Formation of professional competencies of future teacher-biologists using project-based learning technologies

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Abstract

This research is aimed at forming the professional competencies of future teacher-biologists by using project-based learning technologies. The study was created in the fall semester of 2022–2023 and was carried out with the participation of 168 students. In the research, a 3-week online training was given to the participant group and this training was designed for the participant groups. When the training was completed in the research, the data collection tool was applied, delivered and collected to the participant groups participating in the study. The analysis of the data was made in the relevant programmes and the findings were added to the research in the presence of tables. As a result of the research, it was seen that the students participating in the research understood the project-based learning technologies and had high values as they expected this relationship to be established.

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1. Introduction

It is very important for educators to organise lessons that will direct students to knowledge rather than to transfer information directly, and to use different methods, techniques and approaches in this process. In this context, it is known that project-based learning is one of the most effective ways that will enable students to take a more active role in the classroom, become aware of the problems in their environment, produce different solutions to these problems and continue the learning process more efficiently (Caballero-Garcia & Grau-Fernandez, 2019). With project-based education, students create a product by doing project work and the work in the preparation process of this created product is carried out within the framework of project-based learning (Gurumurthy Iyer, 2020). Project-based teaching is an approach that points to the theory and practice of utilising real-world studies in time-limited projects by facilitating individual and collaborative learning to achieve target behaviours (Beresova, 2016).

It is known that it is very important to create learning environments that will help the active processing of information, due to the effect of actively processing information on increasing student retention. Project-based teaching, which is based on students working alone or in small groups to produce tangible products, is an approach in which students construct knowledge and even transform it into a product instead of receiving information (Karaca, Karahoca, & Karahoca, 2016). Instead of passively receiving information, people began to acquire it through the processes in which they were active. Project work provides students with vital skills such as budget planning and preparation; the ability to use technology such as the Internet and computer; cognitive process skills such as decision-making and critical thinking; self-control skills such as goal setting and time management; interest in learning and curiosity for future tendencies such as self-control; and sense of achievement give beliefs such as self-efficacy belief (Çiydem, Özdemir, & Erturk, 2017). Project-based teaching method allows students to work individually or collaboratively to create their own knowledge by performing meaningful learning (Elfeky, Alharbi, & Ahmed, 2022). Since project-based teaching is not only a way of learning but also a way of working together, students take responsibility for their own learning and lay the foundations for how they will work with others in their adulthood, projects are realistic, largely student-focused, constructive and central to the programme (Wang, 2022).

As a result of the developments in information technologies, the perspective on project-based teaching approach has changed, and technology-supported and content projects have been widely used. Internet, multimedia tools, digital cameras, video cameras, various computer programmes, printers and faxes, e-mails, copiers etc. have become indispensable tools for projects in the project-based teaching approach (Bidaki, Mousavi, & Ehteshampour, 2020). Considering the resource capacity and accessibility that can be accessed with the Web service, it is clear that the Web service can be used for both educational and informational purposes. The Web, one of the basic services of the Internet, has brought about a new dimension to education by bringing advantages such as audio and video transmission. Thus, the curricula of school organisations that follow technology have begun to change in this direction (Haatainen, 2022). Faculties and colleges related

to information technologies use project-based teaching method in design and application-oriented courses. Project-based teaching helps students get used to living in knowledge-based and technological societies (Makhamadievna, 2022). Through the inclusion of real-life topics and technology in the curriculum through project-based teaching, students are encouraged to be independent, think critically and learn for life (Ortega, James, Twyman, Chambers, & Chowdhury, 2022).

In this sense, by using project-based learning technologies, it will be seen that this method will be supported for the formation of professional competencies and establishing a relationship of future teacher-biologists.

1.1. Related studies

Fish et al. (2021), in the year of the work they have done that is presented to the students in a project-based practical education in teaching courses, intended to inform the experiences of projects, and their work is shaped accordingly, as a result of the research project-based teaching, training opportunities, motivation and modelling of the participants showed a positive attitude towards education and research, it is observed that this model achieves results better with expressing themselves.

Lapina and Prakasha (2022), in the work they have done in the year students in project-based education, expressed that they were conducting integrated application and application for a joint work sought to uncover a common theme, and as a result, project organisation, technology tools and such of the requirements for a design to implement projects that provide benefits and achieves results, it is observed that the proposed year.

Orlova and Firsova (2022) brought literature in the digital transformation of the education system to create a new model in studies of students' communicative competence in the formation of Project-Based Learning has attempted to address some aspects of the application and, as a result, project work, digital educational environment in the educational process to enhance motivation for learning and achieving results necessary in educational communication technology that allows the modelling of becoming a learning achieves results that are observed.

When the relevant research part is examined, it is seen that project-based teaching provides benefits to the literature in the field of writing. In addition, teachers in general, project-based teaching have also stated that positive attitudes stated that they felt more comfortable with this model; this study also takes place between the same result expectations.

1.2. Purpose of the study

This study aimed at forming the professional competencies of future teacher-biologists by using project-based learning technologies, and answers to the following questions were sought for the general purpose determined:

1. What are the project-based teaching use cases of the participant group participating in the research?

2. What is the situation of the participant group participating in the research in devoting time to project-based teaching live events?

3.   What is the purpose of using project-based education and professional competence of the participant group participating in the research?

4.   Is there a significant difference between the project-based education and professional competence views of the participant group participating in the study according to the gender variable decisively?

5.   What are the opinions of the participants who participated in the research on project-based education and professional competence after the study?

2. Method

In this section, the method used in the research, the data collection tool etc. will be provided information in detail, and also that numerical values will be given in tables.

2.1. Research model

Considering the type of the study as a model, it is seen that the quantitative research model was supported in this study. It is seen that a type of research that makes every situation observable by objectifying and presents information about a situation in a measurable and quantifiable way is called a quantitative research model (Uzunboylu et al., 2022). In this sense, by using project-based learning technologies, it will be seen that this method will be supported for the formation of professional competencies and establishing a relationship of future teacher-biologists.

2.2. Working group/participants

It is seen that the period of this research was implemented in the 2022–2023 fall academic year, and the participant and data part of the research consists of 168 students, who are future educators and teachers in Kazakhstan. The participant group participating in the research received their training through live lessons.

2.2.1. Gender

In this section, it is seen that the participants included in the research are presented in Table 1 by making a distinction as male and female.

Table 1. Distribution of the participant groups participating in the research by gender variable

Gender	Male		Female	
	F	%	F	%
Variable	87	51.79	81	48.21

As can be seen in Table 1, the gender values are given and when these values are carefully examined, it is seen that 51.79% (87 people) are male participants, while 48.21% (81 people) are female participants. In the gender section, the findings reflect the actual gender distribution.

2.2.2. Project-based teaching use cases of the participant groups included in the study

In this section, answers to the first problem situation of the research were sought and information was added. The participants included in the study were expected to use project-based teaching use cases during the day. Detailed usage information is given in Table 2.

Table 2. Project-based teaching use cases of the participant groups included in the study

Project based teaching usage	1 hour		2 hours		3 hours or more	
	F	*%*	*F*	*%*	*F*	*%*
Variable	15	8.93	95	56.55	58	34.52

When the data is examined by considering the first problem situation in the study, it is seen that the participant groups' information on the use and working time of project-based teaching regarding the problem situation of the research is given and this data is examined. While expressing that they spare time for project-based teaching, 56.55% (95 people) stated that they spare time for project-based teaching in the range of 2 hours and 34.52% (58 people) stated that they spare time for project-based teaching for 3 hours or more. In this context, it is seen that the participant groups prefer the daily inclusive education usage amount, which can support the communication of the students with their peers, as 2 hours at the most.

2.2.3. Status of allocating time for project-based instruction and live activities of the participant groups participating in the research

In this section, the situations related to the participation of the participant groups in the project-based teaching and live activities according to the daily usage time periods were investigated and examined. Detailed information is given in Table 3.

Table 3. Status of allocating time for project-based instruction and live activities of the participant groups participating in the research

Project-based teaching time for live events	1 hour		2 hours		3 hours and above	
	F	*%*	*F*	*%*	*F*	*%*
Variable	11	6.54	49	29.17	108	64.29

When we look at Table 3, it is seen that the use cases that the people participating in the study use daily during the project-based teaching and live activities during the day are examined and detailed information is given. In this context, 6.54% (11 people) devoted time for activities as 1 hour, 29.17% (49 people) they brought their language in a range of vibrant activities to devote time to 2

hours and 64.29% (108 people) spent over 3 hours for activities. In this context, research in project-based teaching allocations and the amount of daily live events are a good time to use in groups is up to 3 hours as preferred.

2.2.4. Class status

In this section, the class information of the participant groups forming the study group was examined and detailed information was given in Table 4.

Table 4. Distribution of the groups of participants participating in the research according to their class status

Class	Third class		Fourth class	
	F	%	*F*	%
Variable	82	48.81	86	51.19

When Table 4 is examined, the distribution of the participant groups participating in the study according to their class status has been taken into consideration, and the information regarding this section has been added to the table. In this context, when Table 4 is considered, it is seen that 48.81% (82 people) are in the third grade, while 51.19% (86 people) are in the fourth grade. In the class situations section, the findings reflect the actual distribution.

2.3. Data collection tools

When the data collection tool part of the study is explained, it is seen that a form was prepared for the people who created the research and the experts helped in the formation of this data collection tool. The data collection tool, on the other hand, was prepared and designed specifically for this study by the people who created the research and examined by experts and simplified by removing the unsuitable items from the research. It is seen that the personal information form called 'Project-Based Teaching and Vocational Competence' data collection tool, which was applied to the participants and developed by the researchers, was used. The content validity of the developed measurement tool was examined by two professors and two associate professors working on inclusive education and special education, and unnecessary items were removed from the measurement tool and simplified and rearranged.

1. Personal Information Form (Demographic Data): In the personal information form; Information such as gender, class, project-based teaching education usage situations and project-based teaching live activity time-separation usage environments are included.

2. Project-Based Teaching and Vocational Competence Data Collection Tool: A 5-point Likert-type data collection tool was prepared in order to obtain information about the existence of some knowledge of the participants participating in the study and their permanent behaviour, their views on project-based teaching and vocational competence. 17 items of the measurement tool consisting of a total of 20 items were used and 3 items were extracted from the measurement tool, thanks to expert opinion. The opinions of the people who participated in the research were consulted from two factorial dimensions, such as 'Project-Based Teaching' and 'Vocational Competence'. The

Cronbach Alpha reliability coefficient, in which the data collection tool was examined, was calculated as 0.95. The data collection tool was in the range of 'strongly disagree' (1), 'disagree' (2), 'undecided' (3), 'agree' (4) and 'strongly agree' (5). The measurement tool was also collected from primary school teachers in the form of an online environment.

2.4. Application

When this part is considered as an application, it is also known as the part where a dimension in the study meets the participant groups. 168 students, who will be the future of us who continue their education in various schools in the Kazakhstan region, were determined by the researchers and it was aimed to convey their vocational qualifications with project-based education. Transfers such as project-based teaching live events times and usage situations were prepared and transferred with the Microsoft Teams videoconference application programme, and this event environment was organised by the people who prepared that environment before. and how they will approach and communicate within the scope of project-based teaching. The training model was temporally processed for a total of 60 minutes, 45 minutes of which were activities, 15 minutes of which were questions and answers, and the measurement tool applied to the people participating in the research as a live event was collected by means of an online questionnaire and transferred to the Statistical Package for the Social Sciences programme by coding in the computing software environment.

2.5. Analysis of the data

In the analysis part of the data obtained from the research, the statistical data obtained from the people participating in the research were analysed in the Statistics programme by using frequency (f), percentage (%), mean (M), standard deviation (SD), t-test, respectively. The numerical values of the data obtained from the programme are given in tables, accompanied by comments in the findings section.

3. Findings

In this section, the findings regarding the use of project-based teaching, technologies and live activities education of the participants participating in the research are included.

3.1. Project-based education and vocational competence use purposes of the participant group participating in the research

In this section, the project-based education and professional competence usage purposes of the participant group participating in the research were investigated and detailed information is given in Table 5.

Table 5. Project-based education and vocational competence use purposes of the participant group of the research

Variable		*F*	%
Project-based education and	Being better professionally	85	50.60
	To be more	77	45.83

Zhuldyz, T., Lazzat, K., Almash, K., Zhamal, I., Anargul, S., & Bagdat, K. (2022). Formation of professional competencies of future teacher-biologists using project-based learning technologies. *World Journal on Educational Technology: Current Issues*. *14*(6), 1739-1751. https://doi.org/10.18844/wjet.v14i6.8322

vocational competence use purposes	successful in terms of education		
	Other	6	3.57
	Total	142	100

When examining Table 5, the study of the participating groups included in the project-based education and professional qualification of the problem state the purpose of the study and were investigated according to the relevant information have been added to the picture, and in this context 50.60% and (85 people) 'Being professionally better' option responds to and are accepted while 45.83% (77 people) 'to be more successful in terms of education' option and finally responds to 3.57% (up to 6 people) you choose, it is observed that the other field. In this context, it can be said based on Table 5, which uses project-based teaching on students, that they prefer their professional qualification status, that the research has found that most segments tend to the problem situation according to the problem situation.

3.2. Project-based educational and professional competence status of the participant group participating in the study according to the gender variable

In this part of the study, it is seen that the project-based education and professional qualification status of the participant group participating in the study according to the gender variable and detailed information are given in Table 6.

Table 6. The project-based education and professional competence status of the participant group participating in the research according to the gender variable

Project-based education and vocational qualifications	Gender	*N*	*M*	SD	Df	*t*	*p*
	Male	87	4.29	0.54	168	0.428	0.527
	Female	81	4.27	0.58			

It is seen in Table 6 that there is no significant difference according to the time and gender criteria when the project-based teaching and professional competence status of the study is examined according to the gender variable [Df (168) = 0.527, $p < 0.05$]. The group of surveyed participants of project-based education and vocational qualification status when examined, the male participant group for this area, the average score (*M* = 4.29), but the female participants in this project-based education and vocational qualification of their status regarding the mean score (*M* = 4.27), it is observed that. In this context, it can be said that there is no difference between the project-based education and professional qualification status of male participants in this study compared to female participants, and the findings of the study are high in decency.

3.3. Project-based education and professional competence opinions of the participant group participating in the research after the study

In this section, after the end of the training given in the study, the opinions of the students were applied and detailed information is given in Table 7.

Table 7. The opinions of the participants who participated in the research on inclusion education after the study

Substances	M	SS
1. I try hard enough for project-based teaching	4.41	0.86
2. I understood that he could teach with project-based teaching and technology.	4.39	0.77
I can easily find solutions to problems that may arise with project-based teaching and technology.	4.33	0.81
4. I am happy to relate to project-based teaching and vocational competence issues.	4.39	0.79
5. I am happy to add space to my field with project-based teaching and technology.	4.51	0.82
6. I am honoured to participate live in the activity classes.	4.43	0.63
7. Thanks to project-based teaching, I know myself and use technology better day by day.	4.31	0.83
8. It makes me happy to talk about project-based teaching to my family and friends.	4.38	0.85
9. I do not feel alone when I participate in live lessons with project-based teaching.	4.41	0.81
10. When I get information about vocational competence issues, I find myself saying something.	4.48	0.71
11. In the project-based teaching activity, I want to know my friends to accept me and I act accordingly.	4.35	0.82
12. I envision myself in the profession in the future and I know that this training will be beneficial for me.	4.29	0.79
13. I think that I can communicate positively with my peers with the concepts of professional competence.	4.37	0.81
14. Individuals with special educational needs I am confident in helping with activities that suit their needs.	4.34	0.76
15. I enjoy being with them to help them participate in professional competence activities.	4.38	0.83
16. I can control undesirable behaviours and be	4.32	0.87

with my friend in project-based teaching activities.		
17. I share these activities I have taken with another friend and make him/her more knowledgeable.	4.36	0.79
Total	4.38	0.80

As seen in Table 7, it is seen that the findings are given after the project-based education and professional competence opinions of the participant groups included in the study. When the post-study findings are examined, it is seen that there is a significant difference and the values are high. Although it is seen that a significant value is one in all statements, one of the most prominent statements of the participant groups participating in the research is 'I share these activities I take with another friend and make him/her more knowledgeable' $M = 4.36$. 'I think I can communicate positively with my peers' has $M = 4.37$. In addition, it is seen that another statement in the research 'I am happy to add space to my field with project-based teaching and technology' has $M = 4.51$.

Although positive results were seen for project-based teaching and professional competence in each item of the research, it is seen that among the opinions of the students participating in the research, 'I do not feel alone when I participate in live lessons with project-based teaching' is $M = 4.41$. 'I find myself saying something when I get information about proficiency issues'. It is seen that it has a value of $M = 4.48$. Finally, it is seen that the average values in the research is $M = 4.38$. In this context, Table 7 shows the opinions of the people participating in the research have improved positively with the technology of project-based education and vocational qualification education. is also seen

4. Discussion

Bodnenko et al. (2022) in the work they create in cloud-based services based on and are meant to demonstrate the basic features of project based learning, as a result, during the project execution phase and the result is proper communication within a team; outdoor education; self-learning and self-development; education of students in different years of the development of digital literacy of students and the values are high, it is observed that the results they achieve. When this value is combined with the results of the research, it is seen that the results of the study show that project-based teaching is used for a maximum of 2 hours during the day, in this context, it can also be said that the discussion part of the research that project-based teaching is important.

Gasni and Chandra (2022) in the year they have done the research, the goal is for students to develop knowledge and skills in engineering design components as an effective pedagogy of project-based learning is intended to review in research methods created with diligence, and as a result, students in both cognitive skills demonstrated ability to both lead and project-based instructional model, it is observed that the areas with very well understand that achieves results. When this value is combined with the results of the research, participation situations for project-based teaching live events are investigated in the study and it is seen that groups of participants with a maximum of 3 hours or more prefer to reach the results that they use in a pleasant way. In this context, it can be said in the discussion part of the research that preferring project-based teaching benefits the cognitive field and their own fields.

Fan et al. (2022) in the year the work they have done in student-centred educational programmes in an effort to offer this article, project-based learning course developed by using an innovative method and electronic engineering undergraduate programme is intended to provide, and as a result, project-based course based on our innovative model of teaching practice, it is observed that achieves results showed a significant improvement in student satisfaction. In this context, this value when combined with the results of the research made reference to the views of the vocational qualification conditions when participating in research groups and project-based teaching, according to their opinions and feeling better with every step in this model was louder they also have been achieved by using this model, it is seen that the results which are expected to continue their education.

It is seen that the researches mentioned in the discussion section benefit project-based teaching and the professional qualification situations that come with it. The students participating in each study are undoubtedly aimed to be in a better place, considering that this interpretation is the greatest value that it adds to our research, it also takes its place among the same situations and expectations from this research decisively. The inclusion of such research and studies for a better future and society is also offered as a suggestion for research.

5. Conclusion

In studies, the results part is known as the end of an event and the part where it gains meaning. In this context, when the first result of this research is discussed, it is seen that the number of people who make up the participant group has come. In this context, it is seen that the results of this research in which 168 people voluntarily participated have been reached. Another result of the research is that by considering the first problem situation, it is seen that the participants' groups were given information about the use and working time of project-based teaching related to the problem situation of the research, and as a result, the results preferred by the participant groups were reached for a maximum of 2 hours. When another value of the research was considered, the use cases that the people participating in the research used daily during the project-based teaching and live activities during the day were examined and as a result, it was found that the maximum was 3 hours or more.

When a result of the research is discussed with comments, it is seen that the participants' groups of project-based education and professional competence usage purposes were investigated according to the problem situation of the study, and it was concluded that most of the relevant information was directed to the problem situation, and it was concluded that they preferred project-based teaching and professional competence situations over students. The time of the study, which focused on the value of another research project-based teaching and professional competence of the state variable when analysed according to gender, and gender is not a significant difference according to criteria that male participants female participants in this study also reached the conclusion that, according to project-based education and professional qualification of the state of the two values it is seen that the conclusion is reached that is high in between. And when the final result of the research is considered, it is seen that there is a significant difference in the project-based educational and professional competence views of the participant groups when the results are examined, and it is concluded that the values are high. Also, I took another friend with her to be more knowledgeable of the activities that I share and provide high value, with the concepts of

professional competence, positive communication with my peers I think I could establish the value of high-and project-based teaching and technology field to field the value is high I'd be happy to add my own to the conclusion that was reached.

As a result of the research, it was found that the students participating in the study understood project-based learning technologies and also had high values, as they expected this relationship to be established.

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