Özden C., & Atasoy, R. (2019). Determination of educational needs of technology and design courses in secondary school students. *International Online Journal of Education and Teaching (IOJET)*, *6*(3), 511-523.
http://iojet.org/index.php/IOJET/article/view/637

Received: 01.05.2019
Received in revised form: 30.06.2019
Accepted: 02.07.2019

DETERMINATION OF EDUCATIONAL NEEDS OF TECHNOLOGY AND DESIGN COURSES IN SECONDARY SCHOOL STUDENTS

Research Article

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DETERMINATION OF EDUCATIONAL NEEDS OF TECHNOLOGY AND DESIGN COURSES IN SECONDARY SCHOOL STUDENTS[1]

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Abstract

Parallel to the overwhelming development of information and technology in today's world, changing work and living conditions have caused changes in the educational needs of both society and the individuals. This study aimed at determining the educational needs for technology and design courses of today's students who grow with technology and the digital world. The participants in this study in which a mixed method was used were the 7th year students studying in state secondary schools of TRNC (Turkish Republic of North Cyprus) in the 2016-2017 academic year. In the qualitative dimension, the students were assigned to write a composition and in the quantitative dimension, a needs analysis questionnaire was implemented. The data were analyzed through content analysis, arithmetic averages, and standard deviation. The priority in this research was to determine the students' expectations towards technology and design course and according to these expectations, their educational needs were categorized. At the end of the research, the needs for technology and design course were determined in three different categories: general needs, needs for design, and needs for information technologies.

Keywords: education, technology, design, coding, needs analysis

1. Introduction

Rapid developments in information and technology have affected individuals' learning, expectations, and needs for learning to a very great extent. At this point, countries all around the world need to overview their educational programs and adopt new approaches in order to raise the individuals of the future. In this regard, changes in the community, have urged the involved to develop formal education programs (Kiani, Ghazanfarpour, Yazdanparast & Saeidi, 2019).

In order to prepare a course content that can meet the expectations of economic, social and technological change and innovation, it is important that the programs start with the needs analysis first. In the process of implementation of educational programs, it is expected that the demands and expectations of the society, business world, various working groups, and other stakeholders involved are met. Among these, specifying particularly students' educational needs is an important step (Demirel, 2015).

Needs analysis is a crucial stage in developing programs to determine any shortages (Long, 2005). There are various definitions of "needs analysis" in literature. For Berwick (1989) and Şahin (2006), needs are the gap between the current situation and future expectations. Pratt (1980) and Stufflebeam, McCormick, Brinkerhoff and Nelson (1985)

[1] This work was presented as a paper at the International Conference on Interdisciplinary Educational Reflections Conference at Near East University in Nicosia, 29-30 March 2019.

define "needs analysis" as a set of procedures specifying and evaluation needs, and determining the most important ones among them. Specifying needs helps to collect information necessary for learning experiences and to determine the level of program targets in meeting actual needs. In this respect, Demirel (2015) emphasizes the importance of specifying individual, social, and the subject related needs before design educational programs.

Needs analysis is carried out through different methods and forms the basis of educational programs for the learners (Brown, 1995). In a "needs analysis" process, one or more than one techniques such as questionnaires, interviews, writing compositions as well as examining previous reports and the current program can be used (Koç, Demirbilek & Yılmaz İnce, 2015; Demirel, 2015). Witkins (1994) stressed that "needs analysis" should firstly be conducted with the people who have already experienced the changes and then with the second and third parties. In this regard, the analysis should be started first with the learners so that it may help to reach the targets specified in the programs

Needs analysis for program development helps to specify both learner and teacher readiness, defining changing educational needs parallel to the paradigm in the community, collecting information about how to shape educational services, understanding learners, and what they need to know (Doğanay, Demircioğlu & Yeşilpınar, 2014). The first particular point to be considered when design educational program is to be sure about the need for a new program or the need for a revision of the current program. In order to specify this, as Demirel (2015) suggests, the current program should be overviewed in detail so as to determine how much it responds to the needs of the individuals and the community.

Taba stated that in the process of program development, educational needs should be studied before all (Demirel, 2015). In other words, Taba emphasizes the necessity of a needs analysis at the beginning of program development. Similarly, as in Taba's model, Demirel, Dick and Carey argue say that needs analysis should be the starting point in the program development process (Läänemets & Kalamees-Raubel, 2013; Demirel, 2015; Leonard, Hasbullah & Nurani, 2016).

Needs analysis done to specify the needs for learning becomes the target and helps form the necessary infrastructure of learning-teaching experiences, teaching material, and evaluation of educational programs (Acar Erdol & Gözütok, 2017; Koçer, 2013). Needs analysis helps revise learning processes to reach targets and becomes a reference source for policymakers, program developers, experts, and others involved (Gürler, 2018). The needs analysis should be an ongoing process to provide a motivating learning environment to respond to learners' changing individual and social needs and expectations (Hoang Oanh, 2007). Following a needs analysis during program development, targets, content, learning conditions, and evaluation are determined according to the needs of individuals and the community. Technology and design teaching program is one of the educational programs that requires needs analysis.

Different teaching programs are used in technology and design courses across the world. Many countries (England, Finland, Australia, Greece, Germany, Spain, South Korea, Hong Kong, USA) across the globe now require that educators teaching computing, coding, integrating with other courses from the earliest years students enter school (Rich, Browning, Perkins, et al. 2018; Toikkanen & Leinonen 2017). Akbaş (2003), Karaağaçlı and Mahiroğlu (2005) stated in their studies that technology education programs, designed to meet the needs of the communities and individuals, aim to develop learners' scientific thinking skills, and for this reason technology programs should develop with constructivism. In addition, as Karaağaçlı and Mahiroğlu (2005) state technology teaching should be a "learning - by doing"

process for higher level outcomes. In this respect, according to Tulukçu (2017) technology and design education should include: Applied programs should be designed to develop students' metacognitive thinking skills, students should have the opportunity to use technology for their own good in their daily lives, the programs should be open to adapt current technologies for sustainability, the programs should be designed in an interdisciplinary approach and should be a pathway between technology and design courses and others to transfer information and skills, the programs should provide a link between old learned and new learned, the programs should guide students in the process of developing a product or a project, due to ongoing technological developments, students should be made aware of lifelong learning, teachers should always update themselves.

Students called the "Z" and "Alpha" generation, starting from early ages, grow up familiar with the digital world such as computers, smartphones, and i-pads. Considering this viewpoint, educational programs need to be designed to meet students' needs. On the other hand, the contents of technology and design courses cannot be ignored particularly in the economical productions. One of the most crucial aims of education is to address to every individual. Therefore, programs should be designed to guide students in their future jobs and careers. In order to provide harmony between individual learning needs and community's expectations and creating a competitive business market, technology and educational contents should go hand-in-hand.

This period, which is defined as the digital technology age, has changed dramatically the known parameters, routines and practices related to educational needs and the process of teaching and learning. Parallel to the improvement of technology, meaningful and permanent learning channels have enriched. This situation has been effective in highlighting the interdisciplinary approaches that necessitate the integration of education and technology. On the other hand, one of the implications of this integration has been also to enable teachers to use the current technology effectively in educational environments (Harris, Mishra, & Koehler, 2009). This development went beyond the concept of the program in which technology integration was limited to technology courses only. Especially in the production, service and industry sectors, software and coding have differentiated the expectations about the education programs and teacher competencies. In this context, instead of programs where technology integration is only limited to technology courses; there is evidence supporting the technological pedagogical content knowledge (TPACK) model that supports technology knowledge, content knowledge and pedagogical methodology together (Mishra & Koehler, 2006).

The TPACK approach aims to teach with the appropriate technology, rather than just focusing on teaching technology. Koehler and Mishra (2005) consider TPACK's approach as a presentation of new concepts and subjects with technology in different forms of teaching rather than simply adding technology to the content to be taught. For school organizations, this means the integration of different course contents with technology and necessitates the development of teachers' competencies in using computer technologies. However, this integration cannot be achieved at the same level and speed in countries where teaching is based on traditional teaching methods and away from innovative technologies. In fact, the European Commission (2013) emphasizes that the use of technology in schools does not meet the expectations of many students in the research report on the use of information communication technologies in schools.

The competence of the technology and design course to create knowledge workers of the future in TRNC, where course contents mostly focus on developing skills in a traditional way, should be reconsidered with 21. century skills. In this regard, the contribution of the

current programs and applications to students' expectations and motivation is a big concern. There is evidence that digital technologies are a big factor in educating the new generations (Ağca & Özdemir, 2013; Calao, Correa, Leon & Robles, 2015; Lopez, Gonzales & Cano, 2016; Pilli & Aksu, 2013; Sanjanaashree, Anand & Somaa, 2014; Şeker & Erdoğan, 2017). Considering that the learning needs, approaches and learning tools of the technology generation students are differentiated, it is important to make a needs analysis which is a sub-step of programme implementation. On the other hand, a study in students' needs in technology and design courses has not been observed in the literature. In order to involve students in active learning processes, their needs and expectations should be considered. Through this perspective, students' adaptation and inclination towards the development in information technology were taken up in this study and it was aimed to specify rapport between students' expectations and the current technology and design program. In this regard, it is hoped that this research will fill the gap in the literature and will add contributions to the programme development process positively.

1.1. The Aim of the Study

This study aimed to determine the educational needs of the 7th year students in state secondary schools in TRNC in Technology and Design courses. The following research questions were directed;

i. What do the 7th year students expect from Technology and Design courses?

ii. What are the students' educational needs in Technology and Design courses?

1.2. Research Method

The research was conducted in the mixed model and the exploratory combined ordered method. Through this method, firstly qualitative data are collected then the quantitative dimensions of the research are shaped (Creswell, 2014). This study was carried out in the 2016-2017 academic year. The students who are directly affected by the changes in educational programs were assigned to write compositions in qualitative dimensions of the study for reflecting their common expectations about technology and design courses. The findings obtained from the qualitative data and in the light of literatüre, a needs analysis questionnaire was done in parallel with the expectations. In the process of setting the questionnaire items, determining the expectations of the participants, Delphi-questionnaire and literature scan techniques were applied. The Research model is as in figure 1.

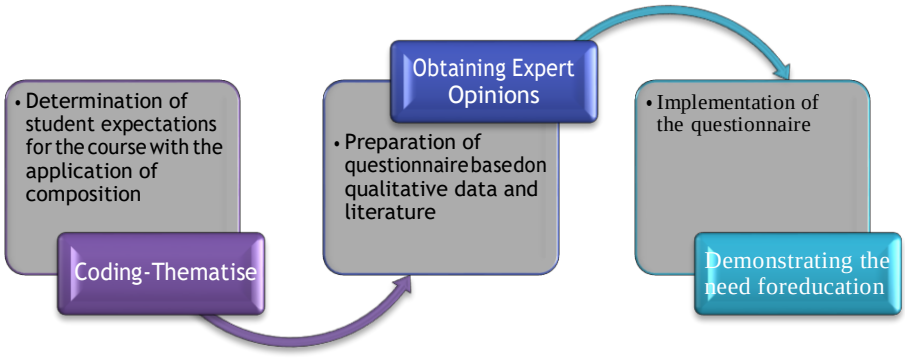

Figure 1. Research Model.

1.3. Study Group

97 randomly picked volunteer students studying in state secondary schools in Lefkoşa in 2016-2017 academic year composed the study group. The number of participants is not a

determining factor as long as the sought data are obtained in qualitative studies. Therefore, the number of participants in this research and the composition contents provided the criterion. The questionnaire was given to 702 students in state schools, TRNC, in the 2016-2017 academic year picked through stratified simple random sampling method. In such a method, every participant unit relates to a category without any exceptions, the change in categories is as small as possible and the change among categories is as big as possible, divided into sub-groups and the samplings picked separately from every category and independently (Büyüköztürk et al., 2016). 53 of the questionnaires were returned without feedback, 36 were exempted from the analysis because they were either not answered or marked inappropriate. Thus, 613 questionnaires were evaluated, which meant that more than %10 of the 3116 seventh year students (%19,6) were reached. In descriptive researches, %10 sampling is assumed as the lowest rate to be considered (Özen & Gül, 2007). In this respect, the %19,6 rate in this research is a sufficient sampling rate. The participants were represented as P^1, P^2, P^3,..., P^{97}.

1.4. Data Collection Tools and Analysis

97 seventh year students picked randomly were assigned a composition titled "What is an ideal technology and design course for you?" to express their expectations. Every single sub-theme forming the basis of this research was supported by direct quotations. The statements in the compositions were subjected to content analysis and the students' expectations were put into categories and themes. The data obtained were overviewed by two experts and were themed and categorized according to common coding. These data formed the items of a "needs analysis" to be carried out with the seventh year students in all state schools in TRNC. While forming the questionnaire items, the most expected needs were given the priority in evaluation. The coding-categorizing processes went through NVIV0 10 package program.

In the process of collecting quantitative data, a 58-item bank, based on the students' views about technology and design courses, was formed. In the following stage, in the light of Delphi technique in questionnaire developing, five experts in curriculum development, one expert in educational administration, two experts in information technologies, and two experts in technology and design were consulted for their views. On shaping the needs analysis questionnaire, the experts were consulted once more after 15 days and a 38-item needs analysis questionnaire was created and implemented for a pre-test study with 162 randomly picked students. With the data collected, a 38-item and three-dimensionally finalized needs analysis questionnaire were prepared. The statements in the questionnaire were written and evaluated in the light of two linguists' guidance clearly and comprehensively incorrect Turkish language structure. The content validity of the questionnaire was approved by the experts' views. The analysis of the 613 secondary school students from 702 students who were randomly selected by stratified sampling method was analyzed in the main application.

In naming the questionnaire dimensions, experts were consulted. The first dimension of the questionnaire consisted of a 12- items "general needs" dimension in technology and designing courses. The second is a 13-items "design needs" dimension and the third is a 13-items "information technologies needs" dimension. The questionnaire was prepared in 5-Likert type. The statements were ordered as (5) "I extremely need it"(scores between 4,20-5,00); (4) "I need it quite a lot" (scores between 3,40-4,19); (3) "I need it" (scores between 2,60-3,39); (2) "I need less" (scores between 1,80-2,59); and (1) "I don't need any" (scores between 1,00-1,79). The reliability of the "needs analysis" questionnaire was calculated through Cronbach' alpha and was found as 0,91 according to Büyüköztürk et al., (2016), the reliability of this questionnaire is high.

2. Findings

The distribution of the data obtained from students' views reflected in compositions and their frequencies in terms of the number of participants are as in Table 1.

Table 1. *Students' expectations from technology and design courses*

Themes	Categories	*n*	*f*
General Requirements for the Course	Produce a project	47	56
	Developing imagination	86	114
	Teamwork	92	129
	Express ideas	57	63
	Transfer what is learned	64	71
	Making inventions	74	117
Design Needs	Design of a desirable product	84	93
	Expansions of three-dimensional geometric shapes	61	87
	Robot, drone making	94	134
	Mechanical design	53	92
	Three-dimensional drawing	49	58
Information Technologies Needs	Code writing	83	128
	Moving a robot by coding	91	146
	Moving the character with coding	89	135
	Writing algorithms	59	72
	Sharing codes	76	103
	Drawing three-dimensional shapes on the computer	92	139
	Drawing animation with coding	83	94

**n* refers to the number of participants expressing views about the item. "Frequency", on the other hand, indicates the number of views expressed for each item.

As it can be observed in Table 1, after the coding procedure, students' views are shown under three main themes. Although students' expectations are commonly expressed in all three themes, they mostly appeared under the " information technologies needs" theme. The other common expectations appeared under "developing imagination", "teamwork", "design of a desirable product", "robot making", and "mechanical design" sections.

The most common frequency themes in terms of the general needs in the subject are under the headings of "developing imagination", "teamwork", and "making inventions". The students expressed their expectations saying they wished to have social, interactive environments where they could express themselves without any worries.

"It is better to do the design with classmates" expressed P[25]. "I'd like to invent something in class and share it with my friends" P[14]. "We can transfer our learnings in this course to other courses" P[90]. "...our power of imagination develops in class" P[15]. "We should be able to invent something new" P[29]. "Studying without a break can cause stress. We can think freely in this course" P[17]. "This course sounds like developing the power of imagination" P[18]. "We should invent something" P[65]. "A special effect in this course may be helpful in arts and drawing courses" P[46].

In the "design needs" theme the most frequently mentioned themes were "making robots, drones, mechanical design, and design of a desirable product".

P[3] expressed, "We should design three-dimensional drawings to meet human needs", "Three-dimensional drawings are related to arts and drawing" P[40]. "I think of mechanical inventions and robots" P[86]. "Design robots and make them speak would be fun" P[6], "We can make rockets or planes" P[39]. "We can invent something new, like new drones" P[62].

The most frequently mentioned themes in the "information technologies needs" are "moving a robot/character by coding", "drawing three-dimensional shapes on the computer", and "code writing".

P[44] said, "Coding is so popular in the world. We can do it", "Technology course refers to using computers" P[70]. "I prefer to have this course on the computer, because everything applied can be remembered easily" P[52], "This course reminds me of code writing" P[10]. "We should write codes on the computer" P[15], "We can do drawings and animate them to make films" P[92].

In the second sub-problems, students' needs in technology and design course program were examined. The results are given as arithmetic averages and standard deviations in Tables below.

Table 2. *Students' general needs in technology and design courses*

	General Requirements for the Course	Mean	SD
M1	To give an example of the connection between design and technology	2,91	1,27
M2	To explain the basic design process	2,86	1,26
M3	Establish a cause-effect relationship in a design project	2,92	1,33
M4	Express ideas on the project	3,40	1,39
M5	Presenting creative design ideas for project work	3,05	1,32
M6	Making group work while producing the project	3,43	1,34
M7	Planning the construction stages of the project	3,07	1,29
M8	Using the internet in project research	3,13	1,34
M9	Technical drawing of the project	3,41	1,33
M10	To prepare the necessary materials for the design	3,13	1,34
M11	Building design	3,13	1,36
M12	Use resources economically when producing projects	2,88	1,38

As it can be noted in Table 2, the most frequently mentioned general needs in this dimension ($\bar{x}$=3,43) was "Making group work while producing project" and the least mentioned ($\bar{x}$=2,86) was "To explain the basic design process". The arithmetic averages of the other items were close to each other. In this regard, it can be assumed that the seventh year students in schools in TRNC agreed on common needs. The indication of the general distribution of arithmetic average is that there is average and high-level needs, "I need it" (scores between 2,60-3,39). Table 3 below shows students' needs for the design.

Table 3. *Students' design needs in technology and design courses*

	Design Needs	Mean	SD
M13	design appropriate inventions	3,41	1,35
M14	To produce parts suitable for the invention to be designed	3,13	1,30
M15	To make moving mechanical designs	3,47	1,37
M16	To produce designs on the computer	3,47	1,36
M17	Use width, length, and depth in shapes	3,40	1,32
M18	To use the relation between shape and ground in objects	3,25	1,25
M19	To place an object on the surface according to the distance length	3,11	1,32
M20	To imagine the three dimensions of an object	3,12	1,38
M21	Drawing an open shape of a geometrical item with depth	2,92	1,34
M22	Thinking the image of geometric shapes from another angle	2,92	1,32
M23	To draw the image of geometric shapes from another angle	3,41	1,36
M24	Position the object in the coordinate plane	3,03	1,36
M25	To present design projects with computerized animation	3,49	1,43

As it can be noted in Table 3 "To present design projects with computerized animation" was the most needed item in design ($\bar{x}$=3,49). This finding indicates that students most need to use information technologies in design courses. Items 15 and 16 ($\bar{x}$=3,47) show that "To produce designs on the computer" and "To make moving the mechanical designs" are needed the most. The smallest needs ($\bar{x}$=2,92) are in "Drawing an open shape of the geometrical item with depth" and "Thinking the image of geometric shapes from another angle". These findings indicate that students do not have sound experience and knowledge in making the design. On the other hand obviously, students are willing to produce animations on the computer, making mechanical designs, producing designs on the computer, using width-length and depth in shapes, and design new products. In this dimension "I need it" (scores between 2,60-3,39) refers to an average and high-level need. Students' needs for using information technologies are presented in Table 4 below.

Table 4. *Students' needs in Information Technologies in Technology and design courses*

	Information Technologies Needs	Mean	SD
M26	Writing Algorithms	3,41	1,42
M27	To distinguish between the algorithmic sequence in the coding and the mathematical sequence of operations	3,43	1,30

M28	To draw shapes with width, length and depth with program coding	3,51	1,29
M29	To produce designs in which the shape and the floor are compatible by coding	3,46	1,27
M30	Positioning an object in a coordinate plane by coding	3,67	1,35
M31	Drawing an object from different angles by coding	3,41	1,30
M32	To imagine the unfolding of three-dimensional geometric shapes how to draw by coding	3,45	1,32
M33	To draw the unfolding of three-dimensional geometric shapes by coding	3,48	1,26
M34	To change the angle of the depth image of shapes with programming	3,52	1,29
M35	Drawing an object according to the distance length by coding	3,46	1,32
M36	Giving motion to a picture with coding	3,68	1,35
M37	To draw the imagined animation three-dimensional with program coding	3,59	1,33
M38	To share the program prepared with the coding on the Internet	3,29	1,46

As it can be noted in Table 4, "Giving motion to a picture with coding" item is the most needed activity to be done using information technologies in technology and design courses ($\bar{x}$=3,68). The least needed item ($\bar{x}$3,29) is "To share the program prepared with the coding on the Internet". These needs-based on application are the ones that are expressed as "I need it quite a lot" with scores between 3,40-4,19. This indicates that students mostly need "Information Technologies" that can be used in different courses.

When all the dimensions are considered together, it can be seen that students are most interested in producing projects/products in a social learning environment, doing activities in logical and spatial thinking and skills, and making projects/products in a digital environment.

3. Conclusion and Discussion

The findings in this research are grouped into three dimensions. In the first dimension, it was observed that the level of students' educational needs are very close to each other. In this dimension the students expressed their willingness in teamwork, developing imagination, creativity, express themselves, In this regard, it can be suggested that educational programs should be designed in which group work in learning environments to develop skills are done and students should be provided with the opportunity to express themselves, and design their own products. In the second dimension, it was observed that students wish to do more, inventing something, moving mechanical design products, using width, length, and depth in shapes, three-dimensional designs. This indicates that students are interested in adopting today's technologies to produce something. At this point, it can be concluded that new content and applications appropriate to the interests and wishes of the students should be included in the technology and design course programs. In the third dimension, drawing three-dimensional shapes with coding, code writing, giving motion to a picture with coding, drawing animation with coding and positioning an object in a coordinate plane by coding are the most needed items. This indicates that students are in great need of producing an algorithm and making three-dimensional designs, drawings and animations with coding.

These findings indicate the need for information technologies supported coding applications in technology and design curriculum.

The findings in Kocabatmaz's study (2011) using information technologies in class, technical drawings, students' will in making designs as they wish, and using technological tools are similar to the findings in this research. In a study by Tulukçu (2017) the findings show that technology and design teachers had positive attitudes towards computer supported teaching styles, developing social skills, renewing teaching programs parallel to technological developments, and developing transfer skills. The findings in this research related to students' needs match well with the ones mentioned above. In a study by Leonard et al., (2016), master degree students, whose needs were analyzed and was designed a course program for their needs, produced more technical and practical thesis after receiving courses on research methods. Cheruvu (2014) stressed that teachers could raise everlasting success by collecting systematic information to specify students' perceptions and needs.

It is thought that the results of this research aiming to determine the student needs of technology and design courses may have some improvements in program development studies and policy makers in education. First of all, it can be said that the current curriculum is far from meeting the expectations of today's students and the environment. On the other hand, it can be said that the students gave clues about the content of an education which could contribute to the increase in the motivation of the students. Finally, it can shed light on the identification of educational content for policymakers in education and guide studies that take into account student needs that are often overlooked in determining needs for researchers. Additionally, to use information technology in education environments teachers should be educated by technological pedagogical content knowledge model. The model can make teachers more flexible and professional in using technology in pedagogical techniques.

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