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Makerspace in libraries in the context of project-based learning (PBL): a traditional review

Makerspace u bibliotekama u kontekstu projektne nastave (PBL): tradicionalni pregled

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Sažetak / Abstract

Aim: The study presents the contributions of the makerspace regions of libraries and the Project-Based Learning (PBL) approach and analyses the studies conducted on this topic.
Design: Traditional review methods were applied through descriptive research and document analysis. This study is not a literature review. Firstly, the Web of Science database was searched for keywords on the topic. The Web of Science queries were conducted in January 2025.
Research limitations: As part of the study, the Web of Science database was searched for "project-based learning" and "makerspace".
Results: When searching the Web of Science for "librarianship-makerspace" and "Project-Based Learning (PBL)" as part of this study, no publications on this topic were found, even though the three topics are so close to each other. No results were also obtained when querying the three titles with "and" in the same query. This shows that the library profession has not yet reached a sufficient level of knowledge about research and project-based learning (PBL)
Originality: The study found that there are no publications on PBL in the field of librarianship, especially the studies on Makerspace do not include Project-Based Learning (PBL). This is the original aspect of the study.

Cilj: Studija prikazuje doprinose makerspace područja biblioteka i pristup projektnoj nastavi (PBL) te analizira studije provedene na ovu temu.
Dizajn: Tradicionalne metode istraživanja su primijenjene putem deskriptivnog istraživanja i analize dokumenata. Ova studija nije pregled literature. Na početku, baza Web of Science je pretražena po ključnim riječima ove teme. Web of Science upiti su provedeni u januaru 2025. godine.
Ograničenja istraživanja: Kao dio studije, baza Web of Science je pretražena pojmovima "projektna nastava" i "makerspace".
Rezultati: U toku pretrage baze Web of Science po pojmovima "bibliotečki makerspace" i "projektna nastava (PBL)" kao dijela ove studije, nije pronađena nijedna publikacija s ovom temom, iako su ove tri teme bliske. Rezultati nisu dobijeni ni prilikom pretraživanja tri naslova s "i" u istom upitu. Ovime se pokazuje da bibliotečka profesija još uvijek nije dosegla dostatan nivo znanja o istraživanjima i projektnoj nastavi (PBL).
Originalnost: Studija je otkrila da nema publikacija o projektnoj nastavi (PBL) u polju bibliotekarstva, pogotovo studije o makerspaceu ne uključuju projektnu nastavu (PBL). Ovo je originalni aspekt studije.

1. Introduction

Learning involves the process of absorbing and internalising information by the individual. The educational sciences have changed with technological change and the expectations that accompany it. In particular, the expectations of graduates of educational systems have led to this change. In traditional learning methods, learning takes place between two parties: the teacher and the learner. In modern educational approaches, the focus is on developing skills such as discovering, interpreting and utilising information (Öztürk, 2014: 29).

In recent years, skills such as critical and creative thinking, which have emerged as 21st century skills, have emerged as one of the skills that students should acquire through education. Accordingly, various educational approaches have been developed over time.

One of these approaches is project-based learning (PBL), which enables students to gain real-world experience through active collaboration with others (Uysal, 2016: 90).

2. Project-Based Learning (PBL)

William Heard Klipatrick laid the foundation for project-based learning in 1918 (Korkmaz, 2002: 42).

The basis of the PBL approach is John Dewey's "Reconstruction", Kilpatrick's "Project Method", Brunner's "Discovery Learning Approach" and Thelen's "Group Research Models", and this approach aims for learners to learn the topics in an integrated way (Akçin, 2006: 41).

In Dewey's book *Democracy and Education*, he mentions laboratory schools and their educational plans. Dewey argues that in student-centred education, in the PBL approach, students are part of a learning team and can choose their own topics and progress at their own pace (Korkmaz, 2002: 43). Dewey's approach forms the basis of today's PBL approach, and this student-centred approach has emerged.

The self-learning method allows the information to be better anchored in the minds of the learners. Because the application process in the PBL approach is left to the learner, they learn right from wrong through their own experiences by trying things out, making mistakes and coming to a conclusion. This ensures the permanence of the information.

In the PBL approach, learners aim to produce an original product related to tasks that resemble real life and require high level thinking skills such

1. Uvod

Učenje uključuje proces apsorpcije i internaliziranja informacija od strane pojedinca. Obrazovne nauke su se promijenile s tehnološkim promjenama i očekivanjima koja ih prate. Pogotovo su do ove promjene dovela očekivanja diplomanata obrazovnih sistema. U tradicionalnim metodama učenja, učenje se odvija između dvije strane: učitelja i učenika. U modernom obrazovnom pristupu, fokus je na razvijanju vještina kao što su otkrivanje, tumačenje i korištenje informacija (Öztürk, 2014: 29).

Posljednjih godina, vještine poput kritičkog i kreativnog mišljenja, koje su se pojavile kao vještine 21. stoljeća, pojavile su se kao vještine koje bi učenici trebali steći kroz školovanje. Samim tim, vremenom su se razvili različiti obrazovni pristupi.

Jedan od ovih pristupa je projektna nastava (PBL), koja omogućava učenicima da dobiju stvarno iskustvo putem aktivne saradnje s drugima (Uysal, 2016: 90).

2. Projektna nastava (PBL)

William Heard Klipatrick utemeljio je projektnu nastavu 1918. godine (Korkmaz, 2002: 42).

Osnovu pristupa projektne nastave čine "Rekonstrukcija" Johna Deweyja, "Projektna metoda" Kilpatricka, "Pristup 'učenje otkrivanjem'" Brunnera i Thelenov "Model grupnog istraživanja" i ovaj pristup ima za cilj integrisano učenje (Akçin, 2006: 41).

U knjizi *Demokratija i obrazovanje* Dewey spominje laboratorijske škole i njihove obrazovne planove. On argumentira da su u obrazovanju usmjerenom na učenike, u PBL pristupu, oni dio tima za učenje i mogu sami izabrati temu i napredovati sopstvenim tempom (Korkmaz, 2002: 43). Deweyjev pristup čini osnovu današnjeg PBL pristupa, te je nastao pristup usmjeren na učenike.

Metoda samostalnog učenja omogućava učenicima da bolje zapamte informacije. Budući da je proces primjene u PBL pristupu na učenicima, oni uče šta je tačno a šta pogrešno kroz vlastito iskustvo, isprobavajući, praveći greške i dolazeći do zaključaka. Ovo osigurava trajnost pamćenja informacija.

U PBL pristupu, učenici imaju za cilj da proizvedu originalni proizvod povezan sa zadacima koji liče na one u stvarnom životu i iziskuju visok nivo vještine razmišljanja kao što je istraživanje, rješavanje problema i korištenje onog što je naučeno (Özmen et al., 2013). U PBL pristupu, pojedinci pokušavaju pronaći rješenja za probleme na koje nailaze te traže alternativne načine koji ih ohrabruju da razmišljanju i razvijaju kreativnost.

as research, problem solving and application of what has been learnt (Özmen et al., 2013). In the PBL approach, individuals try to find solutions to problems they encounter and look for alternative ways, which encourages them to think and develops their creative thinking skills.

The teacher takes on a role where they step out of the position of teacher and become a guide, guiding learners in the research process. The PBL process, which is carried out in a planned way at certain stages, can only be successful if it is implemented in this way.

Shearer and Quinn (1996) state that a creative environment can be created in the classroom through projects and students:

a. Develop a sense of self-confidence,
b. Establish a relationship between the real world and science and maths concepts,
c. Understand the importance of learning mathematics and science,
d. See interdisciplinary connections and recognise that knowledge is not a phenomenon that belongs to only one discipline, and thus create interdisciplinary transitions,
e. Develop their scientific and mathematical problem-solving skills,
f. They can work in individual and co-operative learning environments (in Saracaloğlu et al., 2006: 244, originally from Shearer & Quinn 1996).

Learners can observe that different disciplines work together during the project development process. Especially in the classroom, the best answer to students' frequent complaints "What good is this information to me?" will be to see specifically where the information adapted to real life is needed for the project. In this context, all processes will have a concrete meaning in the minds of the students.

The learners have specific roles. The diagram created by Yurtluk (2003), originally from shows the roles of learners (in: Vatansever Bayraktar, 2015, originally from Yurtluk, 2003). Looking at Figure 1, the learner not only internalises a topic but also gains the ability to establish relationships with different courses, problem-solving skills, collaboration skills and research skills. In addition, the learner will understand that they must take responsibility and try to achieve an outcome or success. This phenomenon will enhance their educational experience and their overall life.

Učitelj preuzima ulogu gdje izlazi iz pozicije učitelja i postaje vođa vodeći učenike u istraživačkom procesu. PBL proces koji se izvodi po planu u određenim fazama, može biti uspješan ako se tako implementira.

Shearer i Quinn (1996) navode da se kreativno okruženje u učionici može stvoriti kroz projekte pa učenici:

a. razvijaju osjećaj samopouzdanja,
b. uspostavljaju vezu između stvarnog svijeta i koncepata iz nauke i matematike,
c. razumiju važnost učenja matematike i nauke,
d. vide interdisciplinarne veze i prepoznaju da znanje nije fenomen koji pripada samo jednoj disciplini te stvaraju interdisciplinarne prelaze,
e. razvijaju naučne i matematičke vještine rješavanja problema,
f. mogu raditi u individualnim i kooperativnim okruženjima za učenje (Saracaloğlu et al., 2006: 244, prema: Shearer & Quinn, 1996).

Učenici mogu primijetiti da istovremeno koriste različite discipline za vrijeme procesa razvijanja projekta. Posebno u učionici, najbolji odgovor na česte pritužbe učenika "Koja je korist od ovih informacija?" bude to što vide gdje su tačno informacije prilagođene stvarnom životu potrebne u projektu. U ovom kontekstu, od učenika procesi dobivaju konkretno značenje..

Učenici imaju specifične uloge. Dijagram koji je kreirao Yurtluk (2003) pokazuje uloge učenika (u: Vatansever Bayraktar, 2015, prema: Yurtluk, 2003). Gledajući Sliku 1, učenik ne samo da usvaja temu već dobija i mogućnost da je poveže s drugim predavanjima, razvija vještine rješavanja problema, vještine saradnje i vještine istraživanja. Dodatno, učenik će razumjeti da mora preuzeti odgovornost i pokušati ostvariti ishod ili uspjeh. Ovaj fenomen će poboljšati njegovo obrazovno iskustvo, ali i cjelokupan život.

Rezultat studije koju su vodili Yılmaz i Gültekin (2007) pokazuje učinak PBL-a na procese učenja. Studija je zaključila da PBL povećava akademski uspjeh, čini učenje zabavnim i pruža studentima različite vještine.

Kao rezultat, osobe koje uče po PBL pristupu, završili su svoje procese učenja razvojem različitih vještina. Ove vještine su im obogatile život, unaprijedile ga i povećale trajnost naučenog pomoću praktičnog učenja.

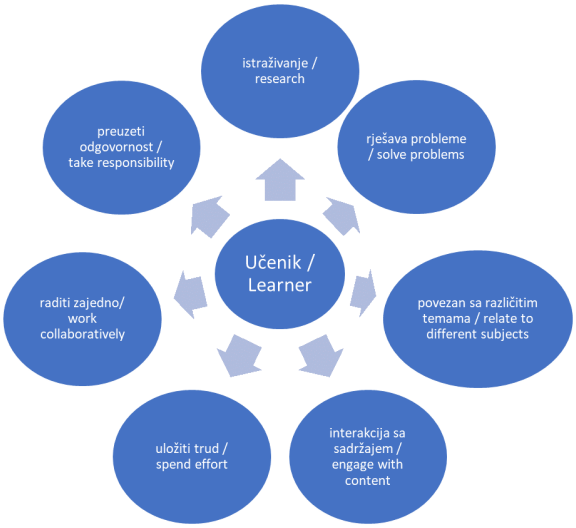

Figure 1. (Source: Vatansever Bayraktar, 2015, originally from Yurtluk, 2003)
Slika 1. (Izvor: Vatansever Bayraktar, 2015, prema: Yurtluk, 2003)

The results of the study conducted by Yılmaz and Gültekin (2007) show the effect of PBL on learning processes. The study concluded that it increases academic success, makes learning fun and provides students with various skills.

As a result, people who learn with the PBL approach complete their learning processes by developing versatile skills. These skills add value to their lives, improve them and increase the permanence of what they have learnt due to the hands-on learning.

Although the PBL approach involves a student-centred approach, the teacher is able to manage and guide this process. In this context, there are some planning elements in the project preparation process:

- Program
- Division of Labor
- Budget
- Research Plan
- Materials
- Publication List (Korkmaz, 2002: 53)

The project development process is carried out under the guidance of the teacher within the framework of these defined planning elements. When looking at the planning elements, it becomes clear that a research plan should be created and a list of months should be drawn up at the end. In order to realise this, the people carrying out the project must be familiar with the research process and methods. In addition, the existence of information sources and the situation inherent to the research process are mentioned here. In this case, the existence of a library in the place where PBL is applied should be taken into account.

Iako PBL pristup uključuje pristup usmjeren na studente, učitelj može da upravlja ovim procesom i vodi ga. U tom kontekstu, neki od elemenata planiranja u pripremi procesa projekta su:

- Program
- Podjela rada
- Budžet
- Plan istraživanja
- Materijali
- Lista publikacija (Korkmaz, 2002: 53)

Proces razvoja projekta nadgleda učitelj u okviru definisanih elemenata planiranja. Gledajući elemente planiranja, postaje jasno da se treba napraviti plan istraživanja s detaljnim planom provedbe po mjesecima na kraju. Kako bi se ovo realizovalo, osobe koje vode projekt moraju biti upoznate s procesima i metodama istraživanja. Nadalje, spominju se postojanje izvora informacija i situacije svojstvene istraživačkim procesima. U ovom slučaju, treba uzeti u obzir postojanje biblioteke u mjestu gdje se primjenjuje PBL.

3. Projektna nastava, biblioteka i makerspace

PBL pristup prirodno obuhvata i istraživački proces. Biblioteka je po svojoj prirodi predodređena za provođenje aktivnosti koje omogućuju pojedincima da pristupe informacijama koje im trebaju i koriste ih (Çakın, 1991: 155). U ovom kontekstu, prostor biblioteke je nezaobilazan dio istraživačkog procesa u kojem se nalaze odgovarajuće informacije. Pogotovo u nauci i tehnologiji, biblioteke imaju funkciju povezivanja, te je za naučni i tehnološki razvoj potreban prostor biblioteke. Iz tog razloga,

3. Project-Based Learning, Library and Makerspace

The PBL approach naturally also encompasses the research process. Looking at the term library conceptually, it aims to carry out activities that enable individuals to access and utilise the information they need (Çakın, 1991: 155). In this context, the library facility is an indispensable part of the research process in which the right information can be found. Especially in science and technology, libraries have a bridging function, and scientific and technological developments require library facilities. For this reason, the issue of libraries should be included in policy documents (Yılmaz & Dalkıran, 2012: 62). In the context of PBL, it can be said that the research process should be carried out as a process that includes the library institution.

In the diagram prepared by Erdem (2002) as an example, the tasks to be completed and the days to be completed are classified, the use of the library is suggested here, and suggestions are even made for the use of library resources and support from librarians.

Looking at the educational processes in primary and secondary education, it is known that the school libraries in our country are not functional. In a study conducted by Börekçi and Uyangör (2018), most of the students mentioned the importance of libraries in their research. In the recommendations section of the study, it was stated that the areas where students can work independently (library, physics/chemistry/biology/information technology lab, etc.) should be

pitanje biblioteka treba uključiti u zvanične dokumente (Yılmaz & Dalkıran, 2012: 62). U kontekstu PBL-a, može se reći da se istraživački procesi trebaju izvoditi kao procesi koji uključuju bibliotečke institucije.

U dijagramu koji je kao primjer priredio Erdem (2002), u kojem su klasificirani zadaci koje treba uraditi raspoređeni po danima, predložena je i upotreba biblioteke, razrađena na upotrebu izvora biblioteke i podršku bibliotekara.

Posmatrajući obrazovne procese u osnovnom i srednjem obrazovanju, poznato je da školske biblioteke u našoj zemlji nisu funkcionalne. U studiji koju su proveli Börekçi and Uyangör (2018), većina studenata smatra da su biblioteke važne za istraživanja. U preporukama studije navedeno je da je potrebno razviti mjesta gdje studenti mogu raditi samostalno (biblioteka, laboratorije fizike/hemije/biologije/informacijskih tehnologija itd.). Studentima za istraživanje treba podrška u vidu korištenja biblioteka, tableta s pristupom internetu, računara ili mobilnih telefona (Börekçi & Uyangör, 2018: 396). Ako se studentima obezbijedi okruženje za istraživačke procese (radionice gdje mogu provoditi projekte u smislu i biblioteke i kursa), oni bi mogli izraziti svoju kreativnost. Takvo okruženje omogućava im da misle šire i detaljnije o projektima koje će provoditi. Ovo je moment u kojem se pojavljuje pitanje makerspacea, jednog od najvažnijih centara kreativnih vještina.

Temeljna logika makerspacea zasniva se na stvaranju kreativnih projekata. Makerspacei su mjesta gdje učesnici mogu sarađivati u stvaranju infor-

Table 1. Sample Plan (Source: Erdem, 2002: 177)

To-do list	Days	1	2	3	4	5	6	7	8	9	10
Determining sub-questions, information sources, information collection tools		X									
Development of information collection tools and division of labor regarding the information collection process			X	X							
Library and internet searching					X	X	X				
Interview with experts					X	X	X				
Check the reliability of the information collected and arrange it to answer the specified sub-questions							X	X			
Discussing the need for different forms of information, such as graphical tables and preparing the necessary ones								X	X		
Selection of visual material such as pictures and photographs								X	X		
Creating the report according to the criteria specified in the plan										X	
For presentation, a meaningful summary of the report is made											X

Tabela 1. Primjer plana (Izvor: Erdem, 2002: 177)

Popis zadataka	Dani	1	2	3	4	5	6	7	8	9	10
određivanje potpitanja, izvora informacija, alata za prikupljanje informacija		X									
razvoj alata za prikupljanje informacija i podjela rada u vezi s procesom prikupljanja informacija			X	X							
pretraživanje biblioteke i interneta					X	X	X				
intervju sa stručnjacima					X	X	X				
provjera pouzdanosti prikupljenih informacija i njihovo uređivanje tako da odgovaraju na navedena potpitanja							X	X			
rasprava o potrebi za različitim oblicima informacija, kao što su grafičke tabele i njihova priprema								X	X		
izbor vizualnog materijala kao što su slike i fotografije								X	X		
pisanje izvještaja po kriterijima navedenim u planu										X	
relevantan sažetak izvještaja za prezentaciju											X

developed. Students should be supported in their research by using libraries, tablets with internet access, computers or mobile phones (Börekçi & Uyangör, 2018: 396). If students are provided with an environment for research processes (workshops where they can carry out projects both in the library and in the course context), they can bring their creativity to the fore. Providing such an environment will allow them to think more broadly and in more detail about the projects they will undertake. It is at this point that the issue of makerspaces emerges, one of the most important centres for creative skills.

The fundamental logic of makerspaces is based on the production of creative projects. Makerspaces are places where participants can collaborate to produce information, physical or digital products (Mersand, 2021: 175). Although these spaces contain digital equipment, they also contain traditional means of production. The basis of makerspaces is the idea that they are democratic spaces as they are easily accessible and the equipment is shared (Halverson & Sheridan, 2014: 497). The basic philosophy of sharing information and resources, as well as equal access for all, makes makerspaces democratic institutions. However, while research labs that house advanced technologies only serve a specific segment, makerspaces offer services to all equally, rather than serving one community or segment (Taylor, 2016: 4). In addition, makerspaces provide individuals with access to a wide range of production equipment to carry out various projects (Demir, 2019: 31). The equipment to support various projects provides the opportunity to explore a wide range of topics. Viewed in the context of education, macija, fizičkih ili digitalnih proizvoda (Mersand, 2021: 175). Iako ovi prostori imaju digitalnu opremu, mogu posjedovati i tradicionalna sredstva. Osnova makerspaceova je da su demokratski prostori jer su lako dostupni i oprema je zajednička (Halverson & Sheridan, 2014: 497). Osnovna filozofija razmjene informacija i izvora, kao i jednak pristup za sve, čini makerspaceove demokratskim institucijama. Dok istraživačke laboratorije koje imaju naprednu tehnologiju služe samo pojedinim segmentima, makerspaceovi pružaju uslugu svima jednako, ne uslužujući samo jednu zajednicu ili segment (Taylor, 2016: 4). Nadalje, makerspaceovi pružaju pojedincima pristup velikom polju proizvodne opreme kako bi se izveli različiti projekti (Demir, 2019: 31). Oprema za podršku različitim projektima pruža mogućnost da se istražuje veliki broj predmeta. Gledano u kontekstu obrazovanja, oni predstavljaju izvore za razvoj R&D projekata u mnogim različitim poljima i predmetima.

Prema Schrocku (2014), makerspace okruženja su pristup učenju koje je zasnovano na učenju putem rada i iskustva i čini ga kombinacija stvaranja, kreiranja, ditajniranja i kulture inovacije, uključujući saradničko učenje, projektnu nastavu ili individualne radne aktivnosti. Prema ovome viđenju, makerspace okruženja su prostori potrebni za učenje putem projektne nastave. Ovi su prostori ključni za učenje jer podržavaju istraživanja i zahtjeve pojedinaca.

U okviru razumijevanja šta sve podrazumijeva usluga makerspacea, bibliotekari neprestano traže pogodnosti za studente da misle, kreiraju, dijele i učestvuju u razvoju; partnerstvo između nastavni-

this provides resources for the development of R&D projects in many different fields and topics.

According to Schrock (2014), makerspace environments are an approach to learning that is based on learning by doing and experiencing and consists of a combination of making, creation, design and innovation culture, including collaborative learning, project-based learning or individual work activities. In this view, makerspace environments are necessary spaces for project-based learning. These spaces are essential for learning individuals to support their research and applications.

Within the understanding what makerspace service entails, librarians are constantly looking for opportunities for students to think, create, share, and participate in growth; the partnership between educators and librarians is essential to fostering these skills. The makerspace is an ideal place to incorporate more STEM activities in a fun and inspiring environment (Julian & Parrott, 2017: 14). The use of makerspaces by school children is essential for their physical and cognitive development.

According to Brumfield (2017), the presence of makerspaces in libraries results from the promotion of creative thinking and the need for research for do-it-yourself solutions. As a result of the need for information resources in spaces defined as makerspaces, these spaces have begun to be established in libraries. Since libraries, by their very purpose, are democratic institutions to which everyone has equal access, makerspace areas have also been set up in libraries.

Although it is known that school libraries are not functional in our country, students can only use the library with their efforts. The responsibility here falls on public libraries. In addition, the workshops established under the title of innovative services in public libraries are expected to contribute to the student's research and application processes. At this point, the instructor must guide the students, direct them to the libraries, and provide information about the workshops.

In school laboratories, scientific studies can be carried out under the supervision of teachers. Pupils cannot carry out individual research by trial and error, which can be seen as a disadvantage in terms of applied education. However, the fact that school libraries do not provide effective and efficient services limits students' research opportunities. The widespread use of workshops (makerspaces) in public libraries makes it possible to access and apply information sources and research results in

ka i bibliotekara ključno je za podsticanje ovih vještina. Makerspace je idealno mjesto da se uključi više STEM aktivnosti u zabavnom i inspirativnom okruženju (Julian & Parrott, 2017: 14). Za učenike je korištenje makerspacea ključno za njihov fizički i kognitivni razvoj.

Prema Brumfieldu (2017), prisutnost makerspaceova u bibliotekama rezultira promocijom kreativnog razmišljanja i potrebom za samostalnim istraživanjem. Kao rezultat potrebe za izvorima informacija u prostorima definisanim kao makerspaceovi, ovi prostori su se počeli uspostavljati u bibliotekama. Kako su biblioteke, po svojoj svrsi, demokratske ustanove kojima svi imaju jednak pristup, makerspaceovi su postavljeni i u njima.

Iako je poznato da školske biblioteke nisu funkcionalne u našoj zemlji, studenti mogu koristiti biblioteku samo samostalno. Odgovornost ovdje pada na javne biblioteke. Osim toga, od radionica koje su uspostavljene pod imenom inovativnih usluga u javnim bibliotekama očekuje se da doprinesu studentskim istraživanjima i procesima prijave. U ovom trenutku, instruktor mora voditi studente, uputiti ih u biblioteke i dati im informacije o radionicama.

U školskim laboratorijama, naučne studije se mogu izvoditi pod supervizijom učitelja. Učenici ne mogu izvoditi individualna istraživanja s ispitivanjima i greškama, što se može vidjeti kao nedostatak u smislu primijenjenog obrazovanja. Međutim, činjenica da školske biblioteke ne daju efektivne i učinkovite usluge ograničava istraživačke mogućnosti studenata. Široko rasprostranjena upotreba radionica (makerspaceova) u javnim bibliotekama omogućava pristup i upotrebu informacijskih izvora i rezultata istraživanja u jedinstvenom okruženju. Projektna nastava se spominje u Ministarstvu nacionalnog obrazovanja (Odluka o srednjim školama i Odluka o predškolskim i osnovnim školama Ministarstva nacionalnog obrazovanja), koje objašnjava i vodi obrazovnu politiku naše zemlje. Jedan od ciljeva srednjoškolskog obrazovanja je stvoriti osobe koji imaju kreativne i kritičke vještine mišljenja i koji mogu sarađivati. Međutim, ove vještine nije moguće dobiti s klasičnim obrazovanjem i pristupom te je potreba za drugim okruženjima za učenje naglašena u studiji Demira and Yılmaza (2018). Iz tog razloga, biblioteke i makerspaceovi se čine ključnim za projektni rad i inovativni pristup obrazovanju.

a single environment. Project-based education is mentioned in the Ministry of National Education (Decree on Secondary Schools and Decree on Preschool and Primary Schools of the Ministry of National Education), which explains and guides the education policy of our country. One of the goals of secondary education is to educate people who have creative and critical thinking skills and can co-operate. However, it is not possible to acquire these skills with the classical education approach and the need for other learning environments is emphasised in the study by Demir and Yılmaz (2018). For this reason, libraries and makerspaces seem to be essential for project work and the innovative education approach.

4. Method

In this study, studies related to the research topic were analysed and evaluated using the traditional review method, one of the qualitative research methods. As part of the survey, queries were carried out in the Web of Science database and studies on the research topic were analysed. The queries in the Web of Science were conducted in January 2025. It includes studies conducted before this date. In addition, the content of the publications obtained as a result of the queries was analysed and the scope of the topic covered in the publications produced was determined.

5. Findings

As part of the study, the table shown in Figure 2 was obtained as a result of the query "project-based learning approach" in the Web of Science. As it was found that the number of publications on these two topics has increased over the last 15 years: the data from 2011 onwards is shown in Figure 1. In studies conducted mainly in the field of educational

4. Metoda

U ovoj studiji, analizirane su studije povezane s temom istraživanja, koje su ocijenjene tradicionalnom metodom pregleda, jednom od kvalitativnih istraživačkih metoda. Kao dio ispitivanja, izvršeno je pretraživanje baze Web of Science te analizirane studije na datu istraživačku temu. Pretraživanje baze Web of Science provedeno je u januaru 2025. godine. Ono uključuje studije provedene prije ovog datuma. Nadalje, analiziran je sadržaj publikacija dobijenih kao rezultat upita i određen opseg tema obuhvaćenih u objavljenim publikacijama.

5. Nalazi

Kao dio studije, skala prikazana na Slici 2 dobijena je kao rezultat upita "pristup projektne nastave" u bazi Web of Science. Ispostavilo se da se broj publikacija na ove dvije teme povećao u posljednjih 15 godina: podaci od 2011. godine pa nadalje prikazani su na Slici 1. U studiji provedenoj većinom u polju obrazovne nauke, pronađeno je da je tema postala popularna posljednjih godina u kontekstu inovativnih obrazovnih pristupa.

U okviru studije, prvo je napravljen upit u bazi podataka Web of Science za "učenje u projektnoj nastavi" i "makerspace". Kao rezultat upita, dobijeno je 18 publikacija. Nazivi publikacija su sljedeći:

Osamnaest članaka proizišlih iz ispitivanja organizirani po tematskim područjima prikazani su u tabeli ispod. Dok ukupno 12 publikacija dolazi iz obrazovnih nauka i vezanih polja, dvije publikacije su iz polja bibliotekarstva i informacionih nauka. Nadalje, 10 publikacija je objavljeno nakon 2020. Tri publikacije nakon 2020. objavljene su u 2021, dvije u 2022, dvije u 2023. i tri u 2024.

Članci pronađeni u pretrazi ocijenjeni su na osnovu naslova i sažetaka te su izdvojeni članci koji sadrže oba termina (učenje projektne nastave i makerspa-

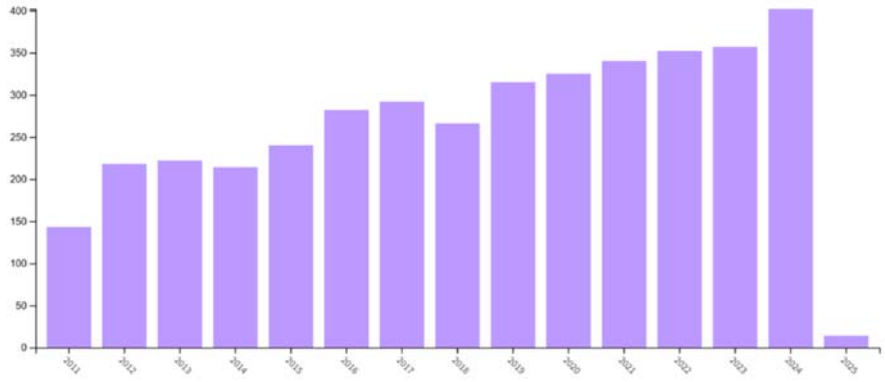

Figure 2. Project-based learning apprach Web of Science query
Slika 2. Pristup projektne nastave – upit za Web of Science

	Article Title	Authors	Publication Year
1	Integrating And Assessing The Use Of A Makerspace İn A Russian Cultural Studies Course: Utilizing Immersive Virtual Reality And 3D Printing For Project-Based Learning	Enkin, E; Tytarenko, O; Kirschling, E	2021
2	Makerıet: A Norwegıan Unıversity Makerspace	Güler, E; Mirtaheri, P; Andersson, Ap; Gjovaag, T	2017
3	Situating Makerspace Curricula For Students With Learning Differences Within Vygotsky's Cultural Historical Psychology	Tilak, S; Viar, R; Turner, B; Kennedy, K	2024
4	Exploring Modalities Of Reflection Using Social Online Portfolios For Maker-Oriented Project-Based Learning	Chan, MM; Holbert, N	2019
5	Makerspaces İn First-Year Engineering Education	Taheri, P; Robbins, P; Maalej, S	2020
6	Implication Of Makerspace Layout Design İn Rural Primary Schools Of Lianyungang, Jiangsu Province, China	Jiang, BY; Nordin, J; Salleh, MNM	2024
7	The Pedagogical Makerspace: Learning Opportunity And Challenge For Prospective Teachers' Growth Of TPACK	Max, AL; Lukas, S; Weitzel, H	2024
8	What Difference Does An Academic Makerspace Make? A Case Study On The Effect And Outreach Of DTU Skylab	Özkil, AG; Jensen, LS; Hansen, CA	2020
9	Effect Of Personality Traits İn Team Dynamics And Project Outcomes İn Engineering Design	Boudreau, J; Anis, H	2020
10	Integrating Makerspaces İnto The Curriculum - Faculty Development Efforts	Carnasciali, MI; Gillespie, SM; Hossain, AM	2021
11	Digital Learning Support For Makers: Integrating Technical Development And Educational Design	Kaar, C; Stary, C	2021
12	Families' Engagement İn Making Activities Related To Aerospace Engineering: Designing For Parents As Learning Partners İn Pop-Up Makerspaces	Zimmerman, HT; Grills, KE; Mckinley, Z; Kim, SH	2022
13	Sustainability Considerations İn Digital Fabrication Design Education	Georgiev, GV; Nanjappan, V	2023
14	Desıgn, Dıgital Fabrıcatıon & 3d Prıntıng: A Crash Course For Desıgn Students	Dastoli, C; Bolzan, P; Bianchini, M; Del Curto, B; Maffei, S	2018
15	Toward Capturing Divergent Collaboration İn Makerspaces Using Motion Sensors	Chng, E; Seyam, MR; Yao, W; Schneider, B	2022
16	Full Steam Ahead: Hands-On Elementary Educatıon And Persıstence Durıng Covıd-19	Das, M	2020
17	An Interdisciplinary Capstone Course On Creative Product Development With Cross-College Collaboration	Kim, SW	2020
18	Learning Experience Design With Maker Education	Araña-Suárez, RE; Hernández-Castellano, PM; Morales-Santana, MA; Hernández-Pérez, M	2023

Figure 3. Articles
Slika 3. Članci

science, it was found that the topic has become popular in recent years in the context of innovative educational approaches.

Within the scope of the study, a query was first made in the Web of Science database for "project-based learning" and "makerspace". As a result of the query, 18 publications were obtained. The publication names are as follows:

The 18 articles that resulted from the survey are listed in the table below, organised by subject area. While a total of 12 publications come from the educational sciences and related fields, two publications are from the field of library and information science. In addition, 10 of the publications were published after 2020. Three publications after 2020 were published in 2021, two in 2022, two in 2023 and three in 2024.

The articles found in the search were evaluated based on their titles and summaries, and articles containing both terms (project-based learning and makerspace) were identified. In reviewing the articles that were directly related to the topic, it was found that they discussed the use of makerspaces in PBL approaches. Whilst most studies focus on the technology, there are also studies that recommend

ce). U pregledu članaka koji su direktno vezani za temu, pronađeno je da govore o upotrebi makerspacea u PBL pristupu. Dok se većina studija fokusira na tehnologiju, ima i onih koje preporučuju upotrebu ovih prostora za pojedince s poteškoćama pri učenju. Treba napomenuti da je većina studija provedena u sektoru obrazovanja.

Pretraga je dala dva rezultata kada je opseg pretrage bio limitiran na "bibliotekarstvo":

1. Families' engagement in making activities related to aerospace engineering: designing for parents as learning partners in pop-up makerspaces (Uključivanje porodica u kreiranje aktivnosti vezanih za vazduhoplovno inženjerstvo: dizajniranje za roditelje kao partnere u učenju u pop-up makerspaceovima)
2. Toward capturing divergent collaboration in makerspaces using motion sensors (Prema hvatanju divergentne saradnje u makerspaceovima korištenjem senzora pokreta)

Prilikom ispitivanja dvije studije provedene u oblasti bibliotekarstva, utvrđeno je da je njihov sadržaj bio sljedeći:

Field: Web of Science Categories	Record Count	% of 18
Education Educational Research	6	33.333%
Education Scientific Disciplines	6	33.333%
Engineering Multidisciplinary	3	16.667%
Computer Science Information Systems	2	11.111%
Computer Science Interdisciplinary Applications	2	11.111%
Computer Science Software Engineering	2	11.111%
Engineering Manufacturing	2	11.111%
Information Science Library Science	2	11.111%
Computer Science Artificial Intelligence	1	5.556%
Computer Science Cybernetics	1	5.556%

Figure 4. Category of the articles, according to Web of Science

Slika 4. Kategorije članaka prema Web of Science

the use of these spaces for individuals with specific learning difficulties. It should be noted that most of the studies were conducted in the education sector.

The search yielded two results when the scope of the study was limited to "librarianship":

1. Families' engagement in making activities related to aerospace engineering: designing for parents as learning partners in pop-up makerspaces
2. Toward capturing divergent collaboration in makerspaces using motion sensors

When examining two studies carried out in the field of librarianship, it was found that their contents were as follows:

1. The study entitled "Families' engagement in making activities related to aerospace engineering: designing for parents as learning partners in pop-up makerspaces" aimed to investigate the involvement of families in activities in six temporary makerspaces set up in libraries and one museum. As part of the pedagogy of project-based learning, a study was conducted to develop discussion questions and support family participation in engineering design applications in temporary makerspaces outside of school. The study focused on giving families in rural areas the opportunity to try out makerspaces they were not previously familiar with, with an emphasis on equity and accessibility. The study concluded that parents play an important role as learning partners and it was found that this approach is a practical solution for museums and libraries without makerspaces.
1. Studija s naslovom "Families' engagement in making activities related to aerospace engineering: designing for parents as learning partners in pop-up makerspaces" imala je za cilj da istraži uključenost porodica u šest privremeno napravljenih makerspaceova u bibliotekama i jednim u muzeju. Kao dio pedagogije projektne nastave, studija je provedena da razvije raspravu i podrži porodice koje učestvuju u aplikacijama za inženjerski dizajn u privremenim makerspaceovima izvan škola. Studija se fokusirala na davanje prilike porodicama u ruralnim područjima da isprobaju makerspaceove s kojima nisu prije bili upoznati, s naglaskom na jednakost i pristupačnost. U studiji je zaključeno da roditelji igraju važnu ulogu kao partneri u učenju i pronađeno je da je ovaj pristup praktično rješenje za muzeje i biblioteke bez makerspaceova.
2. Cilj studije "Toward capturing divergent collaboration in makerspaces using motion sensors" jest otkrivanje različitih tipova saradnje u makerspace okruženjima analiziranjem društvenih mreža i istraživanje učinka društvenih veza u ovim okruženjima na razvoj projekta. Studija raspravlja o tome kako to istraživanje služi kao prvi korak prema mjerenju i podrški produktivnoj interakciji u okruženjima projektne nastave. Rezultati studije sugerišu da su studenti koji su imali interakciju s drugim studentima na različitim nivoima makerspace vještina na različite načine, bili bolji.

Eksperimentalne studije provedene u oba članka naglašavaju doprinos makerspace prostora u biblioteci

2. "Toward capturing divergent collaboration in makerspaces using motion sensors" The aim of the study is to uncover different types of collaboration in makerspace environments by analysing social networks and to investigate the impact of social relationships in these environments on project development. The study discusses how this research serves as a first step towards measuring and supporting productive interactions in project-based learning environments. The results of the study suggest that students who interacted with other students at different levels of makerspace skills in different ways performed better.

The experimental studies conducted in both articles emphasise the contribution of makerspace areas in libraries to children's project development and creativity. The fact that makerspaces offer services within the framework of social institutions that serve the principle of equal access, such as libraries and museums, is an important point emphasised in the studies.

6. Results and discussion

The 18 articles analysed in the study include makerspace and project-based learning (PBL) topics. It was found that studies were conducted on makerspace examples that mainly included digital tools in the content of the studies. It was found that studies were conducted on topics such as VR technology, 3D printing techniques, digital production and prototyping. In addition, makerspaces, which are considered an application area for project-based and experiential learning approaches, were also presented as a place for prototyping.

The PBL approach of courses offering digital fabrication and 3D printing were evaluated within the studies in terms of how they motivate students, the potential of the approach for integrated learning and how the STEAM curriculum is delivered in makerspace environments and the impact of these spaces on the learning approach. The studies showed that maker activities have a positive impact on project work and motivate students for project-based learning in this context and that students are satisfied.

When the Web of Science searches conducted as part of this study were examined in the context of Librarianship-Makerspace and PBL, there were no publications on this topic, even though the three topics are so closely related. Querying the three titles with "and" in the same query also produced no results. This shows that librarianship has not yet

na razvoj projekata i kreativnosti kod djece. Činjenica da makerspaceovi nude usluge u okviru društvenih institucija koje se zalažu za princip jednakog pristupa za sve, kao što su biblioteke i muzeji, važna su poenta naglašena u studiji.

6. Rezultati i diskusija

Osamnaest analiziranih članaka u studiji uključuju teme makerspacea i projektne nastave (PBL). Utvrđeno je da su studije provedene na primjerima makerspacea većinom uključivale digitalne alate. Utvrđeno je da su provedene studije o temama kao što je VR tehnologija, 3D tehnike štampanja, digitalna produkcija i izrada prototipa. Nadalje, makerspaceovi, koji se smatraju područjima primjene za pristupe učenju zasnovane na projektima i iskustvu, predstavljeni su i kao mjesto za izradu prototipa.

PBL pristup seminarima koji nudi digitalnu proizvodnju i 3D štampanje ocijenjen je u studijama u smislu načina kako motivišu studente, potencijalnog pristupa integrativnom učenju i kako se STEAM kurikulum održava u makerspace okruženjima, kao i učinak ovih prostora na pristup učenju. Studije pokazuju da aktivnosti u njima imaju pozitivan utjecaj na projektni rad i motivišu studente za projektnu nastavu u tom kontekstu te su studenti zadovoljni.

Kada su se provodila pretraživanja baze Web of Science, kao dio studije, u kontekstu bibliotečkog makerspace-a i PBL-a, nije bilo izdanja na ovu temu, iako su ove tri teme blisko povezane. Pretrage tri naslova s "i" u samom upitu također nisu dale rezultata. Ovo pokazuje da bibliotekarstvo još uvijek nije doseglo zadovoljavajući nivo spoznaje u vezi s istraživanjem i PBL-a. Spoznaja da bibliotekarstvo i PBL teme formiraju cjelinu, ne samo u polju bibliotekarstva već i u polju obrazovne nauke, trebalo bi osigurati razvoj škola u ovom pogledu i učiniti postojanje biblioteka u konceptu istraživanja očiglednim.

Studije se uglavnom bave utjecajem makerspace okruženja na PBL pristup. Navodi se da osobama koje uče na PBL pristupu (i u osnovnom kao i u visokom obrazovanju) treba radionica. U ovom trenutku, studije su pokazale da su laboratorije u školama neadekvatne (Demir et al., 2011). Radionice u školama su nedovoljne za studentska istraživanja i primjenu i potrebna su razumljivija predavanja. Osnivanje makerspaceova u školskim bibliotekama ili korištenje makerspaceova u javnim bibliotekama, kojima svi imaju jednak pristup, učinit će PBL procese efektivnijim i učinkovitijim. Školske biblioteke nisu aktivne u mnogim školama u našoj zemlji. U školama koje imaju školske biblioteke, one

achieved a sufficient level of awareness in relation to research and PBL. The awareness that librarianship and PBL topics form a unit, not only in the field of librarianship but also in the field of educational science, should ensure the development of schools in this respect and make the existence of libraries within the research concept self-evident.

The studies generally address the impact of makerspace environments on the PBL approach. It is stated that people learning for the PBL approach (regardless of primary or higher education) need a workshop. At this point, studies have determined that the laboratory environments in schools in our country are inadequate (Demir et al., 2011). The workshops in schools are insufficient for research and application by students and more comprehensive seminars are needed. The establishment of makerspaces in school libraries or the use of makerspaces in public libraries, to which everyone has equal access, will make the PBL process more effective and efficient. School libraries are not active in many schools in our country. In schools that have school libraries, they are not sufficient to meet the needs. For this reason, public libraries are responsible for this. Schools and teachers can co-operate with libraries, assign project tasks in the schools according to the equipment available there or provide the equipment of the libraries for the project tasks to be assigned.

7. Conclusion

The studies conducted within the scope of this work show that makerspace environments interact strongly with project-based learning (PBL) and that digital production tools in particular support this learning approach. Through VR (virtual reality), 3D printing, digital prototyping, and other production technologies, students are able to actively participate in the learning process by transforming theoretical knowledge into practice, while also developing 21st-century skills such as creative thinking, problem-solving, collaboration, and technological literacy. Makerspaces have been found to have positive effects not only on technical skills but also on higher-level learning outcomes such as interdisciplinary thinking and project management.

However, literature reviews reveal that there are no studies that address the concepts of "librarianship," "makerspace," and "PBL" together. This situation indicates that there is still a significant gap in the integration of libraries with contemporary learning models. However, today's libraries should not only be points of access to information but also active

nisu odgovarajuće za ove potrebe. Iz tog razloga, za to su odgovorne javne biblioteke. Škole i učitelji mogu sarađivati s bibliotekama, dodjeljivati projektne zadatke u školama prema dostupnoj opremi ili ponuditi opremu biblioteka za dodjelu projektnih zadataka.

7. Zaključak

Studije provedene u okviru ovog rada pokazuju da su makerspace okruženja snažno povezana s projektnom nastavom (PBL) i da digitalni proizvodni alati posebno podržavaju ovaj pristup učenja. Putem VR-a (virtualne realnosti), 3D štampanja, digitalne izrade prototipa i druge produkcijske tehnologije, studenti mogu aktivno učestvovati u procesu učenja transformirajući teoretsko znanje u praksu, dok razvijaju i vještine 21. stoljeća kao što su kreativno mišljenje, rješavanje problema, saradnju i tehnološku pismenost. Pronađeno je da makerspaceovi imaju pozitivan učinak ne samo na tehničke vještine već i na višoj razini ishoda učenja kao što su interdisciplinarno razmišljanje i upravljanje projektom

Međutim, pregled literature otkriva da nema studija koje se odnose na koncept "bibliotekarstva," "makerspacea" i "PBL-a" istovremeno. Ova situacija pokazuje da još uvijek postoji znatan nedostatak u integraciji savremenih modela učenja u biblioteke. Međutim, današnje biblioteke ne trebaju biti samo tačke pristupa informacijama već i aktivna okruženja za učenje gdje pojedinci mogu razviti svoje vještine produkcije informacija, istraživanja i kreativnog razmišljanja. U ovom kontekstu, može se tvrditi da postoji niska svijest o projektnoj nastavi i inovativnim obrazovnim pristupima, pogotovo u bibliotekarstvu. Međutim, savremene biblioteke se ne trebaju ograničiti na pružanje pristupa informacijama; one trebaju biti osmišljene kao aktivna okruženja za učenje gdje se može provoditi eksperimentalno učenje, kreativna proizvodnja i zajednički rad. Školske biblioteke i javne biblioteke posebno imaju kritični potencijal kao obrazovni prostori za ovu transformaciju.

Polje bibliotekarstva treba preuzeti odgovornost za obezbjeđivanje mnogostranog okruženja koje nadilazi informacijske usluge i direktno doprinosi procesima učenja korisnika. U tom smislu, osnivanje makerspaceova u bibliotekama zahtjeva od bibliotekara da preuzmu nove uloge i postanu stručnjaci u poljima kao što su učenje dizajniranja, tehnološko navođenje, pomaganje u digitalnoj proizvodnji, uz ekspertizu u informisanju. Naročito javne i školske biblioteke mogu biti u centru transformacije kao pristupačni prostori za učenje i stvaranje za sve.

learning environments where individuals can develop their information production, inquiry, and creative thinking skills. In this context, it can be argued that there is a low awareness of project-based learning and innovative educational approaches, particularly in librarianship. However, contemporary libraries should not be limited to providing access to information; they should also be designed as active learning environments where experiential learning, creative production, and collaborative work can be carried out. School libraries and public libraries, in particular, have critical potential as learning spaces for this transformation.

The discipline of librarianship should take on the responsibility of providing multifaceted environments that go beyond information services and directly contribute to users' learning processes. In this context, the establishment of makerspaces in libraries requires librarians to take on new roles and become proficient in areas such as learning design, technology guidance, and digital production support, in addition to information expertise. Public libraries and school libraries, in particular, can be at the center of this transformation as accessible learning and production spaces for everyone.

It is well known that many schools in Turkey have inadequate library infrastructure, and existing libraries are limited in their ability to meet users' experiential and applied learning needs. This situation highlights the need to transform public libraries into more inclusive, multifunctional learning centers. Integrating libraries into PBL processes will not only enhance educational outcomes but also strengthen the social function of libraries. In this context, librarians can work in collaboration with teachers to actively participate in planning and executing project tasks, while also providing the necessary digital equipment to guide users through production processes.

In conclusion, libraries should be at the center of contemporary learning approaches and offer their users the opportunity to produce knowledge beyond access to information through environments enriched with models such as makerspace and PBL. In this regard, research and applications to be developed in the field of librarianship will be an important step in transforming libraries from passive information centers to active learning and production areas.

Dobro je poznato da mnoge škole u Turskoj imaju neadekvatnu bibliotečku infrastrukturu i da su postojeće biblioteke ograničenih mogućnosti da udovolje korisničkim potrebama za eksperimentalnim i primijenjenim učenjem. Ova situacija naglašava potrebu da se javne biblioteke pretvore u inkluzivnije, multifunkcionalne obrazovne centre. Uključivanje biblioteka u PBL procese neće samo povećati obrazovne ishode već i ojačati društvene funkcije biblioteke. U tom smislu, bibliotekari mogu u saradnji s nastavnicima aktivno učestvovati u planiranju i izvršenju projektnih zadataka istovremeno obezbjeđujući potrebnu digitalnu opremu i vodeći korisnike u stvaralačkim procesima.

Napokon, biblioteke bi trebale biti centar savremenog pristupa učenju i svojim korisnicima, pored pristupa informacijama, ponuditi i mogućnost proizvodnje znanja putem okruženja obogaćenih modelima kao što su makerspace i PBL. U tom pogledu, istraživanje i primjena koji će se razviti u polju bibliotekarstva bit će važan korak u transformaciji biblioteka iz pasivnih centara informacija u prostore aktivnog učenja i stvaranja.

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The authors declare that there is no conflict of interest.

This study was conducted in accordance with the Academic Integrity Code of Kastamonu University.

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