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RESEARCH ARTICLE

The Effect of Originally Designed Innovative Activities on Students' Innovative Thinking Tendencies and Students' Views on the Process*

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ABSTRACT

The aim of this study is to investigate the effect of an inquiry-based learning method supported by innovative activities on students' innovative thinking tendencies in teaching the 7th grade "Force and Energy" unit. Another aim of the study is to determine the opinions of the experimental group of students who were taught innovative activities about the process. In order to obtain the data for the purpose of the study, an explanatory design, which is one of the mixed research methods in which quantitative and qualitative research methods are used together, was used. As a result of the study, it was found that there was a statistically significant difference in favor of the experimental group between the "Innovative Thinking Tendency Scale" scores of the students in the experimental and control groups after the application. When the answers given by the students to the interview questions directed to them are analyzed, in the first question, students defined innovative individuals as curious, well-intentioned, careful, respectful, patient, self-confident, intelligent, thinking, having the ability to design and criticize, using their minds, attentive, finding impressive ideas, and putting forward plausible ideas. In the second question, students stated that the use of innovative activities in the Force and Motion unit had effects such as facilitating learning, understanding the subject better, enabling thinking, providing permanent learning, and enabling visualization. In third question, the students talked about the advantages and disadvantages of these activities. Also, with last question students talked about both positive and negative aspects of the process.

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1. Introduction

Today, the needs and expectations of the age have changed, and countries have had to adjust their existing policies to keep up with this change. The economy has ceased to be dependent on capital, land and industry, and has become dependent on intellectual capital (Taş, 2017). In other words, producing and selling something alone is no longer sufficient in today's conditions. The main factor that ignites this new economy's fuse and constantly changes and develops the marketing, product, process, system, and skills required for these is the concept of "innovation" (Akkaya, 2016). The development in science and technology in today's conditions, the business lines formed with this development, and the individual characteristics required by these business lines are changing rapidly. Partnership for 21st century skills (P21), within the scope of skills and competences, refers to being ready for work environments, learning, innovation skills, developing innovation, and learning about life in an even more complex situation (P21, 2009). The ability of countries to sustain their existence, develop and produce themselves depends on

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producing and developing as a society. At this point, societies should raise people who have the individual qualities and skills required by the 21st century. Today, innovative thinking skills are considered as one of the most important skills to develop faster and keep up with the 21st century (Şanlı, 2020). Recently, the concepts of innovation, innovative thinking and innovation, which are among the skills that are aimed to be gained by individuals, have been encountered a lot (Deveci & Kavak, 2020). In the STEM Education Report prepared by the General Directorate of Innovation and Educational Technologies of the Ministry of National Education, it is stated that our national education system aims to raise people who can keep up with the times, think inquisitively, acquire 21st century skills, be innovative, and develop products. On the other hand, "Innovative Thinking" is included under "Engineering and Design Skills" in the 2018 Science Curriculum of the Ministry of National Education. Within the scope of this skill, it is aimed for students to approach problems from an interdisciplinary perspective by integrating science with technology, mathematics, and engineering, to reach the level of invention and innovation by using the knowledge and skills they have, to create products and to develop methods on how they can add added value to the created products (Ministry of National Education, 2018).

Innovation is the most important factor to increase productivity, create a sustainable economy, develop, increase quality, and make organizations successful. It is accepted that the only way for sustainable profitability and growth all over the world now and in the future is through innovation (Taş, 2017). Innovation is developing new ideas by differentiating previous ideas and applying the developed ideas (Özer, 2020). In other words, innovation also means renewing, changing, and producing better, creative products and services (Süzen, 2020). Innovation affects all areas of life; it is a broad concept that covers technology, economy, culture, products and services, and all kinds of events (Akkaya, 2016). In addition, looking at innovation only as innovation does not fully explain the word, because this concept also includes creativity, invention, change, and R&D (Alkan, 2014). Innovative thinking is the individual's production of new, different, and original ideas (Tanrıverdi & Alkan, 2018). For this reason, for the job market that needs the changing qualities of manpower, students should be trained in learning, and teaching processes where they can actively create knowledge (Kocasaraç & Karataş, 2018). Since people are involved in all stages of innovation, from its emergence to its spread, the place of knowledge, learning, and education is seen as extremely special (Keskin, 2021). The purpose of innovation in education is to create a teaching-learning process that will raise individuals who can think creatively and keep up with the current situation and provide them with higher quality, more effective skills, and the skills of both today and the future (Taş, 2017). Innovation in education includes behavioral changes of students, teachers, parents, and administrators (Demir Başaran & Keleş, 2015). Innovation in education does not only depend on certain lines, but also includes approaching problems, mood, willingness to experience, educational organizations, and school atmosphere (Şahin, 2018). In this context, it is possible to develop students' positive attitudes towards innovation and innovation skills through education (Akkaya, 2016). For this reason, in order to raise innovative individuals in the education system, it is necessary to structure the programs, highlight the innovation dimensions of the program, and create teaching programs based on improving innovation (Konakman et al., 2016). As a result, the current programs are updated in terms of new approaches, developments, theories, the requirements of our age in terms of learning and teaching, and the changing needs of society and people (Board of Education and Discipline, 2017). OECD (2018) explains that students should have the skills to create new values and produce innovative approaches in all areas of life in the 2030s. For this reason, the concept of innovation should be included in the education process, the development of students' innovative features should be supported by more current and future-oriented teaching techniques or methods, and students should be encouraged to think innovatively (Aras, 2020). It is also emphasized that the desired learning outcomes can be achieved more easily in learning environments where innovative teaching activities are used and learners' creativity skills are activated (Akbay et al., 2022; Taşdelen & Özel, 2024).

When the literature is examined, it has been found that in some studies, innovative thinking skills are given a small place in STEM activities, but there is no other study that specifically designed original innovative activities to develop students' innovative thinking skills/tendencies. Starting from this point of view, it is aimed to investigate the effect of inquiry-based learning method supported by innovative activities originally designed in the teaching of the 7th grade "Force and Energy" unit of secondary school on the innovative thinking tendencies of students. In the study, it was also aimed to get the opinions of the experimental group students about the teaching process and the innovative activities used in the process. It is thought that the study will contribute to the literature in terms of bringing original innovative activities to the relevant literature and examining the effect of these activities on the innovative thinking tendencies of the students.

2. Method

The purposes and procedures of the current study were granted approval from the ethical committee of the Gazi University (12.03.2021 / 80287700-302.08.01- 51638).

2.1. Study Design

In this study, a research method called mixed-method research, in which quantitative and qualitative research methods are used together, was used to obtain data for the purpose of the research. According to Creswell (2019), the

mixed method is a research approach in which the researcher obtains both quantitative and qualitative data to understand the research problem, integrates these data, and draws conclusions with the advantages of integration. The mixed method provides a better understanding of the research problem than a single method used (Creswell & Plano Clark, 2018). The purpose of the mixed method is to center the analysis results of the quantitative data we have obtained and to analyze the quantitative findings obtained through the analysis of qualitative data by explaining in depth (McMillan & Schumacher, 2010).

The research was carried out with explanatory design, one of the mixed method designs. The explanatory design is a process that begins with the collection and disclosure of quantitative data and then continues with the collection and analysis of qualitative data (Creswell & Plano Clark, 2018). The quasi-experimental method was used to obtain the quantitative data of the study. Qualitative data was obtained through semi-structured interviews.

2.2. Study Group

The study group of the research consists of 37 students selected from two branches, studying in the 7th grade of a secondary school in the province of Van, İpekyolu District in the fall semester of the 2021-2022 academic year. The experimental group of the research consisted of the group that was taught with the original designed innovative activities, and the control group was the group that was taught with the research-inquiry-based activities in the curriculum without using innovative activities. All students in the experimental and control groups (N=37) who participated in the application process in obtaining quantitative data in the research were included in the research. In order to obtain the qualitative data, the quantitative data obtained from the students in the experimental group were analyzed and the average scores of the students were ranked as the lower group between 0-33, the middle group between 34-66 and the upper group between 67-100. A total of 6 students were determined by choosing two volunteer students from each group, lower, middle and upper. Semi-structured interviews were conducted with these students.

2.3. Data Collection Tools

In this study, the Innovative Thinking Tendency Scale for Secondary School Students developed by Deveci and Kavak (2020) and semi-structured interview questions developed by the researchers were used as data collection tools. The Innovative Thinking Tendency Scale for Secondary School Students, developed by Deveci and Kavak (2020). As a result of the analyzes made, the Cronbach alpha reliability coefficient of the scale consisting of 5 factors and 25 items was calculated as 0.91.

With the semi-structured interview questions prepared by the researchers, it was aimed to reveal how the participants expressed the concept of innovation. In addition, students' opinions on the innovative activities used in the implementation process, the subjects they learned and the teaching process were consulted. In this direction, semi-structured interview questions were prepared by the researchers. The questions were examined by a field trainer and an assessment and evaluation specialist in terms of suitability for the purpose. The semi-structured interview questions directed to the students within the scope of the research are given below:

1. What do you think are the qualities that an innovative individual should have? Please explain.

2. What do you think about the use of innovative activities in the Force and Energy unit?

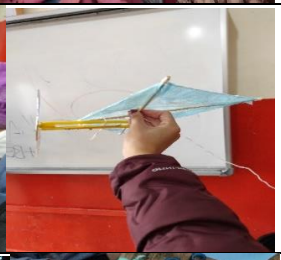
3. What do you think about the use of innovative activities that we did together in the process in the science lesson? Please explain.

4. When you consider the whole process, how do you evaluate the learning experience you have spent?

2.4. Data Collection

In accordance with the purpose of the study, the application process was carried out within the scope of the lessons in which the subjects included in the 7th grade Force and Energy Unit were taught. Before the application, the Innovative Thinking Tendency Scale was applied to both groups as a pre-test. The application covered the weeks (7 weeks) in which the subjects of the 7th grade fall semester Force and Energy Unit were covered. The teaching process was continued during the weeks in which the unit was explained by using research questioning, question-answer and discussion methods within the scope of the curriculum in the control group. In the experimental group, lessons were taught with original innovative activities prepared by the researcher within the scope of Force and Energy Unit. Attention was paid to ensure that the activities and materials used during the application correspond to the achievements and that they are suitable for the affective, cognitive, and psychomotor developments of the students participating in the research, and that they are also clear, understandable and reliable. Five activities, which were thought to meet these criteria and prepared by the researcher, were examined by science educators who were experts in their fields, and then they were put into practice. The table regarding the process is given below (Table 1).

Table 1. Process of the research.

Weeks	Achievements	Activities	Photos
Week 1	Innovative thinking tendency scale was applied to both groups.		
Week 2	F.7.3.1. The gravitational force acting on the mass is called weight. F.7.3.2. Compares the concepts of mass and weight.	"The person who gets the dynamometer all the way down wins the quiz" activity	
Week 3	F:7.3.2.1. Explains that the work done physically is related to the applied force and the path taken.	"Innovative vehicle design consisting of geometric shape" activity	 
Week 4	F.7.3.3.1. From the conversion of kinetic and potential energy types, she/he concludes that energy is conserved.	"Rubber powered kite" activity	 
Week 5	F.7.3.3.2. Explain the effect of friction force on kinetic energy with examples.	"An innovative glove" activity	 
Week 6	F.7.3.3.3. Designs a means of reducing the effect of air or water resistance.	"Designing a vehicle that is resistant to weather or water resistance" activity	 
Week 7	Innovative thinking tendency scale was applied to both groups.		

As can be seen in Table 1, the activities related to the determined achievements were carried out in the determined weeks and photographs of the process were given.

When the implementation process was completed, semi-structured interviews were conducted with 6 students selected from the experimental group. Original innovative activities prepared by the researcher were not applied to the students in the control group during the application process, and the teaching process was continued during the weeks in which the unit was explained by using research questioning, question-answer and discussion methods within the scope of the curriculum.

2.5. Data Analysis

SPSS 28.0 statistical analysis program was used in the analysis of the quantitative data obtained from the study. Shapiro Wilk normality test was applied to examine the distribution of the answers given by the students to the items in the scale and to investigate whether the quantitative data showed a normal distribution. Independent groups t-test was used to determine whether there was a difference between the pre-test and post-test mean scores of the students in the

experimental and control groups, and the significance level was accepted as 0.05 in all analyzes.

In experimental studies, there are some factors that can negatively affect the internal validity of the study. Factors such as participants' development levels, attitudes, teaching activities, unexpected events, application of test and measurement tools, and data loss are among the factors that may reduce internal validity (Fraenkel et al., 2012). In this study, the pre-test effect level of the scale, the conditions of the pandemic period, student expectations are some of the reasons that may worsen the internal validity. However, the research design used in the study, valid and reliable measurement tools, lesson plans designed for the application process, original activities developed and SPSS 28.0 analyzes used were carried out in order to minimize these effects.

Content analysis, one of the qualitative data analysis methods, was used to analyze the qualitative data obtained with this research. In the analysis of the qualitative data obtained from this study, the stages specified by Miles and Huberman (1994) and Yıldırım and Şimşek (2016) were followed. In the analyzes made by the experts, consensus and disagreement calculations were made among the experts and the consistency among the experts was calculated as 0.83. In the literature, it is considered sufficient to have a coding agreement rate of 0.70 and above among experts (Yıldırım & Şimşek, 2016). Finally, the data were analyzed with the HyperRESEARCHTM program to reveal the relationships between the obtained data.

3. Findings

3.1. Findings Obtained from Analysis of Quantitative Data

Before starting the analysis of the data obtained from the research, it was investigated which statistical method would be used to analyze the data obtained from the scale. Parametric and non-parametric methods can be used in the analysis of data obtained in quantitative research. In order to use parametric methods, all data obtained from the scale should show a normal distribution (Çepni, 2007; Sim & Wright, 2002). If the data do not show normal distribution, non-parametric methods should be used. In order to determine the analysis method to be used in the research, it was first investigated whether data collected from the scale showed normal distribution and the Shapiro Wilk test was applied to the data. Analysis results are given in Table 2.

When Table 2 is examined, it is seen that the significance levels of the groups' Innovative Thinking Tendency Scale pre-test and post-test scores are greater than $p>0.05$ as a result of the Shapiro Wilk test. This value reveals that the pre-test and post-test scores of the groups show normal distribution (Shapiro & Wilk, 1965).

Table 2. Shapiro Wilk Test results regarding pre-test and post-test scores of the groups.

Test	Group	Statistic	df	p
Pre-test	Experimental	0.91	19	0.09
	Control	0.95	18	0.50
Post-test	Experimental	0.91	19	0.08
	Control	0.92	18	0.12

As a result of Shapiro Wilk analysis, it was seen that the data obtained from the Innovative Thinking Tendency Scale showed normal distribution and it was decided to use parametric methods in the analysis of the data. First, independent groups t-test was applied to the data in order to understand whether there was a significant difference between the Innovative Thinking Tendency Scale pre-test mean scores of the students in the experimental and control groups before the application. The obtained results are given in Table 3.

Table 3. Independent groups t-test results regarding the pre-test scores of the groups.

Group	N	M	Sd	t	p
Experimental	19	83.10	17.72	0.31	0.76
Control	18	81.33	17.45		

When the data in Table 3 are examined, the pre-test mean score of the Innovative Thinking Tendency Scale of the students is M=83.10 in the experimental group and M=81.33 in the control group. According to the data in the table, there is no significant difference between the pre-test mean scores of the students in the experimental and control groups ($t=0.31$; $p>0.05$). The absence of a significant difference between the groups before the application is suitable for its purpose in terms of revealing the effectiveness of the application.

Independent groups t-test results showed that there was no significant difference between the groups' pre-test mean scores on the Innovative Thinking Tendency Scale. After the application, independent groups t-test was conducted to understand whether there was a significant difference between the post-test data obtained from the Innovative Thinking Tendency Scale, which was applied again to the experimental and control groups. The findings obtained from the analyzes are given in Table 4.

Table 4. Independent groups t-test results regarding the post-test scores of the groups.

Group	N	M	Sd	t	p
Experimental	19	113.15	9.90	6.12	0.00
Control	18	80.22	21.16		

When the data in Table 4 are examined, it is seen that the post-test mean score of the Innovative Thinking Tendency Scale of the experimental group students is M=113.15 and the

mean score of the control group students is M=80.22. There was a statistically significant difference in favor of the experimental group between the scores of the Innovative Thinking Tendency Scale after the application of the students in the experimental and control groups ($t=6.12$; $p<0.05$). Effect size calculations were made for the result obtained and it was found that the effect size "d value" was 0.80. Researchers stated that this effect size value was "large" (Cohen, 1988).

3.2. Findings Obtained from Analysis of Qualitative Data

The qualitative data of this study were collected from 6 students selected from the experimental group in order to explain the results obtained from the analysis of the quantitative data and to illuminate the reasons for these results. Two semi-structured interview questions were asked to the students. The answers given by the students to the questions posed to them were reviewed in detail and the codes and themes related to each question were extracted. As a result of the analysis of the codes and themes obtained, separate findings were obtained for each question and direct quotations from the answers of the students were included in the findings. The students were coded as S_1, S_2, S_3… since the answers of the students would be quoted directly and the students' own sentences would be transferred without changing them. The codes and themes and frequency values of the answers given by the students to the questions are reported below.

In the semi-structured interviews with the students, the first thing to ask the students was "What do you think are the qualities that an innovative individual should have? Please explain." question was posed. The codes and themes obtained from the answers given by the students and the frequency values indicating the repetition frequency of the answers are given in Table 5.

Table 5. Frequency values of the answers with codes and themes related to the first question.

Theme	Code	f
Personal characteristics	Curious	5
	Well-intentioned	4
	Careful	3
	Respectful	3
	Patient	3
	Self-confident	2
	Intelligent	2
	Sharer	1
	Logical	1
	Powerful	1
Professional characteristics	Thinking	6
	Having design skills	5
	Criticize	3
	Observant	2
	Feling innovative	2
	Using mind	1
	Attentive	1
	Finding impressive ideas	1
	Suggesting plausible ideas	1

When Table 5 is examined, it is seen that the students evaluated the characteristics that an innovative individual should have with the answers gathered under two themes as personal and professional characteristics. When students talk about the personal characteristics of innovative individuals, these individuals are curious (f=5), well-intentioned (f=4), careful (f=3), respectful (f=3), patient (f=3), self-confident (f=2) and intelligent (f=2) people. Under the theme of professional characteristics, students defined innovative individuals as those who think the most (f=6), have design skills (f=5), and criticize (f=3). Direct quotations from the students' answers to the question are given below:

S_1: *"…You should first visualize it before your eyes and do it better than that. It should be more critical. She/He should think about it and act accordingly. If someone does that in front of me, I think they should pay more attention to her/him."* (31.2514, 22.04.2022).

S_5: *"She/He is very strong, she/he has to think very well. One mistake, that innovative thing can break immediately.*

She/He should be very careful, confident, patient…" (39.5236, 22.04.2022).

S_6: *"She/He should be smart, smart. She/He should think logically, find ideas that make sense, ideas that will affect people"* (41.7874, 22.04.2022).

Secondly, "What do you think about the use of innovative activities in the Force and Motion unit?" question was posed. The codes and themes obtained from the answers given by the students and the frequency values indicating the repetition frequency of the answers were given in Table 6.

Table 6. Frequency values of the answers with codes and themes related to the second question.

Theme	Code	f
Information	Facilitating learning	6
	Understanding of the subject	5
	Providing thinking	2
	Providing permanent learning	1
	Providing visualization	1
Attitude and Value	Feeling excited	5
	Feeling happy	5
	Being motivate the lesson	5
	Liking the lesson	3
	Feeling curious	2
	Feeling confused	1
	Difficulty in designing	1
Behaviour	3D product design	4
	Internet use	2

When the codes and themes that emerged regarding the answers given by the students to the question are examined, it is seen that the answers are gathered under three themes: knowledge, attitude and values, and behavior. Students stated that the use of innovative activities in the Force and Motion unit had an effect on their knowledge. The effects of activities such as facilitating learning (f=6), understanding the subject better (f=5), providing thinking (f=2), providing permanent learning (f=1), providing visualization (f=1) under the theme of knowledge. They reported codes indicating that it was also observed that the students gave answers to the theme of attitudes and values. It was seen that the most emphasized codes by the students under this theme were feeling excited (f=5), feeling happy (f=5) and being motivated for the lesson (f=5). Finally, it was revealed that the students explained that the activities carried out during the lessons had an effect on their behavior. In this theme, students stated that their skills of designing 3D products (f=4) and using the internet (f=2) have improved. Direct quotations from the students' answers to the question are given below:

S_2: *"…The activities affected my learning of the subject, of course. For example, we made gloves, sir. I realized that doing it like this was more comfortable, but it was very difficult to design something for the glove*." (47.1027, 22.04.2022).

S_3: "…*I was excited before the lesson. I was wondering what we would do*" (40.2963.5236, 22.04.2022).

S_6: "*It refreshes our minds, helps us keep it in our minds, and enables us to get high grades even if we remember it when we come out in the exams. For example, if there is a project, I design new things in my mind, I go and research on the internet about the event…"* (51.1247, 22.04.2022).

Then, "What do you think about the use of innovative activities that we did together in the process in the science lesson? Please explain." question was posed. The codes and themes obtained from the answers given by the students and the frequency values indicating the repetition frequency of the answers are given in Table 7.

When Table 7 is examined, it is seen that the students reported codes that can be grouped under two themes as advantages and disadvantages for using innovative activities in science lessons while answering the question. While the students talk about the advantages of innovative activities, they say that these activities enable learning the lesson (f=6), provide the opportunity to use the information in daily life (f=4), increase motivation towards the lesson (f=4), improve thinking (f=4) and communication skills (f=2) and increased creativity (f=1). It was revealed that the students made statements such as being difficult to implement (f=5), difficulty in finding ideas (f=4) and causing problems within the group (f=3) as disadvantages of using innovative activities in science lessons. Direct quotations from the students' answers to the question are given below:

S_4: *"…Yes my teacher, it helps me to learn. There is a model plane that we made, for example, when we let it into the air, for example, the power force gives it upwards so that it takes off more… But on the other hand, I was saying that I can't do it, it's hard to come up with an idea or something. So it was hard…"* (49.5289, 22.04.2022).

S_5: *"…The learning effect is very good. For example, we built a walking ship with what we learned. We worked so hard on it. For example, we learned to be partners, and whoever said his project, we would agree with him. But we had some difficulties in the group"* (53.8057, 22.04.2022).

Table 7. Frequency values of the answers with codes and themes related to the third question.

Theme	Code	f
Advantages of innovative activities	Enabling learning the lesson	6
	Provide the opportunity to use information in daily life	4
	Increasing motivation towards the lesson	4
	Improving thinking skills	4
	Improving communication skills	2
	Increasing creativity	1
Disadvantages of innovative activities	Being difficult to implement	5
	Difficulty finding ideas	4
	Causing problems within the group	3

Finally, "When you consider the whole process, how do you evaluate the learning experience you have spent?" question was posed. The codes and themes obtained from the answers given by the students and the frequency values indicating the repetition frequency of the answers are given in Table 8.

Table 8. Frequency values of the answers with codes and themes related to the fourth question.

Theme	Code	f
Positive evaluations	Trying to design	3
	Applying knowledge to daily life	3
	Having a fun	2
	Collaborative work	2
	Trying to generate ideas	2
Negative evaluations	Difficulty finding with ideas	4
	Inability to work as a team	2
	Inability to agree	1
	Inability to put the idea into practice	1

When the themes that emerged regarding the answers given by the students to the last question are examined, it is seen that the themes are divided into two as positive and negative evaluations. While evaluating the whole application process, the students repeated the codes of trying to design the most (f=3) and applying knowledge to daily life (f=3) as positive evaluations. In addition, it was found that students made explanations about the process such as having fun (f=2), working collaboratively (f=2) and trying to generate ideas (f=2). While the students were making negative evaluations, they frequently repeated that they had difficulty in finding ideas (f=4). They explained their other negative evaluations as not being able to work as a team (f=2), not meeting a common idea (f=1) and not being able to put the idea into practice (f=1). Direct quotations from the students' answers to the question are given below:

S_2: "*…I always thought i would find an idea. For example, our idea is that we will design something, what will we design? We will design something like this, but it has to be innovative. I actually found it at home. My brother was helping me. When a plastic pen was rubbed against a rubber, the plastic pen broke, we saw it, it was a very fun activity, my teacher."* (59.1307, 22.04.2022).

S_3: *"My teacher is like this now, the disadvantage is no one listens to anyone, everyone does it according to their own mind, if we were a team, we would do better.*" (56.4058, 22.04.2022).

4. Discussion and Conclusion

With this research, it was aimed to investigate the effect of using innovative activities that were originally designed in the teaching of the Force and Energy Unit of the Science course, on

the innovative thinking tendencies of the students and to determine the students' views on the process. In the quantitative part of the study; The "Innovative Thinking Tendency Scale" was first applied as a pre-test to the experimental group who taught lessons with innovative activities and to the control group who taught lessons based on inquiry-based learning. It was concluded that there was no statistically significant difference between the groups' mean scores on the Innovative Thinking Tendency Scale pre-test scores. At the end of the study, the Innovative Thinking Tendency Scale was re-applied to the experimental and control groups as a post-test. With the analyzes made, it was concluded that the "Innovative Thinking Tendency Scale" post-test mean scores of the experimental and control groups showed a statistically significant difference in favor of the experimental group. When the literature is examined, Konakman et al. (2016), in their study; While reaching the conclusion that there is an increase in the innovativeness levels of the classroom teacher candidates who design innovative materials; Gök (2021), in his study, examined the effect of science-based entrepreneurship education integrated with the 5E learning cycle on the innovative thinking tendencies of 7th grade students. The researcher asked the students about the characteristics that an innovative individual should have both before and after the application. After the application, it was concluded that the definitions of students were more similar to the characteristics-definitions that an innovative individual should have in the literature (Gök, 2021). It is seen that the obtained result is supported by the literature. In this context, the reason why students' innovative thinking dispositions differ in their pre-test and post-test scores; It can be attributed to the fact that the students discovered the nature of innovation while they were designing innovative activities in the lessons, and that they produced new ideas and carried out activities in which they designed something new with the group. Therefore, this may be proof that the implementation process has a positive effect on students.

Afterwards, semi-structured interviews were conducted with the students selected from the experimental group. First of all, the students were asked, "What do you think are the qualities that an innovative individual should have? Explain" was asked. While answering this question, it is seen that the answers of the students converged on several points and the answers were explained with codes that can be grouped under two themes as personal and professional characteristics. Students learn the personal characteristics of an innovative individual; Curious, well-intentioned, careful, respectful, patient, self-confident, intelligent, sharing, logical, strong individuals. Professional characteristics of innovative individuals; They defined them as those who think, have the ability to design, and criticize, yearn, feel innovative, use their mind, attentive, find impressive ideas, and put forward plausible ideas. When the relevant literature is examined, it has been stated that an innovative individual has characteristics such as taking risks, being an entrepreneur, being able to tolerate uncertainty, being curious about new things, being open to innovations, and wanting to experience, using imagination, analyzing, self-criticism, and being compatible (Atalay Altaş, 2021; Atlı, 2019; Korucu & Olpak, 2015). It is seen that the definitions of the characteristics that an innovative individual should have are similar to the definitions in the literature. This shows that activities that support innovation have a positive effect on students' understanding of the characteristics that an innovative individual should have. Because during the application, students exhibited behaviors such as taking risks, using their imagination, criticizing, working in groups, searching for solutions to problems, struggling with the difficulties encountered while designing, producing something new or making a new addition to the existing one. It is thought that exhibiting these behaviors causes a positive reflection in students' discovering the characteristics that an innovative individual should have.

Secondly, "What do you think about the use of innovative activities in the Force and Motion unit?" The question was asked and it was found that the answers given could be divided into three themes: knowledge, attitude and value, behavior. Students stated that the use of innovative activities in the knowledge theme, Force and Motion unit, has effects such as facilitating learning, understanding the subject better, providing thinking, providing permanent learning, and providing visualization in the mind. Under the theme of attitude and value, the students explained that the use of innovative activities in the Force and Motion unit contributed to their excitement, feeling happy, being motivated, and curious about the lesson. Finally, under the behavioral theme, the students emphasized that innovative activities improved their ability to design 3D products and use the internet. When we look at the literature, it is supported by the studies of Bilgin et al. (2014), Kösterelioğlu (2014), Soysal (2019) and Özel et al. (2022) that the lessons in which the activities are carried out with group work arouse feelings such as happiness, excitement, and motivation for the lesson. It is stated by researchers that learning environments that prepare the ground for the development of creativity are an effective motivation method towards the lesson and contribute to the students' developing positive attitudes towards learning (Davaslıgil, 1984).

Then, "What do you think about the use of innovative activities that we did together in the process in the science lesson?" question was posed. While answering this question, the students talked about the advantages and disadvantages of these activities. When we look at the literature, it is seen that the courses organized with an approach that supports innovation positively support individuals to develop a positive perception towards innovation and to be innovative individuals. (Konakman et al., 2016). In addition, it is known that the use of social activities, experiments, projects, and academic research

in learning/teaching processes increases students' innovative thinking skills (Kalo, 2022).

Lastly "When you consider the whole process, how do you evaluate the learning experience you have spent?" question was posed. Students talked about both positive and negative aspects of the process. According to the literature, it is seen that the activities carried out in collaborative and project-based learning environments; known to increase innovation skills (Soysal, 2019; Tonbuloğlu et al., 2013).

5. Recommendations

The effect of innovative thinking activities on different variables such as students' academic achievement, attitudes and motivations towards the course can be examined.

The participant group of this study consisted of secondary school students. With other studies, different subjects can be taught with innovative thinking activities to different participants.

In this study, a mixed research was conducted by taking the opinions of the students on the process. Qualitative studies, in which the process is examined in depth, can be conducted with other studies.

By conducting different researches, using innovative activities in different subjects or units of the Science course, the effect of these activities on students' innovative thinking tendencies can be examined.

Compliance with Ethical Standards

The purposes and procedures of the current study were granted approval from the ethical committee of the Gazi University (12.03.2021 / 80287700-302.08.01- 51638).

Conflict of Interest

The authors have no conflict of interest to declare.

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