that they can apply this for a square as well.

Analysis of Web2.0 effectiveness in educational objectives of cognitive taxonomy

The coding was done at the end of the interviews conducted to determine the reasons for the effect of the Web2.0 on the realization of the educational objectives in the factual, conceptual, procedural and metacognitive knowledge dimensions of cognitive taxonomy and shown in Figure 2.

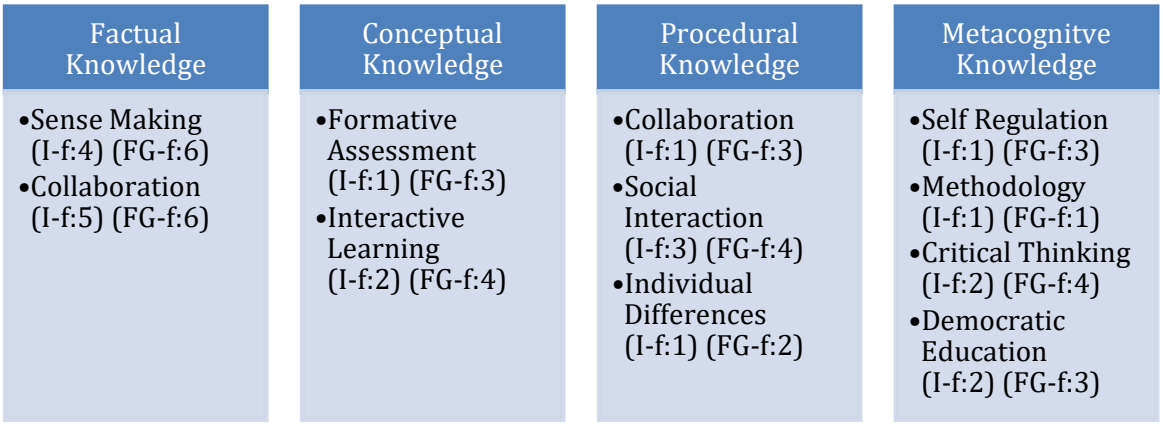


FIGURE 2. *Interview results clarifying the effect of Web 2.0 in cognitive taxonomy*

Figure 2 shows the parameters from teacher interviews. In each knowledge category, findings regarding Web 2.0 tools as follows;

In factual knowledge, Web 2.0 tools have positive impacts on learning process by using organizers which easies students to learn. Together with this, they provide students to work in collaboration and share information and thus, learn in an interactional way. Teachers' views as follows;

> T15 coded teacher; ... social media groups make huge contributions to teaching process where students share and exchange their ideas and correct mistakes. In the group that I have formed, I sometimes ask as 'what do you think about the notions that I find significant?' Those who can guess reply. Then I tell them to search to talk about it tomorrow. So, students search, share, discuss, and comment. Thus we can prevent the possible ambiguity. Because sometimes, students can catch the points that I miss.

In the conceptual knowledge, on the other hand, social media devices which have an important place in Web 2.0 technologies, contribute to students by giving a chance of evaluating, realizing missing points and being corrected by friends or teacher. At the same time, information that learners want to get or feedback of questions, enable other students' attention and involvement in learning process. Teachers' views as follows;

> T13 coded teacher; .... social media (Facebook, twitter) or instant messaging smart phone applications (WhatsApp, messenger) draw students attention more than others. They can turn into an effective tool in obtaining objectives. Students can test themselves on EBA with questions regarding topic. They can make inferences in what they have learnt or what they have not understood. Whenever I am online, I try to provide the missing information or else student clears up the missing parts by searching on the internet and verify them with friends on social platforms. The positive side is that; this becomes a lifestyle for learners.

> T8 coded teacher; By means of answers of questions we share in social media groups and feedbacks regarding this answers, we can see the correct answers or solution of questions and this helps enabling the learning process continue in a rapid way. If a classification needs to be done, students share whatever they know, even when some of them do not agree, I wait them to finish and finally I share the correct answer to enable them an opportunity to fix missing points.

> T5 coded teacher; It becomes easier for students to classify a subject and to recognize it with their sharing with one another in Web 2.0 settings. All students get the necessary information, share whatever they know and fix missing info by participating in the discussions actively that I share on the classroom wall (EBA) to make them understand the classifications better and make their learning stronger. Even things that they forget from our school class can be permanent as they think like "they told this in group".

In procedural knowledge, social media devices which are one of the Web 2.0 technologies, enable other students to see and learn different process steps regarding problem solving while also enabling them to work in collaboratively. Social media devices

in Web 2.0 technologies enable students to meet under different topic headings and look for solutions. Thus; students can create a social environment and find solutions to problems. Web 2.0 technologies enable each student to proceed according to her speed. In addition, these technologies enable teachers to see the techniques and methods they use in teaching, and to see students and support them considering their levels in this environment. Teachers' ideas as follows;

> T20 coded teacher; I send assignments to students via EBA and they form groups themselves and share. They discuss the questions/ problems and share solutions. Thus, students can see the different ways or similar steps in problem solving. This groups enable students to learn alternative solution steps and this is the most important advantage. Students can both solve the problems in collaboratively and learn the solutions with different views via peers.

> T16 coded teacher; sometimes students can solve the other students' questions without me by sharing their ideas in WhatsApp groups. So, this creates a cooperative learning and interactive environment where students explain or exchange ideas.

In meta-cognitive knowledge, Web 2.0 technologies can enable students to develop a proper methodology for themselves through the ways they have found or to see how the others proceed in problem solving. In this process, Web 2.0 offers environments where the students can learn how to learn a topic they do not have any idea about it. Web 2.0 technologies and social media tools in it also create a democratic discussion environment where students can exchange ideas freely and criticize by coming together with other students under different subject headings. Teachers' ideas as follows;

> T21 coded teacher; Web 2.0 environments enable students to raise self –awareness. When Web 2.0 is used properly, it is like an ocean where students develop their own learning styles and create new learning environments. Student can discuss the given problem in discussion groups with an interest. Everyone can reflect their own ideas. Some students don't get enough satisfaction from the given answers and continue to search the internet. The student actually tries to find a reliable and satisfying source for herself. This helps the student develop her own learning styles. In the following steps, with this awareness, we can see that the students try to reach the knowledge.

> T 14 coded teacher; With Web 2.0 technologies and other social media environments, the students can express their ideas and make their own evaluations about any topic, can criticise and comment. Thus, Web 2.0 environments improve cognitive skills and increase brain activities. They make us think. Web 1.0 is more based on memorization, somebody prepares something and we use it without adding any comment and criticising or transmitting our criticisms. From this point of view, students don't have a chance to be involved in process to improve their cognitive skills.

> T19 coded teacher; on social media (EBA, WhatsApp, Facebook) I start a discussion topic related with the lecture by giving problem/ idea / question. What do you think about? is an example. Sometimes some of them reply instantly and the others submit their ideas by searching the Net and those who do not think in a similar way argue their own ideas. A discussion arises among students whether 'this is correct' When they proceed to wrong directions I intervene. Sometimes I can see they can reach a consensus. Thus, I try to teach respecting others and defending their own opinions.

In accordance with this research question, teacher views and parameters show us that technology has an important place in the process of obtaining cognitive objectives.

DISCUSSION and CONCLUSIONS

In technology, especially digital media has enabled to reach information easily by becoming more and more interactive and functional and reach different info as information technologies improve and diversify. This reveals the need of re-building the education system (Şahin & Kartal, 2013). With this reconstructing, technologies, which are used to obtain desired objectives, are expected to have a big role. In the research, analysis of teachers' views regarding

the effectiveness of technology has taken place in reaching cognitive objectives. While these views are being viewed, it has also been analysed as regard to base them academically.

Because of the examinations, it was concluded that the opinions of teachers about the effectiveness of technology in achieving cognitive objectives are high. This result shows that teachers see technology as an effective tool in achieving cognitive objectives. This can be explained in the context of instrument and teaching strategy, which are the most fundamental requirements in acquiring objectives. Arguments whether technology is an instrument or strategy, which stands out as Clark (1983, 1994) and Kozma (1991, 1994) debate makes the acquired result of the study more meaningful. Teachers' opinions regarding technology efficiency, is supposed to be due to the fact that technology is not only used as an instrument but used as teaching strategy as well. The role of technology can be seen as completely different in the educational implementations of 2020. Thus, technology is regarded as both a functional instrument and effective strategy (Clark, Tanner-Smith and Killingsworth, 2016; Gleason and Heath, 2019; Hasting and Tracey, 2005). These qualifications of technology are considered to be basic reasons why teachers' opinions (acquiring cognitive objectives) are high and positive regarding the efficiency level of technology.

In the research, teachers see Web 2.0 and smart board as most influential. There are also studies supporting these tools come as an academic and cognitive success in obtaining objectives. Kennewell and Beauchamp (2007) reached the idea that chance of high interaction with smart board is a strong way to increase the success while other studies also reveal that it creates a positive effect on students learning process and increases their success as the smart board has a key role in learning (Chen, Chiang and Lin, 2013; Greene & Kirpalani, 2013; Lopez, 2010; Özenç & Özmen, 2014; Luo & Yang, 2016; Amiri & Sharifi, 2014; Katwibun, 2014). Similarly, there are also existing studies which suggest Web 2.0 tools increase the success with the help of some factors such as via interaction they offer and collaboration, etc. (Al-Rahmi & Othman, 2013; Ekici & Kıyıcı, 2012; Pimmer et al., 2016; Alp & Kaleci, 2018; Kurtuluş & Kılıç, 2009).

Evidences regarding the efficiency of technology in objectives have been analysed through Web 2.0 and smart board. Teachers stated that smart board has many positive effects on learning in all knowledge levels with its visual, auditory, tactile structure except meta-cognitive level and organizers coming from these senses increase the permanence of knowledge. This shows that by appealing to different intelligence types, smart board enables students with individual differences to participate in learning process. Similarly; Wall, Higgins and Smith (2015) found that colour and movement feature of smart board provides more concentration in information transmission; and ease visual and verbal learning process. In consequence of the study conducted by Jackson, Gaudet, McDaniel and Brammer (2009) the multiple intelligences model is a facilitator option in learning process and students learn at every level with innovative multi-media technology, and they get the information via different software programs offering instant feedback.

During the interviews, teachers stated that applications available as online or on smart board (simulations, experiments, etc.) enable students to be active in learning process and to experience the knowledge they have. This shows us smart board creates an active learning environment in obtaining cognitive objectives. The process in which teachers become a guide and students make the knowledge meaningful, teachers enable the knowledge to be meaningful and permanent as they make students use the knowledge they have via smart board and learn by doing. Luo and Yang (2016) have reached some results, as teachers need to form encouraging education designs on smart board to carry out the active learning process.

Collaborative learning can easily be acquired through smart board and Web 2.0 according to the interviews. In classroom settings, it can be seen that collaborative learning with teachers and friends regarding solutions of problems with applications has an important place in obtaining cognitive objectives. Similarly, Web 2.0 and social networks particularly, can be seen to provide collaborative environments where students can evaluate and criticize one another give feedbacks. Conducted studies also support this. Mercer, Warwick and Kleine Staarman (2010) reached the idea that social platforms such as smart board; can be used with teacher

guidance to support young learners' cooperative communication skills by creating a suitable cooperative learning environment (Kıcı & Dilmen, 2014; Hsu, Ching & Grabowski, 2014; Ching & Hsu, 2013).

Interviews with teachers reveal that smart board and Web 2.0 tools support students meta-cognitive skills by enabling them to make interpretations. Wall, Higgins and Smith (2015) state that smart board gives students a chance to construct their own thinking system. Šliogerienė, Masoodi and Gulbinskienė (2016) state that Facebook can create an online learning environment where students develop their meta-cognitive awareness, learn to learn and evaluate their choices, decisions, and own learning. Web 2.0 tools which encourage active learning are known to make possible the self-regulatory learning (McLoughlin & Alam, 2014). Generally, properly used technologies in education contribute to meta-cognitive skill development.

Web 2.0 tools such as social network used for educational purposes, forums and blogs are democratic platforms where students share their feelings and opinions freely. In these environments, students learn to consider friends' and teachers' feelings and opinions respectfully. Within this process, critical thinking and defending ideas are very important for students in terms of their personal-development. Baş and Tüzün (2007) revealed the fact that blogs enable personal development in critical thinking and in language use such as verbal language, written statement, etc.

If we take into consideration the fact that teachers and students use Web 2.0 tools intensively as formal and informal, it is very important to involve Web 2.0 devices in education process. Web 2.0 tools need to be involved in classroom and non-class activities and need to be benefited. When both smart board and Web 2.0 devices are used effectively and in accordance with desired objectives, it has been seen that this enables different and important paradigms regarding cognitive taxonomy objectives. It is very important to be conscious of these technologies to reach cognitive objectives.

To acquire or to increase cognitive objectives, teachers have important responsibilities in education systems. Teacher paradigms of 21. Century is formed with constructivism and progressivism. Educational technologies also offer this kind of structure. By integrating rapidly-developing technology with learning settings in most effective way, environments should be created where students improve their cognitive thinking skills, learning skills and enabling them active participation and meaningful learning. So teachers need to use the technology properly for this process, for objectives and should benefit from the opportunities that technology offers. Therefore, creating a guideline for teachers to obtain educational objectives and functionalizing the integration of technology with education, and analysing professional competence regarding technology are suggested.

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