Journal of Teacher Education and Lifelong Learning (TELL)

Volume: 5 Issue: 1 Year: 2023 | Research Article | ISSN: 2687-5713

An Activity for Design Skill Labs: Activity Planning Processes and Pre-Service Chemistry Teachers' Views [1]

Ayşe Yalçın Çelik[1]

[1] Gazi University, Gazi Faculty of Education, Division of Chemistry Education, Ankara, Türkiye
ayseyalcin@gazi.edu.tr

Article Info

Article History
Received: 10/02/2023
Accepted: 05/05/2023
Published: 30/06/2023

Keywords:
design skill labs, planning an activity, pre-service chemistry teachers, views

ABSTRACT

The traditional roles of schools are inadequate to prepare students for the change. Thus, Design Skill Labs (DSLs) have been established in Turkey to provide opportunities for students at all levels of education to discover and develop their talents. Nevertheless, the activities currently available in DSLs are not yet sufficient or diverse enough. The aim of this study is to exemplify the process of developing an activity that can be implemented in DSLs and to obtain the opinions of pre-service teachers about them. Two out of six pre-service chemistry teachers planned the activity, and six pre-service teachers are participated in the study. The participants were senior pre-service chemistry teachers from a state university in Ankara. The data collected from the case study were analyzed using content analysis. According to the research findings, DSLs activities differ from other activities carried out in schools in terms of student and teacher roles, learning environment, research problem, and process. Moreover, DSLs activities contribute to students' skill acquisition, personality development, learning, socialization, and mental development.

Citation: Yalçın-Çelik, A. (2023). An activity for design skill labs: activity planning processes and pre-service chemistry teachers' views. *Journal of Teacher Education and Lifelong Learning*, *5*(1), 324-335.

[1] The activity in this study was developed by undergraduate students under the mentorship of the author within the scope of the "Research Project in Field Education" course.

INTRODUCTION

Although there are many different definitions, purposes, and functions of education, one of them is the process of bringing about a desired change in an individual's behavior through his/her own experiences (Ertürk, 1972). Changes in people brought about by education are also reflected in societies, and societies develop and change like people. Education is one of the important elements necessary for a society to progress and develop. Each society has its educational dynamics. As the dynamics of the age change, societies also change (Dinçer, 2003; Parlar, 2012). Thus, education and training activities should focus more on the needs and requirements of the era. The task of the understanding of education is to raise individuals who can respond to the needs of the age and survive. The understanding of education in this era focuses on providing individuals with critical thinking and problem solving, communication and collaboration skills, flexibility and adaptability, initiative and self-direction, social and intercultural skills, leadership and responsibility, information and media literacy and technology skills (Rotherham & Willingham, 2010). There is a need for different approaches and spaces than the current approaches and physical environments in schools to provide such skills and competencies.

These spaces to meet this need are stated as Design Skill Labs (DSLs) in the 2023 Education Vision (MoNE, 2021a). These workshops are defined as workspaces designed for a common purpose at primary, secondary and high school levels, emphasizing the use of the child's hand, and associated with professions (MoNE, 2018). Teachers and students have different roles in design skill labs. Compared to existing approaches, design skill labs emphasize approaches that allow students to learn by doing and experiencing, and that emphasize designing, making, and producing rather than knowing. In this context, the philosophy of design skill labs, like other student-centred approaches, is based on the philosophy of constructivist learning (MoNE, 2021a; MoNE, 2021b). According to the constructivist approach, the role of the teacher is not to present pre-prepared information, but to provide a learning environment where students can do real and physical activities (Piaget, 1976). DSLs are environments where students seek solutions to problems and where learner-content interaction is provided in collaboration with their teachers and peers. From this perspective, project-based learning, problem-based learning, collaborative learning, and design-based learning approaches should be employed in DSLs so that students can produce design-oriented answers to the problems they realize in these environments in cooperation with different disciplines in line with their competencies and skills (MoNE, 2021a).

The laboratory environment provides researchers with more opportunities and benefits (Koskinen, Zimmerman, Binder, Redstrom, & Wensveen, 2011). They can be used to generate alternative explanations, test hypotheses, make more detailed and accurate calculations and observations through the equipment in the laboratory, make more detailed documentation, and to be repeated in other laboratories. In many countries around the world, these design laboratories are structured in different contexts in industrial design schools. This shows that design laboratories will emerge as interdisciplinary research centers of the 21st century (Başkan & Curaoğlu, 2017).

In the 2023 Education Vision, separate design skill labs groups are defined in primary and secondary education to develop different skills and competencies of students. Primary Education Institutions have 10 workshops focused on science, art, sports, culture, and life skills. STEM and Software-Design Labs focus on science; Wood and Metal, Visual Arts and Music Labs focus on art; Drama and Critical Thinking Labs focus on culture; Nature and Animal Care and Life Skills labs focus on life skills; Outdoor and Indoor Sports labs focus on sports (MoNE, 2021b). Having different types of workshops in Primary Education institutions will provide opportunities for students in younger age groups to recognize their skills and interests, combine knowledge and skills from different disciplines, and experience and develop 21st-century skills.

In Secondary Education Institutions, there are labs focused on Science and Culture and Arts. STEM, Robotics, 3D Design, Electrical-Electronics and Software Labs are science-oriented workshops, while

Traditional Handicrafts, Cinema, Music, Painting and Woodworking labs are culture and art-oriented workshops (MoNE, 2021b). These labs take their spaces where students can engage in thinking, designing, and producing activities.

It is observed that some studies aim to determine the opinions of teachers, students, and school principals about DSLs when the literature is examined (Akıllı, Yıldız, Ateş & Ateş, 2020; Aşkar, 2021; Demir, Çaka, Şimşek, Kızıltepe & Özkurt, 2021; Ulutaş & Öztürk, 2021). However, there are a limited number of studies introducing a sample activity and explaining how teachers should prepare an activity that can be applied in DSLs (Orak & Çilek, 2020). In the study conducted by Güleş and Kılınç (2020) with primary schools' teachers, it was determined that teachers played intelligence and mind games and made origami in science labs. Yücel-Toy & Uçar (2022) proposed a model to develop an activity that can be used in DSLs to help teachers. This model consists of 7 stages: getting to know the student, determining the content, determining the objectives, deciding on the labs, planning the activity, implementing the activity and evaluation. There are no studies in which the proposed model of this research is applied and its effectiveness is evaluated. This study aims to prepare an activity that can be applied to DSLs in secondary education schools and to determine the views of pre-service chemistry teachers about DSLs. It was underlined that the activity was interdisciplinary and had been planned by considering the sample activities listed in the MoNE's Guidelines. In this context, a system that can be used in sustainable agriculture practices and irrigate according to the plant's needs will be designed. The lack of activities that can be applied in DSLs draws attention when the literature is examined. The activity will be a source for the needs of teachers and students regarding the use of DSLs. Thus, it is thought that the planned activity will be meaningful and valuable in terms of the related literature.

According to Güleş and Kılınç (2020), one of the problems encountered in DSLs is that teachers are not ready for DSLs, because curriculum updates have not yet been made in teacher training. Therefore, this research can help in the in-service training of teachers who will take part in DSLs and in the planning of pre-service teachers' training by revealing the differences between the activities carried out in traditional learning environments and DSLs.

In line with the above-mentioned purpose, the sub-problems of this research are:

1) What are the opinions of pre-service chemistry teachers about the difference between an activity applied in DSLs and the activities carried out in the laboratory?

2) What are the opinions of pre-service chemistry teachers about the possible contributions of an activity applied in DSLs to students?

METHOD

In this study, case study design, one of the qualitative research methods, was used. A case study is a method used to describe and analyze in detail an event, person, or situation in a natural environment and to interpret it holistically (Yıldırım & Şimşek, 2018). The study aims to examine the views of pre-service chemistry teachers who have experience in planning an activity that can be applied in design skills labs (DSLs) about the possible benefits of DSLs.

Participants

The study was carried out with a total of 6 participants, including 2 pre-service chemistry teachers who planned the activity and 4 pre-service chemistry teachers whose opinions were taken after the activity was presented. The participants were determined by the criterion sampling technique, which is one of the purposeful sampling methods. The preferred criterion in determining the participants is that they have the necessary knowledge to plan an activity that can be applied in DSLs. This study was conducted with pre-service chemistry teachers attending a state university in Ankara. The participants were selected from the senior year (4th year, 8th semester) students who completed the chemistry course in their curriculum and completed the majority of the chemistry education courses. The pre-service teachers received training on design skills labs in two different courses related to field education and examined the "Teacher's Guide" prepared by the Ministry of National Education (MoNE), which includes activities for DSLs.

Data Collection Tools

In the study, data were collected using two methods: (i) interviews and (ii) researcher observation notes.

Individual/Group Interviews

Individual and group interviews were conducted with the participants during the activity planning process and after the activity was presented to the 4 pre-service chemistry teachers. The participants met regularly for at least 40 minutes every week during the activity planning process, and the researcher mentored the participants during these interviews. Open-ended unstructured questions were asked to the participants during the interviews. However, considering the aims of the research, the questions were planned with a certain aim. Participants were asked to explain the difference between an activity implemented in DSLs and activities carried out in the chemistry laboratory and to discuss the possible contributions of an activity implemented in DSLs. The questions were asked directly or indirectly in each interview in a way that allowed the participants to express their opinions clearly. The interviews with the participants who planned the activity were conducted both individually and as a group interview, depending on the research process. All interviews were conducted online and recorded. These records were then analyzed.

Researcher Observation Notes

It was a document in which the researcher records the problems experienced by the pre-service teachers during the activity planning process, how they solved them and the benefits of an activity preparation process for DSLs for pre-service teachers. These notes were recorded by the researcher during weekly meetings with the participants and were subsequently analyzed and compiled for the purposes of the study.

Research Process

The study was conducted in three stages (Figure 1). In the first stage, participants conducted a comprehensive review of the "DSLs Teacher's Guidebook", which is currently the only literature available on activity preparation. The researcher, who is one of the authors of the Guidebook, provided guidance to the participants during the review process, explaining the fundamental principles of activity planning. Specifically, the planning model of the "Science Labs" activities, the titles in the activity plans, and the planning principles of the activity were elaborated upon.

In the second stage, participants planned an activity to be carried out in DSLs. The activities were intended to be interdisciplinary, bringing together students with different abilities through collaborative group work, be suitable for applying student-centered methods such as problem-based teaching and project-based teaching, and have features that enable students to use knowledge in the application process. Participants planned an activity that would address a problem within their own skills and interests. The activity aimed to highlight environmental literacy as a 21st-century theme and information, media, and technology skills to support the development of participants' 21st-century skills.

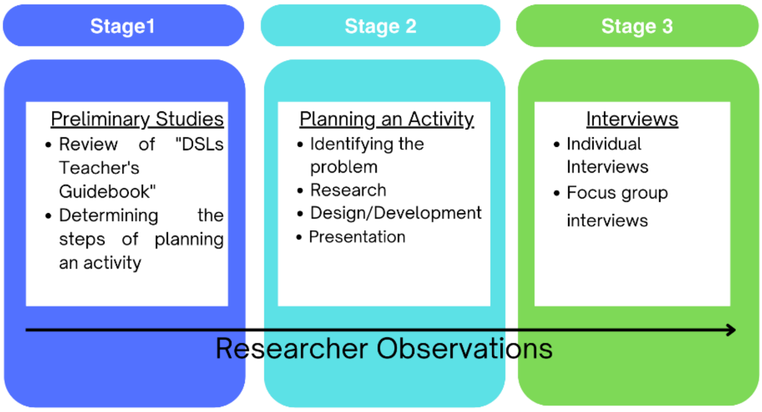

Figure 1. *Research Process*

The activity described in the paper was planned through a 4-step process, as illustrated in Figure 2. The first step involved problem identification, during which participants were instructed to select a problem that would be of interest to high school students, related to 21st-century themes and skills, and suitable for a solution through designing in DSLs conditions. The second step was dedicated to interdisciplinary research, which was necessary to solve the identified problem. Design and development constituted the third step, wherein participants were encouraged to produce a solution-oriented design by conducting design development processes. They were instructed to follow five steps in this stage, namely (i) analysis, (ii) design, (iii) prototype development, (iv) implementation, and (v) development. The last step was the presentation phase, where participants showcased their designs to their peers (i.e., pre-service teachers) and received feedback.

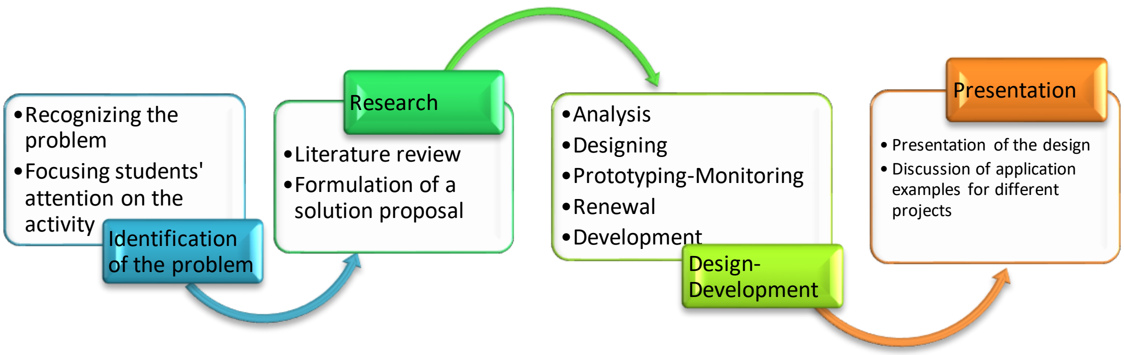

Figure 2. *Process of planning the activity*

The planned activity and its planning stages are described below.

1-Identification of the Problem

The first step was problem identification, with a focus on environmental literacy, one of the key themes of the 21st century. The activity aimed to raise awareness about sustainability, sustainable agricultural practices, recycling, and renewable energy sources. Participants were tasked with identifying a problem related to these themes.

Research problem: The environment we live in faces numerous challenges, including pollution and other ecological problems. By taking a moment to observe our surroundings, we can identify the sources of pollution and consider other environmental issues that may arise. One solution to address such issues is sustainable gardening, which involves using recycled materials and sustainable practices to beautify our surroundings. For instance, we can create a planter or garden using recycled materials such as old pots, cans, or even

pallets.

However, sustainable gardening requires proper planning and care, especially when we are away from home. To address this issue, we need to design a system that can water our plants automatically even when we are not around. This could involve installing a drip irrigation system or using a self-watering planter.

By exploring these topics and designing solutions, we can contribute to a healthier and more sustainable environment.

2-Research

The activities carried out in Design-Based Science Learning (DSL) labs are design-based research activities. At this stage, participants come up with different solution proposals within the framework of the identified problem and conduct research on them. In this activity, participants were expected to conduct research on environmental pollution, recycling, renewable energy sources, and coding. To raise awareness about sustainability and sustainable agricultural practices, recycled materials were used in the planting phase of the project and compost fertilizer was prepared. Thus, participants investigated the preparation stage of compost fertilizer and the differences and benefits of compost fertilizer from other types. This stage can be realized in STEM labs in DSLs, although it would be helpful to specify which specific labs this applies to.

3- Design-Development

In the design-development stage, participants researched the features that a design should have and analyzed design development processes. The specific processes identified were making compost fertilizer from waste garbage, making a flower bed for flower planting in the wood labs, and installing an automatic irrigation system. In the first stage, participants prepared compost fertilizer with materials from household organic waste (Photo 1a). Then, they made a flowerpot using recycled materials by cleaning and painting a waste plastic container and also prepared a bench using wood to hold the flower (Photo 1b). Ultimately, participants designed an irrigation system that activates automatically when the soil moisture declines using a moisture sensor.

Photo 1 a. *Preparing compost fertilizer with organic waste*

Photo 1 a. *Preparing a flowerpot and bench*

During the design phase, they made a drawing in the Tincercard program. They created their drawing as a prototype using Ardunio set (Photo 2). In the first prototype, the irrigation system was connected to electricity. The participants decided that this would be a disadvantage and developed the second prototype by stating that an irrigation system could be designed by adding a solar panel. This stage can be realized in 3D Design and Robotics Workshops in DSLs.

4- Presentation

At this stage, the participants presented the activity to their friends. They shared their experiences in the activity preparation process with their peers and received their opinions.

Photo 2. I*rrigation system with Arduino*

Data Analysis

In this study, data were collected through interviews with participants and researcher notes. Content analysis was used to analyze the interviews and notes, which involved classifying the data into themes to reveal their relationships (Yıldırım & Şimşek, 2018). The researcher analyzed the participants' statements through open and closed coding, content analysis, and constant comparative analysis. Themes and categories were created by using the codes that emerged from the participants' statements during content analysis. Additionally, an expert in science education also analyzed the data. The level of consensus on the coding was calculated using Miles and Huberman's (1994) formula, resulting in a reliability of 87.8%. Finally, the participants confirmed the agreed-upon codes, themes, and categories.

FINDINGS

Research findings 1) The difference between an activity performed in DSLs and activities performed in other teaching environments, 2) The possible contribution of an activity applied in DSLs to students was examined under the headings.

The Difference of DSLs from Other Teaching Environments

Participants were asked to identify the characteristics that an activity that can be implemented in DSLs should have as well as the differences between the activities currently being carried out in schools. The themes and categories that emerged from the analysis of their answers are given in Table 1.

Table 1. *Differences between DSL activities and laboratory activities*

	Student Role	Teacher Role	Learning Environment	Research Problem	Process
Positive aspect	Technology user	Technology user	Working in different spaces (labs)	A problem from everyday life	Interdisciplinary work
	Researcher	Be resourceful	Be fun		
	Entrepreneur	Can motivate			
	Designer	Leader			
	Creative/producer				
	Talented				
Negative aspects			Risky environment (Safety)	Difficulty relating to learning outcome	Long working time
					Violation of the examination system

The differences between an activity implemented in DSLs and an activity carried out in the laboratory were grouped under 5 categories: student and teacher roles, learning environment, problem, and process (Table 1). According to the category of differences in student roles, students in DSLs have the roles of researcher, entrepreneur, technology user, designer, creative and talented. One of the participants described his role in DSLs as follows: "In the laboratory, we plan experiments at most. In the laboratory, the purpose is clear, the materials are clear. Here, we made a design". The same participant emphasized entrepreneurial skills with the statement "I think I can market the product we designed very well".

Differences in teacher roles were grouped under the themes of resourceful, technology user (able to use technology), motivator and leader. The participants emphasized that "the teacher should be able to use different devices (such as Arduino sets) in these activities and should be able to code" and "there is even a 3D printer in DSLs. The teacher should know these and be able to use different programs", emphasizing the role of teachers as a technology user. Similarly, one of the participants stated that "the teacher's job is much more difficult. When the process is long, they need to motivate students well", emphasizing the theme of a motivator. Teachers should also be able to use many tools and devices. One of the participants explained the role of "resourceful" with the statement "The teacher should be resourceful and be able to use different tools".

Another difference between DSLs and laboratories is “learning environment”. Participants stated that DSLs are more fun but risky and consist of many workshops. Both participants stated that "There are different tools in DSLs. Students can cut their hands..." and "Chemistry or physics labs are also dangerous, but DSLs, especially wood workshops, can be risky for students... accidents can happen". Another difference is related to the structure of the research problem. The research problem used in DSLs should be related to daily life. One of the participants stated that "activities should be completely intertwined with life. It is sometimes difficult to relate the experiments conducted in the laboratory to life". Another difference is that it is difficult to relate the research problem to the outcome. One of the participants expressed his opinion as follows: "I don't know if the outcome is important in this activity.... We did not focus on the outcome here. We focused on the product, design, and process". The differences in the teaching process in DSLs are interdisciplinary work, long working time, and contradiction to the exam system. The participants expressed that the process took a long time with "it took a long time to create the product" and "we could do experiments in a short time, the process is long in DSLs". In addition, they also stated that the process was contrary to the exam system by using "it may be difficult to implement in schools. It is because of the exam. Students may not want to study. Instead, they solve tests".

Contribution of DSLs to Students

In the study, participants were asked to indicate the possible contribution of an activity applied in DSLs to students. The themes that emerged from the analysis of the answers are given in Table 2.

Table 2. Possible contributions of DSLs activities to students

Skill Acquisition	Personality Development	Learning	Socialization	Mental Development
Hand skills	Self-recognition	Use tools/devices	Ability to communicate	Analytical thinking
Entrepreneurship skills	Self-confidence	Concept learning	Collaborative work	Critical thinking
Engineering skills	Perseverance	Learning to code		Imagination
Ability to design	Taking responsibility	Problem- solving		Creativity

The possible contributions of the activities carried out in DSLs were grouped under 5 categories: skill acquisition, personality development, learning, socialization, and mental development (Table 2). According to the participants, DSLs provide students with the opportunity to acquire manual skills, entrepreneurship, engineering, and design skills. One of the participants stated that "students are very lucky in DSLs, they design, draw and combine like engineers. This is a chance.... there are many who want to be engineers" and expressed its contribution to engineering skills. The other participant stated that DSLs can contribute to the student's ability to design with the words "they will learn to design, they will become makers". Similarly, one of the participants expressed the idea that DSLs can support entrepreneurial skills with the words "Students can create products with high economic value, maybe they will start their own business".

According to the participants, DSLs can support students' development of self-knowledge, self-confidence, perseverance and taking responsibility behaviors. The participants stated that they can learn to persevere with the expressions " learns to persist in the face of challenges " and "learns not to run away from problems". In addition, the participants expressed their thoughts that DSLs provide students with the opportunity to get to know themselves with the statements "... it allows them to discover their interests..." and "DSLs are a great opportunity to discover their talents, students can get to know themselves...". According to the participants, DSLs provide opportunities for students to learn how to use tools/devices, learn concepts, learn to code, and learn problem-solving. All the participants emphasized that DSLs could support coding learning with the words "no other course allowed me to code... students will learn to code" and "... I learned to use the application. I learned to write code, every student will be able to learn these programs to a greater or lesser extent". One of the participants stated that DSLs will contribute to students learning how to use tools/devices with the words "There will even be a 3D printer in DSLs. They can learn to use it", while the other participant stated that "There are many different tools... especially in the wood workshop... they will be able to use them". Similarly, participants expressed that DSLs activities can support students' concept learning with the words "they can learn chemistry better... because they will apply it" and "they can learn many different subjects better about each other".

Another possible contribution of DSLs activities to students is that they create an environment for students to socialize. According to the participants, students will be able to work collaboratively and communicate effectively in these environments. One of the participants expressed this view as "they can learn to work collaboratively with their groupmates". Finally, DSL activities can support students' analytical and critical thinking, creativity, and imagination. One of the participants emphasized the theme of creativity with the words "You have to be creative to design ... it helps them develop their creativity". The same participant also emphasized the theme of creativity with the words "You use your imagination a lot. Imagination develops" and emphasized the theme of imagination.

DISCUSSION

The purpose of this study is to investigate the differences between the activities carried out in Design Skills Laboratories (DSLs) and other activities conducted in the school environment, particularly in chemistry labs, and to determine their potential contributions to students. Pre-service teachers who are familiar with DSLs were asked to plan and present an interdisciplinary activity to other pre-service teachers to achieve this goal. Based on the results of the study, it was found that the activities conducted in DSLs and traditional laboratories differ in terms of the teacher, student, learning environment, research problem, and process. The participants reported that DSLs promote differentiation in student roles, with students assuming more active roles as researchers, technology users, entrepreneurs, designers, and creators during workshops compared to other activities in schools. Examining these roles, it was found that students are expected to exhibit 21st-century skills in DSLs. These skills, also known as P21, are comprised of three skill groups: (i) learning and innovation skills, (ii) information, media, and technology skills, and (iii) life and career skills (Larson & Miller, 2011; Mishra & Kereluik, 2011; Partnership 21, 2009; Rotherham & Willingham, 2010). Among the differentiated student roles in DSLs, the "researcher" and "technology user" roles support the development of information, media, and technology skills; the "entrepreneur" role supports the development of life and career skills; and the "designer" and "creative/producer" roles support the development of learning and innovation skills. Research has shown that DSLs can contribute to the development of students' 21st-century skills (Aksoy & Saraçoğlu, 2021; Gündoğan & Can, 2020; MoNE, 2018).

Although many internal and external stakeholders such as students, teachers, parents, and school administration have an impact on the use of DSLs, teachers constitute the most important element for the effective use of DSLs (Gülhan, 2022). According to the participants, teachers should be able to use different tools and devices (resourceful), code, use different applications, and motivate and lead students throughout the process. These roles are generally different from the roles of teachers in environments where traditional teaching approaches are used. Gündoğan and Can (2020) emphasized that teacher roles need to change to increase the functionality of DSLs. Similarly, in a study investigating teacher competencies in DSLs, it was determined that teachers should have some instructional, social, and personal competencies (Demirata & Sadik, 2021). According to the study, teachers should be individuals who can use coding, robotics, and 2D and 3D design skills in learning environments. In addition, a teacher should be a model for his/her students, be able to guide them and work collaboratively. These findings are in line with the differentiated teacher roles in DSLs that we identified as a result of our research.

While there are only a limited number of studies on DSLs (Aksoy & Saraçoğlu, 2021; Gülhan, 2021), there are other studies that support the findings of this research. For instance, based on the participants' feedback, DSLs can be risky environments for students due to potential accidents that may occur. Participants' apprehension stems from the use of different tools and devices in the workshops. In a study conducted by Gündoğan and Can (2020), classroom teachers also expressed safety concerns. Similarly, Gülhan (2021) found in a study with school administrators, teachers, and students that the negative aspect of DSLs in all three participant groups is that "accidents may occur if adequate precautions are not taken." In the same study, teachers described DSLs as an environment that provides an opportunity for students to have fun because they are active and can design their own products. These environments may make students happier than traditional classrooms. Another distinguishing feature of DSLs from conventional learning environments is that activities in DSLs are not aligned with the examination system of the education and training process. As teacher-centered education is generally dominant in schools (K.Çoban, Yalçın-Çelik, & Kılıç, 2021), activities in DSLs, where students are active and use their manual skills, may worry parents in terms of academic success (Gündoğan & Can, 2020).

Another objective of this study was to determine the contribution of DSL activities to students. According to the participants, students who engage in activities in DSLs develop new skills, and their personality and mental development are supported. They also socialize and learn new things. The themes of communication, collaboration, critical thinking, and creativity in the socialization and mental development category are known as the 4C skills by Partnership 21 (2009). Students who possess these skills are expected to think critically when solving problems, propose solutions that include creativity and innovation, and communicate effectively with others to eliminate misunderstandings during collaborative work (Triana, Anggraito & Ridlo, 2020). In DSLs, students work collaboratively with their peers to solve problems or design a product. They can propose and critique different solutions to solve the problem, and they can create innovative and creative products during the design process. DSLs contribute to the development of students' 4C skills and prepare them for real-life challenges.

DSLs offer a variety of workshops, including music, drama, robotics/software, STEM, and outdoor and indoor sports, which enable students to explore their interests and talents while developing their manual skills and learning to use different tools and devices. Gülhan (2021) found that teachers, students, and parents in schools with DSLs believed that these environments help students get to know themselves. Additionally, Gündoğan and Can (2020) and Akıllı, Yıldız, Ateş, & Ateş (2020) have reported that DSLs support students' manual skills and personality development.

SUGGESTIONS

According to the findings of this research, compared to traditional learning environments such as classrooms or laboratories, DSLs are seen as spaces that prioritize student involvement in teaching activities, provide them with greater learning responsibility, and enable them to acquire diverse skills in the process. As the teaching activities change in these settings, so do the roles of teachers and students, leading to positive outcomes for students. DSLs offer an opportunity for students to develop 21st-century skills, which are considered essential skills for the future. Given the growing recognition of the role of student-centred teaching in fostering 4C skills (Prameswari & Lestariningrum, 2020; Triana, Anggraito & Ridlo, 2020; Weng, Cui, Ng, Jong & Chiu, 2022), the potential of DSLs to enhance these skills is significant. The results highlight the need for further research to investigate the effectiveness of DSLs using experimental designs. Specifically, it is recommended that future studies aim to examine changes in 21st-century skills among students at all levels of education.

Acknowledgements

I would like to thank D. Ergün and S.C. Narin for contributing to the development of the activity, which was designed as part of the " Research Project in Field Education " course in the Chemistry Teacher Education program.

REFERENCES

Akıllı, C., Yıldız, M., Ateş, A. ve Ateş, N. (2020). Tasarım Beceri Atölyelerinin işlevselliği ile ilgili yönetici görüşleri. In Zahal, O. Editor (Eds) *Eğitim Bilimlerinde Teori ve Araştırmalar*, (29-46) Ankara: Gece Kitaplığı.

Aksoy, G., & Saraçoğlu, S. (2021). Tasarım beceri atölyelerine katılan beşinci sınıf öğrencilerinin yaşam becerileri eğitimine yönelik görüşleri, *Uluslararası Sosyal Bilimler Eğitimi Dergisi, 7*(2), 278-326. DOI: 10.47615/issej.988374

Aşkar, Y. (2021). *Tasarim beceri atölyeleri hakkındaki öğretmen görüşleri* . Paper presented at the Uluslararası Eğitim Yönetimi Forumu EYFOR-XII.. Retrieved September 20, 2022, from http://eyuder.org/Download/IcerikDokumanlari/EYFR%2012%20%C3%96ZET.pdf

Başkan, A., & Curaoğlu, F. (2017). Design lab: For future research. *The Design Journal, 20*(sup1), 4751-4753.

Demir, R., Çaka, A., Şimşek, M., Kızıltepe N., & Özkurt, S. (2021). *İlkokul çağı öğrencilerine yönelik uygulanan atölye çalışmalariyla ilgili veli görüşleri*. Paper presented at the Uluslararası Eğitim Yönetimi Forumu EYFOR-XII. Retrieved September 20, 2022, from http://eyuder.org/Download/IcerikDokumanlari/EYFR%2012%20%C3%96ZET.pdf

Demirata, A. & Sadik, O. (2023): Design and skill labs: Identifying teacher competencies and competency-related needs in Turkey's national makerspace project, *Journal of Research on Technology in Education, 55*(2), 163-189. https://doi.org/10.1080/15391523.2021.1938301

Dinçer, M. (2003). Eğitimin toplumsal değişme sürecindeki gücü. *Ege Eğitim Dergisi, 3*(1), 102-112

Ertürk, S.(1972). *Eğitimde program geliştirme*. Ankara: Hacettepe Üniversitesi Basımevi

Güleş, E. & Kılınç, H.H. (2020). Sınıf öğretmenlerinin tasarım beceri atölyelerine ilişkin görüşleri. *Turkish Studies - Education, 15*(6), 4227-4245. Retrieved September 20, 2022 from https://dx.doi.org/10.47423/TurkishStudies.47031

Gülhan, F. (2021). Okul paydaşlarının tasarım beceri atölyelerine yönelik beklentilerine dayalı görüşlerinin değerlendirilmesi. *Uluslararası Beşeri Bilimler ve Eğitim Dergisi*, *7*(15), 235-260.

Gülhan, F. (2022). Ders araştirmasina dayali disiplinler arasi etkinlik plani geliştirme": Tasarim beceri atölyeleri öğretmen eğitimi model önerisi. *Milli Eğitim Dergisi, 51*(234), 1781-1804.

Gündoğan, A. & Can, B. (2020). Sınıf öğretmenlerinin tasarım-beceri atölyeleri hakkındaki görüşleri, *Turkish Studies - Education, 15*(2), 851-876. https://dx.doi.org/10.29228/TurkishStudies.40357

K.Çoban, Ö., Yalçın-Çelik, A. ve Kılıç, Z. (2021). Kimya öğretmenlerinin öğretim stratejileri ve bu stratejilere etki eden faktörler. *Eğitim ve Toplum Araştırmaları Dergisi, 8*(2), 345-361. https://doi.org/10.51725/etad.1030346

Koskinen, I., Zimmerman, J., Binder, T., Redstrom, J., & Wensveen, S. (2011). *Design research through practice: From the lab, field, and showroom*. Elsevier.

Larson, L.C.& Miller, T. N. (2011). 21st Century Skills: Prepare Students for the Future, *Kappa Delta Pi Record, 47*(3), 121-123, DOI: 10.1080/00228958.2011.10516575

Miles, M. B., & Huberman, A. M. (1994). *Qualitative data analysis: An expanded sourcebook*. Sage.

Mishra, P., & Kereluik, K. (2011, March). What 21st century learning? A review and a synthesis. In *Society for Information Technology & Teacher Education International Conference* (pp. 3301-3312). Association for the Advancement of Computing in Education (AACE).

MoNE (2018). *2023 Eğitim Vizyonu*. Retrieved October, 3 2022 from https://www.gmka.gov.tr/dokumanlar/yayinlar/2023_E%C4%9Fitim%20Vizyonu.pdf

MoNE (2021a) *Tasarım Beceri Atölyeleri Öğretmen El Kitabı*. Retrieved October, 3 2022 from http://ogmmateryal.eba.gov.tr/panel/upload/etkilesimli/kitap/tda/index.html#p=2

MoNE (2021b). *Tasarım Beceri Atölyesi- Yöneticiler, Öğretmenler ve Öğrenciler için Rehber*. Retrieved October, 3 2022 from https://www.meb.gov.tr/tasarim-beceri-atolyesi-rehberi-yayimlandi/haber/22993/tr

Orak, S. & Çilek & A. (2020) Tasarım beceri atölyeleri için bütünleşik içerik: Anadolu çocuk oyunları destekli STEM ders tasarımı. *Türkiye Özel Okullar Dergisi, 2020*(54). 39-43.

Parlar, H. (2012). Bilgi toplumu, değişim ve yeni eğitim paradigması. *Yalova Sosyal Bilimler Dergisi, 2*(4), 193-209.

Partnership for 21st Century Skills. (2009). *Framework for 21st century learning*. Retrieved February 1,2023, from https://files.eric.ed.gov/fulltext/ED519462.pdf

Piaget, J. (1976). *Piaget's theory. In Piaget and his school*. Springer, Berlin, Heidelberg.

Prameswari, T. W., & Lestariningrum, A. (2020). STEAM based learning strategies by playing loose parts for the achievement of 4c skills in children 4-5 years. *Jurnal Efektor, 7*(1), 24-34.

Rotherham, A. J., & Willingham, D. T. (2010). 21st-century skills. *American Educator, 17*(1), 17-20. Retrieved Octaber 1, 2022 from https://files.eric.ed.gov/fulltext/EJ889143.pdf

Triana, D., Anggraito, Y. U., & Ridlo, S. (2020). Effectiveness of environmental change learning tools based on STEM-PjBL towards 4C skills of students. *Journal of Innovative Science Education, 9*(2), 181-187.

Ulutaş, B. & Öztürk, Ö. M. (2021). *İzci lideri eğitimcilerin MEB 2023 vizyon belgesinde öngörülen eportfolyo ve tasarım beceri atölyeleri ile ilgili düşünceleri*. Paper presented at the Uluslararası Eğitim Yönetimi Forumu EYFOR-XII . Retrieved October, 3 2022 from http://eyuder.org/Download/IcerikDokumanlari/EYFR%2012%20%C3%96ZET.pdf

Weng, X., Cui, Z., Ng, O. L., Jong, M. S., & Chiu, T. K. (2022). Characterizing Students' 4C Skills Development During Problem-based Digital Making. *Journal of Science Education and Technology, 31*(3), 372-385.

Yıldırım, A., & Simsek, H. (2018). *Sosyal bilimlerde nitel araştırma yöntemleri* (11 baski: 1999-2018). Ankara: Seçgin Yayıncılık.

Yücel-Toy, B., & Uçar Ş. (2022). Matematik öğretiminde tasarim beceri atölyeleri (TBA) etkinliklerinin geliştirilmesi: Bir model önerisi. *Milli Eğitim Dergisi, 51*(234), 1805-1830.