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Factors affecting ICT integration in TURKISH education: a systematic review

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Abstract

This research aims to reveal factors affecting Information and Communication Technologies (ICT) integration in learning environments in Turkey. The meta-synthesis method is used to make in-depth analysis and to interpret qualitative research findings on this issue. Through inclusion and exclusion criteria, 60 studies among 907 candidate studies accessed from databases named Web of Science, Education Resource Information Center (ERIC) and the Turkish Academic Network and Information Center (ULAKBIM) are included in this research. As a result of analyses, it is revealed that ICT integration into learning environments in Turkey is affected by five factors; students, educational material, infrastructure, management, and teachers. Considering these factors, it has been found that certain factors become prominent namely: the ICT and pedagogy competence of teachers; students' ICT competence; a lack of technical equipment and technical support; a lack of educational materials; the attitudes of school administrators; and the quality and lack of in-service training for ICT. It is concluded that the factors affecting the ICT integration in education are directly or indirectly related to each other, and that ICT integration should be addressed with all its stakeholders and phases as a whole.

Keywords Education · ICT integration · Meta-synthesis · Technology integration · Turkey

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1 Introduction

Rapid developments in technology have created information societies in which the accumulation of knowledge increases, information rapidly spreads and accessing information becomes easier (Endres and Chowdhury 2019; Gries et al. 2017). Information societies need individuals who are self-educated, follow innovations, produce information constantly in busy lives, and believe that becoming knowledgeable is equivalent to being strong (Fuchs 2008). The International Society for Technology in Education (ISTE) organization, with the standards it defines for students, which serves more than 100,000 educational stakeholders throughout the world, imposes an important mission on the educational institutions in the training of individuals needed by the information society. According to these standards, by using Information and Communication Technologies (ICT) with a sense of digital citizenship, students are individuals who can manage their own learning processes, produce information, think scientifically and find creative solutions for problems, communicate with people in their field of interest and collaborate globally (ISTE 2016). ICT should be used effectively in learning environments in order for students to acquire these skills (Mishra et al. 2018; Skryabin et al. 2015). The use of ICT in education and the training of students as ICT literate individuals can help them adapt to today's information societies and acquire twenty-first century skills (Haji et al. 2017). In this context, teachers play an important role in preparing their students for the future by using ICT in their classrooms (Chand et al. 2020; Scherer et al. 2019). It can be seen that school administrators who have a positive attitude towards these technologies have an effect on teachers' use of ICT (Kurt 2014; Spiteri and Rundgren 2020). In addition, projects which are for the supply of ICT to be used in learning environments are crucial in this process (Hu et al. 2018). Providing hardware and infrastructure generally constitutes the initial point of countries' policies regarding ICT integration in learning environments (Gil-Flores et al. 2017).

Many countries have instigated projects in order to integrate ICT into their educational systems process (Hu et al. 2018). For instance, in the Magellan Project, which started in 2006 through the partnership of the Portugese Government, the World Bank and Intel, a Classmate PC, which included education-oriented software, was distributed to approximately 416,500 students in 7400 schools (Wikibooks 2020). Within the framework of SMART Education, which started in 2011, South Korea took remarkable steps in developing and applying digital textbooks, introducing online assessment systems, strengthening information and communication ethics, increasing the competency of teachers, and creating environments based on cloud computing in schools (Chun 2017). In Australia, the Digital Education Revolution (DER) Project, which started in 2008, provided computers for approximately 300,000 students in 2701 schools nationwide over a 7-year period (Intel 2020). Within the scope of the project, more than 15,000 educators were trained in technology integration. Furthermore, in Turkey, projects related to the integration of ICT in learning environments started in 1984, and the Catching the Era in Education 2000 Project, the Basic Education Project, and finally the Movement of Enhancing Opportunities and Improving Technology (FATIH) Project were conducted to follow developing technology in the

educational process. Internet network infrastructure and LCD Panel Interactive Board were provided for 570.000 classrooms in Turkish schools at preschool, elementary and secondary levels. In addition, studies were carried out to provide tablet computers to teachers and students (Sezer 2011).

Thanks to such projects being implemented around the world, many schools have been equipped with ICT, and their technological possibilities have increased. However, studies clearly show that hardware and technical infrastructure alone are insufficient for ICT integration in learning environments (Eom and Ashill 2018; Dong et al. 2019; Spiteri and Rundgren 2020). It can be seen that there are problems, including a lack of technical support for technologies integrated into learning environments and a lack of educational software and educational materials with which to use these technologies (Kuru Gönen 2019; Belay et al. 2020). Additionally, many studies conducted in different countries show that teachers' anxiety regarding the use of ICT and a lack of ICT skills and in-service training make the integration of ICT into learning environments difficult (Alvarado et al. 2020; Joo et al. 2016; Munyengabe et al. 2017). Studies related to the integration of ICT into learning environments are considerably important in Turkey, as well as in the rest of the world. Thanks to these studies, the process can be smoothly evaluated by introducing factors affecting the process of ICT integration. Moreover, it is an important process that requires the co-operation of several stakeholders in local, national, and even a global extent beyond being a process in which ICT integration in learning environments is only between school and industry (Paryono and Quito 2010). Therefore, it is extremely important to investigate ICT integration and to share the results obtained (Voogt et al. 2013). In this context, this research can create a reference point to reach large numbers of people covering educators, politicians, and even ICT experts by synthesizing studies on factors affecting ICT integration in Turkey. In addition, it is considered that a country which attempts to provide ICT integration in learning environments with various projects in a thirty year period, and finding factors affecting this process, will offer helpful indicators, for those countries which will take similar steps, in terms of time and cost. Besides, it is considered that a country which tries to provide the integration of ICT into learning environments with various projects in the 30-year-periods and find out the factors affecting its process will offer many tips for the other countries to take similar steps in terms of time and cost. In the literature, it can be seen that in Turkey there are meta-synthesis studies on the use of ICT in learning foreign languages (Yukselir 2017), the sustainability of the use of ICT in education (Daghan and Akkoyunlu 2015), and in-service training regarding ICT (Yıldırım et al. 2015). In view of the international context, there are also meta-analysis and systematic review studies on ICT integration in education (Chauhan 2017; Torgerson and Elbourne 2002). In Turkey, the absence of studies in thematic reviews, that analyze the factors affecting the use of ICT in education, makes it important to conduct such research. Thus, it is considered that the research results will contribute to the literature about ICT integration in education. Therefore, the research aims to reveal factors affecting ICT integration in learning environments in Turkey. In line with the research purpose, the answer to the following question was sought in the research: 'What are the factors affecting the integration of ICT into learning environments in Turkey?'

2 Method

2.1 Research design

The meta-synthesis is not an ordinary review of studies on a particular subject, but a method based on the interpretative analysis of qualitative research findings (Aspfors and Fransson 2015). This method enables the present subject to be examined in depth. (Au 2007). In this context, the meta-synthesis method is used in the research, since there is a need for an in-depth analysis in order to determine factors affecting ICT integration in Turkey. In the literature, it can be seen that studies adopting the meta-synthesis method follow certain procedural steps (Aspfors and Fransson 2015; Fraenkel and Wallen 2000; Staneva et al. 2015; Thomas and Harden 2008; Walsh and Downe 2005). Considering this, the procedural steps below were followed:

2.2 Procedural steps

1. Identifying the research purpose
2. Finding appropriate studies for the research purpose
    - 2.1. Identifying the keywords
    - 2.2. Determining the databases to be searched
    - 2.3. Determining the time period
    - 2.4. Researching and eliminating recurrent studies
3. The selection of studies
    - 3.1. Determining the inclusion and exclusion criteria
    - 3.2. Numbering the candidate studies (Candidate Study 1 [CS1])
    - 3.3. The first examination: Abstract and title
    - 3.4. The second examination: All parts of the studies
    - 3.5. Enumeration of the included studies (Study 1 [S1])
4. Coding and theming the included studies
    - 4.1. Conducting pilot coding by researchers
    - 4.2. Forming the code and theme map
    - 4.3. Thematizing and coding studies
    - 4.4. Finalizing the form of codes and themes
5. Synthesizing the themes which are obtained
6. Reporting the research process and findings

2.3 Data collection and analysis

In the process of data collection and analysis, the procedural steps are followed. Therefore, after the research purpose is determined, the next step is to find appropriate studies for the research purpose. In the process of data collection and analysis, the procedural steps were followed. In this context, after the research purpose was

determined as 'revealing factors affecting ICT integration in education', the next step was to find appropriate studies for the research purpose.

2.3.1 Step 2- finding appropriate studies for the research purpose

Firstly, keywords and databases were determined in order to find appropriate studies for the research purpose. Web of Science, ERIC and ULAKBIM databases were searched in order to access a large part of the literature. After Turkey was selected in the Web of Science database as a region, keywords such as 'ICT Integration or ICT or Technology Integration' were used by selecting such categories as 'Education Educational Research' and 'Education Scientific Disciplines'. As there was no selection of region in the ERIC database, keywords such as 'ICT integration or ICT or technology integration and Turkey' were used to find Turkey-originated studies by adding 'Turkey' at the end of the keywords. In the ULAKBIM database, keywords such as 'ICT or ICT Integration or Technology Integration' were used. The criteria 'all-time' was selected for searching as the time period. Since the first search was completed in September 2019, all searches were conducted on studies up to this date. The analysis process, which started in September 2019, was completed in March 2020 following certain steps.

As a result of searches, the recurrent studies were eliminated and the candidate studies, which were chosen to be included in the research, are shown in Table 1.

2.3.2 Step 3- selection of studies

Inclusion and exclusion criteria were determined in order to select studies. These criteria are listed below:

- Being performed with qualitative and mixed research methods,
- Being performed in an educational environment
- Being implemented in Turkey
- Discussing ICT integration in a learning environment
- Examining the factors affecting ICT integration in education

Considering these criteria, the included studies were selected in a five-step process. The process is summarized in Fig. 1.

> Each study found as a result of a search was named 'CS1, CS2…' by the researchers in order to accelerate the examination process and prevent any complexity.
>
> The titles and abstracts of ten randomly selected studies from the named studies were separately examined by two researchers. It was recognized that both

Table 1 The distribution of candidate studies

Database	Study number
Web of Science	478
ERIC	264
ULAKBİM	165

Each study found as a result of a search was named 'CS1, CS2…' by the researchers in order to accelerate the examination process and prevent any complexity.

The titles and abstracts of ten randomly selected studies from the named studies were separately examined by two researchers. It was recognized that both researchers included and excluded the same studies within the framework of the inclusion and exclusion criteria.

The titles and abstracts of 907 candidate studies included in the research were examined by the researchers. At the end of the examination, sixty-eight studies from the ULAKBIM database, nineteen studies from the ERIC database and eighteen studies from the Web of Science database were selected.

All parts of one hundred and five candidate studies selected in the previous step were examined by the researchers. At the end of the examination, thirty-three studies from the ULAKBIM database, fifteen studies from the ERIC database, and twelve studies from the Web of Science database were included in the study.

Sixty studies included in the research were named 'S1, S2…' as in the previous step (See Appendix 1)

Fig. 1 The process of study selection

researchers included and excluded the same studies within the framework of the inclusion and exclusion criteria.

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Sixty studies included in the research were named 'S1, S2…' as in the previous step (See Appendix 1)

2.3.3 Step 4- Thematizing and coding studies

Coding and thematizing the studies consisted of four steps. By following these steps, the analysis process was completed in about seven months. As a result, the process steps in each phase are presented in Fig. 2.

Pilot coding was developed in order for the content analysis to be used smoothly. Ten randomized-studies were separately coded by two researchers and the resulting codes and themes were discussed by them.

The code and theme map were constituted. This was taken as a reference by the researchers throughout the content analysis and updated when needed with the consensus of the researchers.

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3 The findings of studies included in the research were analyzed by referencing the code and theme map.

4 After the studies included in the research were analyzed, all of the codes and themes were again checked and finalized.

Fig. 2 The process of thematizing and coding the studies

The findings of studies included in the research were analyzed by referencing the code and theme map.
After the studies included in the research were analyzed, all of the codes and themes were again checked and finalized.

Themes and codes, which were prepared by the researchers after the pilot coding, used throughout the content analysis, and updated when needed, are presented in Fig. 3.

2.4 Validity and reliability

Validity and reliability in qualitative research is different from quantitative research. In this context, it can be seen that different strategies are adopted in the literature. Krefting (1991) emphasizes concepts, such as credibility, the accuracy of results and researcher's competence in qualitative research. On the other hand, Lincoln and Guba (1985) suggest using strategies of credibility instead of internal validity, transferability instead of external validity, dependability instead of internal reliability, and verifiability

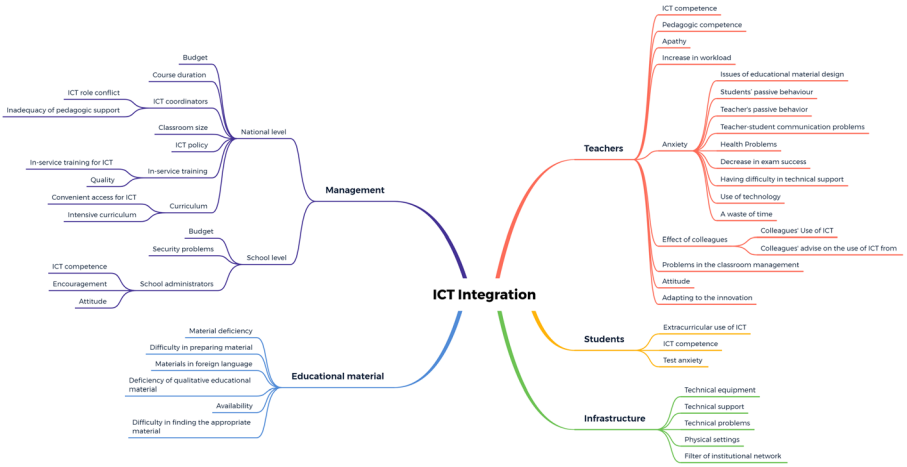

Fig. 3 Factors affecting ICT integration

instead of external reliability. Accordingly, considering the strategies stated by Lincoln and Guba (1985), the following procedures were carried out.

2.4.1 Credibility

One of the methods to increase credibility in qualitative research is expert reviewing. Expert reviewing is the examination of a study in various dimensions by experts who are knowledgeable about the research subject and who are competent in qualitative research methods (Creswell 2003). Therefore, the necessary arrangements were made by taking the opinions of two field experts regarding the keywords, code, and theme map in the research. More extensive data was obtained by accessing a large part of the Turkish-originated study on ICT integration. In this context, different databases, such as Web of Science, ERIC, and ULAKBIM were searched.

2.4.2 Transferability

To ensure transferability in the qualitative research, the sample selection, participants' characteristics and data collection process should be indicated in detail (Sharts-Hopko 2002). Within the scope of this research, the selection of studies and the coding-thematic process were planned and explained in detail.

2.4.3 Verifiability

One qualitative research strategy used to increase reliability is investigator triangulation. Denzin (1978) defines investigator triangulation as the phases of data analysis, collection, and interpretation, by more than one researcher. In this context, all phases of the research were carried out by two researchers. Therefore, the selected studies, codes, and themes during the analysis process, findings and comments were recorded and analyzed over and over again. In the case of disagreements among the researchers, expert review was used. Moreover, the articles were numbered to ensure the verification of analysis results, and the codes eliminated from the article were presented in a list.

2.4.4 Dependability

Dependability is to reveal that research findings are not affected by the researcher's personal interpretation, and are only based on research data (Shenton 2004). Therefore, in line with the suggestions of Lincoln and Guba (1985), the process of obtaining and analyzing the data in the research was explained in detail, how the codes and themes were created, and direct quotations were then made from the findings of the studies.

3 Results

The findings obtained within the scope of the research were presented by using graphics and tables within the framework of the research questions through quotations. As a result of content analysis, factors affecting ICT integration in education were

collected under five themes; teachers, management, infrastructure, educational material, and students.

As demonstrated in Table 2, it was found that the theme 'Teachers' ($f_T = 109$) and 'Management' ($f_T = 100$) have a higher frequency than other themes. They were presented under separate headings in order to reveal the scope of the determined themes in more detail.

3.1 Factors affecting the ICT integration: The theme 'teachers'

The codes in the theme 'Teachers' are presented in Fig. 4.

As demonstrated in Fig. 4, it was found that the codes 'ICT competence and anxiety' in the theme 'Teachers' are emphasized. The studies with codes related to the theme 'Teachers' are presented in Table 3.

While the statement on ICT competence in the theme 'Teacher' by S9-Karaca (2011, p. 51) was that 'the most important barrier to technology use was related to teachers' insufficient knowledge and skills in using technologies', S28-Caliskan (2017, p. 40) also expresses that 'according to them, the most important problems that can be experienced are the insufficient technical skills of teachers and students'. Another apparent thing in the theme 'Teachers' was anxiety. S42-Kayalar (2016, p. 17) reports anxiety on the teacher's use of ICT, underlining 'as a teacher who has rarely used technology in the classroom, I am very nervous about the use of this new technology'. S45-Aslan and Zhu (2018, p. 37) emphasizes the importance of pedagogical competence for teachers' use of ICT by expressing that, 'they perceive that pedagogical knowledge is crucial for teachers to use ICT in their teaching practices effectively'. Additionally, it was revealed that teachers' attitudes and interests towards the use of ICT in learning environments affected ICT integration. S41-Kaleli-Yilmaz (2015, p. 140) express a teacher's attitude towards ICT in their studies as, 'If some people said technology was useful for mathematics education, I do not want to use it, because I believe it is not useful. But, after I notice the real situation is different, and that technology is an essential element for mathematics education'. In addition, S7-Çakır and Yıldırım (2009, p. 960) express that teachers' apathy affects the use of ICT in learning environments by emphasizing that 'one of the issues that computer teachers (n = 9) primarily complain about is the apathy of teachers from other fields in school towards technology'. Indeed, S4-Usluel and Aşkar (2003, p. 123) report that, 'It was

Table 2 Factors affecting ICT integration in education

	f_U	f_E	f_W	f_T
Teachers	59	33	17	109
Management	47	28	25	100
Infrastructure	46	18	11	75
Educational material	28	18	6	52
Students	6	5	5	16
Total	186	102	64	352

f_U Publications in ULAKBİM, f_E Publications in ERIC, f_W Publications in Web of Science, f_T Total frequency.

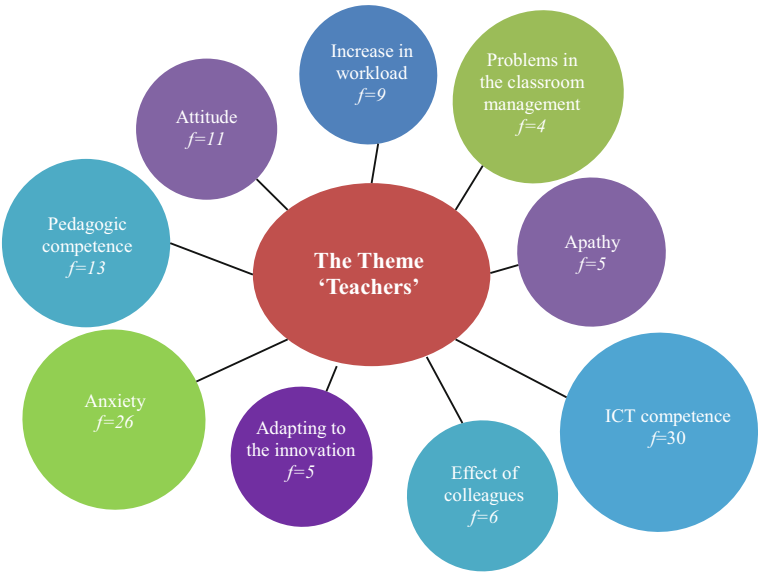

Fig. 4 Codes related to the theme 'Teachers'

determined that the use of computers by their colleagues was effective in teachers' starting to use computers'. It was determined that teachers' adaptation to a new learning environment equipped with ICT is effective in ICT integration. The statement of S28-Çalışkan (2017, p. 40) regarding this issue is, 'It is that teachers and students who are used to the other system have trouble adapting to this situation'. It was observed that increasing workloads with the preparation of materials and content for teachers to use this new learning environment affect the integration of ICT into learning environments. The statement on this issue by S58-Çelik et al. (2017, p. 77) is that, 'They say that they need extra time to prepare materials and good content to use the technology. Other interview groups, too, indicate that teachers' workload increased'. Therefore, S58-Çelik et al. (2017, p. 76) report that the problems experienced in classroom management for courses using ICT affect teachers' use of ICT. They state that, 'It was stated that classroom management gets more difficult as a consequence of the innovations introduced'.

3.2 Factors affecting ICT integration: The theme 'management'

T he codes related to the theme 'Management' were collected under two sub-themes; National Level and School Level. The codes in the sub-theme 'National Level' are presented in Fig. 5.

As demonstrated in Fig. 5, in the sub-theme 'National level' of the theme 'Management', it was observed that there were the codes 'in-service training', 'course duration' and 'curriculum'. Studies with the codes for the sub-theme 'National Level' are given in Table 4.

Expressing the need for in-service training seen in the sub-theme 'National Level', S55-Aydin, Gurol and Vanderlinde (2016, p. 759) state that, 'We need more in-service training, because it is hard to give up old habits'. Moreover, there are studies reporting

Table 3 Studies with the codes related to the theme 'Teachers'

	Studies
ICT competence	S1, S2, S3, S5, S6, S8, S9, S11, S13, S16, S18, S19, S21, S23, S24, S25, S27, S28, S31, S32, S34, S35, S38, S39, S43, S45, S46, S49, S55, S56
Anxiety	
Issues of educational material design	S11
Students' passive behaviour	S11, S39, S46, S47, S53
Teacher's passive behavior	S2, S5, S48
Teacher-student communication problems	S18, S30, S58
Health Problems	S27
Decrease in exam success	S27, S29, S41, S43, S45
Having difficulty in technical support	S46
Use of technology	S5, S18, S27, S41, S42
A waste of time	S18, S41
Pedagogic competence	S3, S5, S11, S22, S27, S35, S38, S39, S41, S45, S47, S50, S53
Attitude	S3, S21, S54
Positive	S1, S41, S45,
Negative	S2, S23, S27, S48, S51
Increase in workload	S2, S10, S18, S21, S26, S41, S42, S47, S58
Effect of colleagues	
Colleagues' Use of ICT	S4, S16
Colleagues' advice on the use of ICT	S10, S21, S50, S54
Apathy	S5, S7, S35, S38, S52
Adapting to innovation	S27, S28, S49, S55, S60
Problems in classroom management	S25, S30, S39, S58

that in-service training is not efficient enough. In one of these studies, S52-Karadeniz and Hacifazlioglu (2013, p. 217) evaluate the quality of in-service training as, 'I attended many in-service training courses arranged by the Ministry of National Education (MoNE). I should confess that I learned it all by myself through trial and error'. It was revealed that the curricula and course duration determined in the national education program affect the use of ICT in learning environments. Emphasizing the intensive curriculum, S51-Göktaş, Gedik and Baydaş (2013, p. 216) report that, 'Due to heavy work loads in the curriculum, teachers cannot use ICT effectively in their courses'. On the other hand, S9-Karaca (2011, p. 51) reports that, 'Many teachers expressed that the lesson hours were not adequate to use technology' by emphasizing that insufficient course duration negatively affects the use of ICT in classes. Moreoever, 24-Kocaman-Karoğlu (2016, p. 190) state that crowded classes are a factor which negatively affects the use of ICT as, 'They mentioned that it would not be easy to apply in classes with very large class sizes'. At this point, it can be seen that insufficient support from ICT co-ordinators, due to the intensity of their workload, provide teachers with negatively affected ICT integration. S53-Akçaoğlu et al. (2015, p. 483) state that

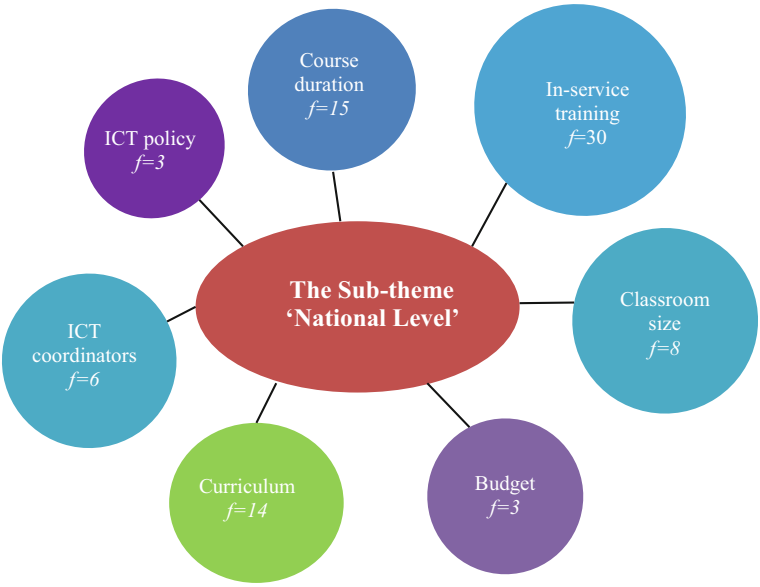

Fig. 5 Codes related to the sub-theme 'National Level'

ICT co-ordinators cannot help teachers apart from offering their technical support: 'We have teachers teaching computer classes to help us, who were assigned to our school at the start of the pilot implementation. They help us with technical things, but this does not help us with how to effectively adapt these technologies into our classes'. On the other hand, S35-Akbaba-Altun (2006, p. 183) draw attention to the heavy workload of ICT co-ordinators in schools: 'Computer co-ordinators have heavy workloads at

Table 4 Studies with codes related to the sub-theme 'National Level'

	Studies
In-service training	
In-service training for ICT	S1, S5, S9, S12, S13, S16, S17, S18, S19, S21, S22, S26, S27, S30, S31, S32, S43, S46, S51, S55, S56, S58
Quality	S18, S21, S27, S35, S38, S52, S53, S59
Curriculum	
Convenient access for ICT	S1, S5, S15, S21, S27, S35, S36, S41
Intensive curriculum	S41, S43, S45, S49, S51, S54
Course duration	S9, S11, S15, S16, S21, S23, S25, S29, S31, S39, S41, S46, S47, S49, S51
Classroom size	S2, S18, S24, S35, S41, S45, S47, S56
ICT co-ordinators	
ICT role conflict	S35, S50, S54
Inadequacy of pedagogic support	S51, S53, S54
ICT policy	S5, S29, S53
Budget	S5, S35, S51

schools. In addition to teaching computer courses at schools, they have to plan the IT classroom schedule, be responsible for the maintenance of IT classrooms, help other teachers to use computers for their courses, and prepare in-service training for their peer teachers and the public'. In addition, the budget allocated for the use of ICT in educational institutions is an important factor for ICT integration. S35-Akbaba-Altun (2006, p. 181) express the problem regarding the budget in educational institutions: 'Maintenance refers to upgrading the hardware and software, repairs and need of technical support. Schools are responsible for finding financial resources to maintain those IT tools. Therefore, many chain problems occur, since elementary schools do not have their own budget'. It is shown that a lack of policies that would enable the establishment of an organizational culture for the use of ICT in education also affects ICT integration. S53-Akçaoğlu et al. (2015, p. 484) tell us that, 'Although the teachers we interviewed ranged in their personal preparedness to use new technologies, the culture of the school also spoke to the readiness of the environment to support changes to practice'.

The codes in the sub-theme 'School Level' of management are presented in Fig. 6.

As demonstrated in Fig. 6, it was found that school administrators play an active role in the sub-theme 'School Level' of management. Studies with codes related to the sub-theme 'School Level' are given in Table 5.

Regarding the situation related to school administrators in the sub-theme 'School level', S35-Akbaba-Altun (2006, p. 184) tell us, 'Some school principals perceive IT classrooms as a burden on their shoulders'. Furthermore, reporting budget conditions, S52-Karadeniz and Hacifazlioglu (2013, p. 216) show that, 'All school administrators agreed that the cost of maintenance of ICT is a hindrance to effective ICT integration. The administrators indicated that they have problems when the guarantee period of the hardware elapses'. In addition, S35-Akbaba-Altun (2006, p. 184) state that, 'School principals feel anxious about the IT classroom materials in their schools. All these expensive materials are the responsibility of school principals if they were stolen or broken. Consequently, school principals tend either to be overprotective and

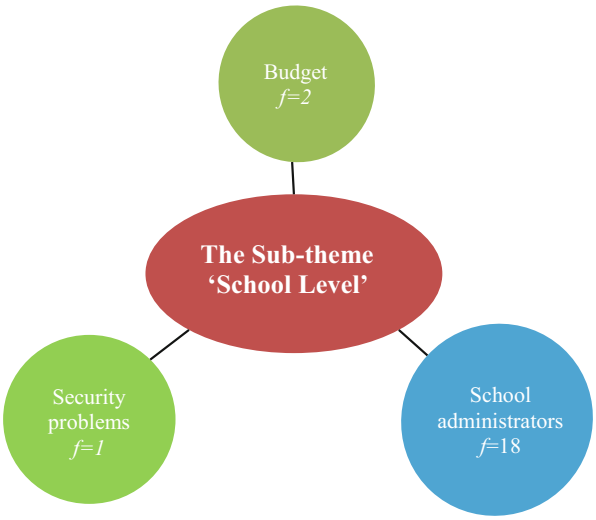

Fig. 6 The codes related to the sub-theme 'School Level'

Table 5 Studies with codes related to the sub-theme 'School Level'

	Studies
School administrators	
ICT competence	S35, S37, S50
Encouragement	S4, S16, S21, S40, S50, S54
Attitude	S4, S5, S15, S21, S35, S37, S40, S41, S50
Budget	S5, S52
Security problems	S35

oversensitive or less motivated and less interested in letting others use these materials'. They find that anxiety over security problems in schools affects the integration of ICT in education.

3.3 Factors affecting ICT integration: Theme 'infrastructure'

The codes in the theme 'Infrastructure' are presented in Fig. 7.

As demonstrated in Fig. 7, it was found that the codes 'technical equipment' and 'technical support' are in the theme 'Infrastructure'. The studies with the codes related to the theme 'Infrastructure' are presented in Table 6.

S32-Bakirci, Cancan and Uzunyol (2017, p. 79) express technical equipment in the theme 'Infrastructure': 'As our school is equipped with technological devices within the scope of the Fatih project, I use the smart board and projection device effectively in my class. This makes the lesson entertaining and saves wasting paper'. In addition, S38-Isci and Demir (2015, p. 447) report how progress is affected due to technical equipment: 'Another problem that is encountered is that the tablets cannot go further because of their insufficient hardware; they do not have enriched materials, z-books and audio-visual materials intended for gains and activities regarding each lesson'. After

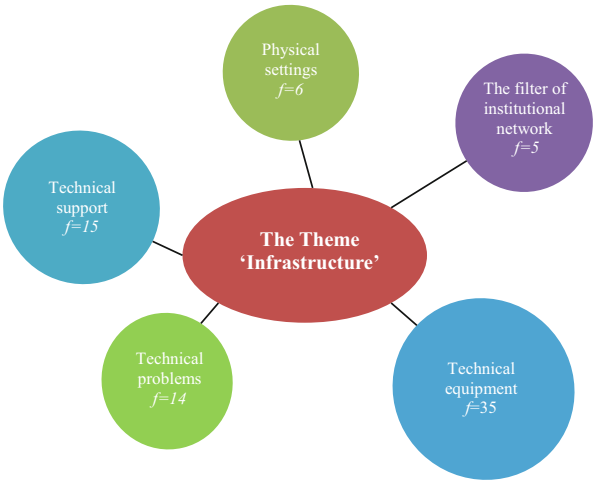

Fig. 7 Codes related to the theme 'Infrastructure'

Table 6 The studies with codes related to the theme 'Infrastructure'

	Studies
Technical equipment	S1, S2, S3, S5, S6, S9, S11, S12, S13, S16, S18, S19, S20, S21, S22, S23, S24, S25, S27, S29, S30, S31, S32, S33, S35, S38, S41, S42, S43, S45, S46, S49, S51, S55, S56
Technical support	S1, S5, S6, S9, S12, S14, S18, S21, S27, S29, S35, S41, S46, S51, S53
Technical problems	S11, S13, S21, S22, S23, S26, S27, S34, S38, S39, S41, S47, S56, S57
Physical settings	S2, S5, S13, S35, S42, S45
The filter of institutional network	S13, S33, S53, S56, S57

technical equipment deficiencies were eliminated, technical problems that emerged over time began to be effective in the integration of ICT in education. S23-Ural (2015, p. 103) states that, 'ICT is difficult to use in the classroom due to problems caused by the Internet and computers'. Similarly, S29-Izmirli & Kirmaci (2017, p.155) also emphasize the technical support deficiency in ICT integration: 'It was also stated that there was no-one at their school to asked for help when they had difficulties in TI, which they claimed to be a barrier for them'. On the other hand, S45-Aslan & Zhu (2018, p. 34) underline the importance of physical settings stating that 'Classrooms ought to be conveniently reorganized for ICT use. Classrooms ought to be spacious, lighting systems ought to be sufficient'. In Turkey, the Internet connections used at school are provided through the filter of the institutional network. S33-Avci, Kula & Haslaman (2019, p. 19) also report that 'Many sites like Youtube are not open due to the MEB barrier, I cannot access things that are useful for me'. The filter of the institutional network can affect ICT integration in certain cases.

3.4 Factors affecting ICT integration: Theme 'educational material'

The codes in the theme 'Educational Material' are presented in Fig. 8.

As demonstrated in Fig. 8, it was found that the difficulty in codes 'Preparing Materials' and 'Material Deficiency' under the theme 'Educational Material' become prominent.

Studies with codes related to 'Educational Material' are presented in Table 7.

S21-Gok and Yildirim (2015, p. 496) report material deficiency in the theme 'Educational Material':

> *"E-contents in EBA are inadequate. For example, I can only reach a digital copy of the Biology book, and this book is prepared for hard copy. At the beginning, I tried to use this digital book in my lessons, but I could not take advantage of this book as I expected. For that reason, I gave up using this digital book, and I do not intend to use a smart board again in my course, because I could not find other type of e-content other than only a digital form of regular books."*

S46-Coruk and Tutkun (2018, p. 49) also point out the difficulty in preparing educational material: 'It will be difficult to find any content for every course, and it could be difficult to create content in courses such as Traffic'. Since it is difficult to prepare

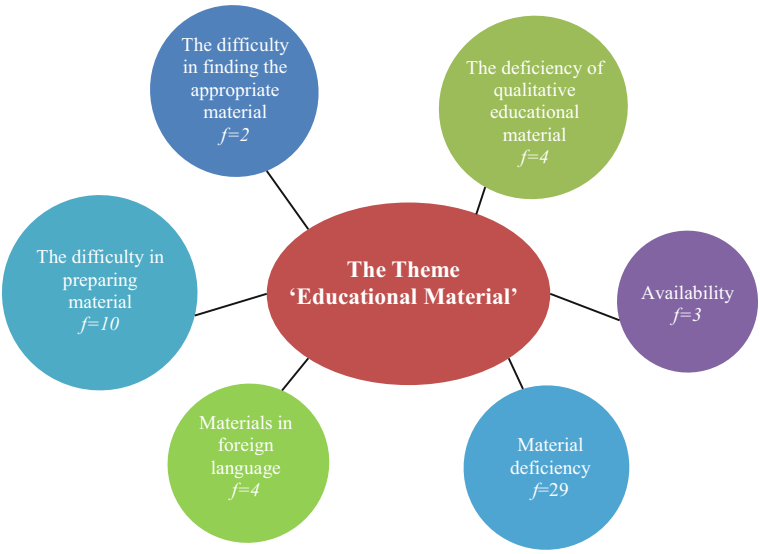

Fig. 8 Codes related to the theme 'Educational Material'

materials, the teacher may be inclined use to ready-made materials. However, S56-Timur et al. (2016, p.290) state that it is also difficult to find suitable materials for courses and this situation affects ICT integration: 'The most serious issue is not being able to find adequate digital content; there is much information pollution." Similarly, it is shown that the fact that materials are in a foreign language makes it difficult to use them. S41-Kaleli-Yilmaz (2015, p. 143) explain that, 'Some software that I want to use in lessons does not have a Turkish version, but I have some difficulties understanding them and refrain because they cannot be understood.' In addition, S35-Akbaba-Altun (2006, p. 183) emphasize a lack of quality educational material with: 'There is a lack of quality and content covered in the software programs. These issues make it difficult for teachers to use them in their classrooms'. Additionally, Q24-Kocaman-Karoglu (2016, p. 189) draw attention to the use of educational materials with: 'I have never used a program named Photo story before and I was unaware of the existence of such a

Table 7 Studies with codes related to the theme 'Educational Material'

	Studies
Material deficiency	S1, S3, S5, S9, S10, S11, S12, S14, S16, S18, S19, S20, S21, S22, S23, S25, S27, S29, S30, S35, S38, S40, S41, S44, S45, S46, S51, S52, S56
Difficulty in preparing material	S4, S5, S9, S11, S16, S21, S43, S44, S46, S52
Materials in foreign language	S2, S35, S41, S44
Deficiency of qualitative educational material	S35, S41, S44, S56
Availability	S13, S21, S24
Difficulty in finding appropriate material	S44, S56

program. However, I saw how easy the program is when I use it. I enjoyed creating something with my students by using technology and I was encouraged'.

3.5 Factors affecting ICT integration: Theme 'students'

The codes in the theme 'Student' are presented in Fig. 9.

As demonstrated in Fig. 9, it was found that the extracurricular use of ICT is emphasized in the theme 'Students'. Studies with codes related to the theme 'Students' are presented in Table 8.

Focusing on the extracurricular use of ICT in the theme 'Students', S58-Celik et al. (2017, p. 76) report that 'Students sometimes concentrate on irrelevant content in their tablets while teachers are teaching the lesson...' Moreover, the effect of children's test anxiety on the use of ICT is evaluated by S41-Kaleli-Yilmaz (2015, p.141): 'Upcoming examinations are big obstacles to students for the application of these technologies. Although students like these applications, especially students in their final year, they said that they wished to solve more problems in preparation for the exams rather than doing the applications, because they believed that their time was wasted'. A student in a study by S18-Ayvaci, Bakirci and Basak (2014, 36) states that students' ICT competence is a factor affecting ICT integration in education: 'It was the first time I encountered tablets. I hardly followed the lesson until I became familiar with them. Since I was trying to get to know the tablet, it took me a lot of time ...'

4 Discussion and conclusion

As a result of the analysis of studies included in the research, five factors affecting ICT integration in education emerge; teacher, management, infrastructure, educational

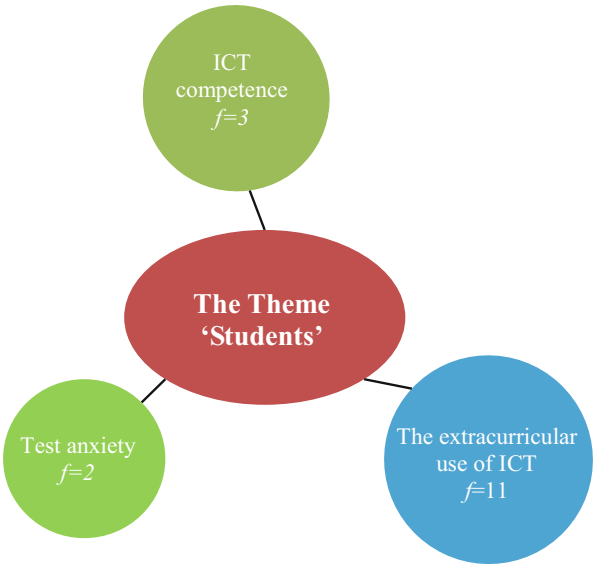

Fig. 9 The codes related to the theme 'Students'

Table 8 Studies with codes related to the theme 'Students'

	Studies
The extracurricular use of ICT	S2, S18, S22, S26, S31, S38, S45, S53, S57, S58, S59
ICT competence	S18, S39, S41
Test anxiety	S41, S53

material, and students. Among these five factors, ICT competence becomes prominent in the factor 'Teachers' which has the highest frequency. Teachers' ICT competence was also highlighted as one of the factors affecting ICT integration in education in numerous studies conductued different countries (Voet and De Wever 2017; Spiteri and Rundgren 2020). The design, management, and evaluation of the learning process are among the teachers' responsibilties. Therefore, it is vitally important for teachers to have ICT skills in order to use ICT in education effectively (Yesilyurt et al. 2016; Gil-Flores et al. 2017; Aslan and Zhu 2018). However, in a number of studies, it is stated that having ICT skills alone is not enough, and that teachers must also have pedagogical competence (Akti Aslan and Duruhan 2020; Getenet et al. 2016; Gurcan and Ozyurt 2020; Spiteri and Rundgren 2020). Similarly, Lawrence and Tar (2018) also reported that pedagogical competence is one of the most important factors for the integration of ICT in education. Therefore, it can be said that teachers' pedagogical competence is as important as ICT competence for an effective integration process. Additionally, teachers' concerns about the use of ICT in their lessons were emphasized in many studies. Joo et al. (2016) find that teachers' anxiety towards the use of technology has a negative effect on their adoption of the use of ICT in education. One of the reasons for teachers' concerns about the use of ICT is the waste of time which may occur in their lessons. As stated in a study by Kaleli-Yilmaz (2015), teachers are worried about losing time while using ICT in their classes and not having enough time to prepare their students for exams. By increasing the competency of teachers on ICT and pedagogy, the time lost in their lessons can be minimized. In addition to this, adequate technical infrastructure and technical support can also help to alleviate teachers' anxiety. International conferences and meetings can be organized to present good examples of ICT integration in the context of school administrators.

The management factor, which is the second highest frequency, is divided into two sub-factors in order to organize it better; national and school. The highest frequency in the national level belongs to in-service training. A lack of in-service training for ICT has also been mentioned in many studies conducted in different countries (Alvarado et al. 2020; Goktas et al. 2013; Karadeniz and Hacifazlioglu 2013; Williams-Miller 2020). In addition, it is reported that there is in-service training for ICT, but the efficiency of training is not as expected (Wikan and Molster 2011; Mulhim 2013; Isci and Demir 2015). In this context, there are studies which indicate the pedagogical inadequacies of trainers who provide in-service training (Akcaoglu et al. 2015). In a number of studies, except for in-service training, the inappropriacy of curriculum for ICT (Williams-Miller 2020; Kula and Deryakulu 2017), intensive curriculum (Mulhim 2013; Aslan and Zhu 2018), and insufficient course duration (Lawrence and Tar 2018; Williams-Miller 2020) are emphasized. These factors can be indirectly related to each

other. Indeed, all three factors are affected by the ICT and pedagogy competence of teachers. If teachers have ICT and pedagogy competence, they can integrate ICT into their curriculums more easily and find solutions to possible technical problems. Therefore, they may be less affected by the intensive curriculum and course duration, since they can use time efficiently. Considering the factors found at school level, the highest frequency belongs to school administrators. The attitudes and behavior of school administrators towards the use of ICT in education (Lawrence and Tar 2013; Perrotta 2013; Tarman et al. 2015), their ICT competency (Deryakulu and Olkun 2009) and their support for teachers on this issue (Joo et al. 2016) are reported in numerous studies. Considering that school administrators are effective both as leaders and as control mechanisms in schools, it is seen that they play an extremely important role for the integration of ICT in education. As a result, based on Rogers's (2003) theory of the diffusion of innovation, it can be said that school administrators must be the agents of change for their schools in order for the use of ICT in education to become widespread.

One of the factors affecting the use of ICT in education is the factor 'Infrastructure'. Based on the factor 'Infrastructure', the lack of technical equipment and technical problems become prominent. This is one of the most important problems affecting the use of ICT in education (Dong et al. 2019; Voet and De Wever 2017). In a number of studies, it is seen that the present technical equipment cannot be used properly and technical problems cannot be solved or are solved too late (Kula and Deryakulu 2017; Lawrence and Tar 2018). Therefore, it is concluded that it is important to provide technical support as well as providing technical equipment. As the inability to create solutions for technical problems by teachers causes technical equipment to be unused for a while, and that repetition of this situation affects teachers' attitudes negatively. In certain studies, the fact that teachers mention they give up using ICT in their lessons due to technical problems which they experience is the outcome of this situation (Lawrence and Tar 2018; Timur et al. 2016). It is necessary for each school to have a sufficient number of technical staff. Therefore, ICT co-ordinators in schools could devote most of their time guiding teachers on the use of ICT instead working on technical problems (Akti Aslan and Duruhan 2018; Rodríguez-Miranda et al. 2014).

Educational materials are an important part of using ICT in education. In the studies which were analyzed, the lack of educational materials and the difficulty of preparing materials were prominent. The lack of educational materials is a factor that makes it difficult to use ICT in schools (Alvarado et al. 2020). Koh et al. (2015) stated that the connection between technology with pedagogy and material should be established in providing ICT integration. In fact, teachers appear to prefer ready-made materials instead of developing educational materials, because they do not have ICT competency or have no time to prepare materials (Sanli et al. 2016). However, materials should be suitable for the subject, grade level, technical equipment and ICT skills of teachers in order for these teachers to use ready-made materials effectively in their classrooms (Karalar and Dogan 2017). While the projects conducted to increase the use of ICT in education generally focus on improving equipment and infrastructure, they remain inadequate of developing educational materials. In this context, projects could be implemented under the guidance of government agencies, universities and research and development centers in order to develop educational materials which are suitable for curriculum programs, technical equipment and grade levels.

Another factor influencing the use of ICT in education is 'Students'. The extracurricular use of ICT under the factor 'Students' is emphasized. Indeed, studies conducted in different countries show that students mostly use ICT for entertainment and communication (Malak et al. 2017; Mascheroni and Ólafsson 2014). For this reason, studies on the creation of ICT awareness can be conducted to enable children discover the opportunities that ICT offers in terms of learning, research and self-development. Additionally, when considering crowded class sizes apart from the extracurricular use of ICT, the use of ICT dominating the whole class requires effective classroom management skills and experience, as well as ICT competence (Belay et al. 2020). When test anxiety in crowded classrooms (Hew and Brush 2007), intensive curriculum programs (Izmirli and Kirmaci 2017) and teachers' insufficient ICT skills (Munyengabe et al. 2017) are combined, the problems experienced in classroom management become more critical. In this context, it could be organised for teachers to know and use software that will facilitate classroom management. In addition, classroom management strategies, which are designed for traditional classroom environments, may be insufficient for technology-supported classrooms equipped with technological devices, such as smart boards and the Internet. Therefore, it is important for teachers to learn and adopt new pedagogical approaches to manage technology-supported classrooms (Tondeur et al. 2016). Moreover, the training to be organized must be adequate in providing both theoretical and practical knowledge. It can be seen that training of this quality makes teachers experience the skills to integrate technology into their teaching processes and contributes to the establishment of a relationship between content with pedagogy and technology (Getenet et al. 2016).

ICT integration in education is a process that includes different elements. As a result of analyses, it is revealed that this process is affected by five factors; teachers, management, infrastructure, educational material, and students. For the use of ICT in learning environments, schools must initially be sufficient in terms of infrastructure and technical equipment. Considering that the technologies of schools are ageing and creating problems day by day, it is extremely important to have personnel to provide technical support. Moreover, the fact that teachers have both ICT and pedagogical competence means they can complete the curriculum on time by them using ICT effectively during their courses and, therefore, they are able to monitor their technology-oriented classroom without worry. In addition to teachers, school administrators also need to have ICT skills. A school administrator with sufficient ICT skills has both a positive attitude towards these technologies and the ability to encourage teachers in the use of such technologies in their classrooms. It is shown that not only school administrators, but also educational materials and students, are effective for teachers' use of ICT in their lessons. Teachers tend to use ready-made educational materials due to difficulties in preparing educational materials. However, a number of teachers have problems in finding ready-made educational materials that are suitable for various subjects and classes. In fact, a lack of educational materials and students' desire to use ICT outside of the classroom negatively affect the integration of ICT into learning environments. Considering all this, ICT integration in education is an extremely complex process consisting of several components. Along with each component affecting the integration process in a different way, the indirect effects of the components on each other also makes the process quite complex. Therefore, for successful ICT integration in education, it is important to conduct and develop relevant

projects that address all components and include all stakeholders, and to make regular evaluations.

5 Limitations of the research

As in all scientific research, this research has several limitations. Knowing these limitations is very important in terms of evaluating the results correctly. This research is limited to sixty Turkish-originated studies which examine the factors affecting ICT integration in education. The selection of the studies is limited to the results of searches with keywords specified in the methodology of the Web of Science, ERIC and ULAKBİM databases in September, 2019.

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