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Full Length Research Paper

The effect of formula t-shirt method for scientists taught in science lessons in secondary schools on academic success

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ABSTRACT

The aim of this research is to investigate whether there is a meaningful difference in the academic success, between the students who are applied the "formula t-shirt method" (experimental group) and the students who are not (in other classes of the school), in the education for the scientists wanted to be taught in the secondary school 5th, 6th and 7th grade science textbooks. Semi-experimental method was used as research method. In the 6th grade, 27 students participated in this study as experimental group (students wearing t-shirts) and 49 students in the other classes of the school that did not participate in the study. Academic achievement test including pre-test and post-test, informative observations, students' and teacher's interviews as well as 20 printed t-shirts were used to collect data. The pilot study of the developed achievement test was applied in another school and also the item analysis of it was performed. According to the research findings, when the experimental group's success post-test results from the application performed, were examined in line with the interviews, significant differences were observed. It was seen that the subjects aimed to be gained with the formula t-shirt method, were adopted by the students and also increased their success. Looking at the results of the research, thanks to wearing the t-shirts prepared by using the human body on the background, and the reconciliation of the students wearing with the scientists on t-shirts, the desired learning was provided. This also contributed to such learning techniques as peer learning, active learning, social learning in terms of visuality and integrity. It is thought that these materials developed with the formula t-shirt method, will also inspire researchers for future studies in terms of their usability in other fields and subjects.

Keywords: Formulated t-shirt method, primary education, material development, scientists, science education.

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INTRODUCTION

In our era, new developments and changes take place every day in the field of science and technology. As well as education, there are also significant innovations and alterations made in many fields such as economy, agriculture, tourism, industry etc. Societies and cultures subjected to continuous change, permanently affect each other and so, this interaction paves the way for different necessities for individuals. The most important of these requirements is undoubtedly education. As they create innovations in the field of education and training. the developments in the world based on science and technology, have made it necessary to constitute new curriculums. In this context, Turkey has also made a renewal in a systematic way in all education programs in 2018.

When the researches made on learning are examined, it is seen that most of the learning takes place through visual description. The habit of using text-based

sentences intensely prevents achieving the desired success in education and training field. It is known that there are different kinds of intelligence and one of them is visual intelligence (Bilasa, 2011; Mandacı Şahin, 2019). That is to say, some students learn better through visual descriptions. Indeed, it can be said that even the students learning in other ways may need visual elements while learning some concepts. Visual elements embody the abstract, increase the attention, simplify what is difficult to understand, and allow information to be seen as a whole. It should not be forgotten that students' past foreknowledge is also very important in this regard (Cornett, 1983).

Another issue that we have come across recently is infographic. Infographic is a form of presentation in which information is transferred visually and through graphics. It is one of the ways to make life easier by enabling us to better understand our environment and everything we interact with. We frequently encounter with infographics which are used to transform the raw information obtained from dense and complex data into more understandable and easy information (Denli, 2016). Foresights show that we will need visual information in the coming years much more. Presenting the information visually, infographics' creating a catchy situation in the minds is seen as one of the important reasons for the increase in the demands for it. In this study, by making use of the infographics, both education has been contributed and through different perspectives, the desired learning has been tried to be provided. In that, a particularly large part of the information stored on the web pages of Internet is filled with textual content Therefore, as internet users, we may be exposed to information bombing intensely and we may get overwhelmed by this situation. When we have to convey information or messages, one of the most effective ways to stand out from these dense stacks of information is transferring the information in a visual way. Because human brains scan an image three times faster than a text.

In addition, while only 20% of the textual information we encounter sticks in our minds, the retention of visual information's rate is 80%.

Because information is processed in short-term memory and then transferred to long-term memory, one of the most popular ways to apply has been memory supportive tips. The basic process used there is "repetition". Integrity is achieved by making sense of the images and writings in memory and associating them with shapes. Therefore, thanks to the inclusion of more sensory organs in learning process, it becomes easier to encode the information in long-term memory and to recall it when necessary (Korkmaz and Mahiroğlu, 2007).

In accordance with this purpose, t-shirts used in science fairs held in Turkey, have been applied to increase the motivation of children participating in them. The Scientific and Technological Research Council of Turkey (TUBITAK) is of the opinion that printed t-shirts are very important to raise awareness of the participant students in project-based studies. The names and emblems of the schools are printed on TUBITAK printed t-shirts made to highlight the names of their own schools, which the students represent at the fair. In order to attract attention to any project, whenever desired, it is possible to highlight the project and attract attention by placing an emblem or icon about the project or the subject on the t-shirts. The printing of an emblem or an icon about the projects that they produce on t-shirts makes students feel more special, valuable and successful (URL-1, 2019).

In this research, the learning's permanence is tried to be supplied through designing the t-shirts to appeal to more sense organs thanks to the writings and visuals for the inventions and studies made by scientists, on them. Therefore, as a result of the learning process with the formula t-shirt method, a different method such as expressing the scientists and their work with visuals, short and concise sentences, it has been examined whether there is an increase in the academic success of the students via this method.

METHODOLOGY

It is already known that the methods of the studies change according to their environmental conditions, subjects, purposes and problems. Therefore, when the researches and studies conducted in this field are examined, semi-experimental method is considered to be the most appropriate method for the purpose and problem of this study (Karasar, 1999; Demircioğlu, 2003; Küçüközer, 2004; Çepni, 2018). In this study, trilogy was performed using interviews, tests and observations to increase the reliability. The aim of this research is to investigate whether there is a meaningful difference in the academic success, between the students who are applied the "formula t-shirt method" (experimental group) and the students who are not (in other classes of the school), in the education for the scientists wanted to be taught in the secondary school 5th, 6th and 7th grade science textbooks. So, in order to evaluate the effectiveness of those materials, "semi-experimental method with pretest and posttest experimental groups" was used (Robson, 1998; Kaptan, 1998; Karasar, 1999; Yıldırım and Şimşek, 2005).

Universe and sample

The universe of this study consists of all 5th, 6th and 7th grade students at secondary schools in Eleskirt, a district of Agri province, in 2018-2019 academic year. In the 2018-2019 academic year, the 5th, 6th and 7th grade students of 100th Year Secondary School in Eleskirt, which is thought to represent the universe in the best way, formed the sample of the research.

Data collection tools

The data of this research includes the studies and discoveries made by scientists within the subjects taught in the 5th, 6th and 7th grade science lessons. The majority of the pretest and posttest questions were prepared by the researcher within these subjects and applied to the students after item analysis. In the application of the formula t-shirt method prepared for these scientists who are involved in the subjects in science lesson, the feelings and thoughts of the students were taken though the semi-structured interview questions. In addition, the behaviors of the students during this process were examined and noted by using the observation method. "Academic Achievement Test, Semi-Structured Interview Questions and Unstructured Observation Form" were used as data collection tools.

Process

Before the implementation of the study, “Formula T-shirt method” was explained to the teacher who would carry out the application and the other teachers entering the related course. They were also shown materials containing examples of the method and the examples of "what else might be topic to the study” were presented. So, the introduction of the method and the relevant information were given to the teachers. In order for the students to adopt the “formula t-shirt method”, to bring the new information into the long-term memory and to bring it back when necessary, to make the application entertaining, the practitioner teacher saying that the t-shirts had to be worn for a certain period of time, gave the necessary preliminary speeches to the students about the method. Then he released the students to configure the information themselves and told them that they had to wear the t-shirts during two weeks without extra explanation.

The students were informed that when they want to get additional information or learn more about the scientists during the activity period, if they could ask a question to the teacher, an explanation would be made; otherwise the teacher wouldn’t give any extra information. The main purpose in doing that was to enable the students to learn and research by themselves actively and socially through a student-centered approach, and to better observe how effective that application was.

Data analysis

Before and after the study, the "Scientists’ Inventions Test (SIT)", consisting of 20 multiple choice test questions, was applied to the experimental group and the other students in the school who did not wear T-shirts. In the research, the opinions of the students were taken through the semi-structured interview method on how the subjects related to the scientists included in the science lesson, were handled by the t-shirt method. In addition, thanks to the interview with the practitioner teacher, the positive and negative aspects of the method were discussed. Interviews were recorded with a voice recorder and put down on a paper in a way that does not change the meaning. In addition, the observations were recorded by taking photographs, taking notes and videotaping. The pre and post-test values of the study were transferred to the computer via “Excel” program. Then “Windows For SPSS 20.0" package program was used to check whether there is a significant difference between the obtained data. So, after analyzing the necessary data, they were interpreted in the findings section.

FINDINGS

Findings from the achievement test

Findings obtained through the Scientists' Inventions Test (SIT) applied to the experimental group (students wearing t-shirts) and the other groups of students who do not wear T-shirts within the scope of science lesson, take place in this section.

As seen in Table 1, considering the pre-test and post-test scores of 76 middle school students from SIT at science lesson, the range value has increased. The standard deviation value is a measure for the difference between 76 students' grades from SIT. When both tests are compared according to the standard deviation value, it can be said that the difference is not too much since the difference between the tests is not very large.

As shown in Table 2, when the levels of SIT pre-test scores of the experimental group and other students in the school were compared with the independent t-test, it is seen that the average of the experimental group students is “X = 40.1852”. On the other hand, for the other students at school, this average is "X = 39.2857". Therefore, it is seen that the SIT grades of these two groups are quite close to each other and the average of the experimental group is slightly higher than the other students’ in the school. Considering the pre-test results applied to compare the success of the experimental group and the other students at school before the application, it can be said that both groups are equivalent and there is no significant difference between them ($t(74) = .252$; $p > 0.05$). This shows that the success of both groups at the beginning of the study migt be regarded as equal.

In Table 3, the SIT post-test scores of the experimental group and the other students at school were compared with the independent t-test. It is seen that the average of the students in the experimental group is "X = 60", while the average of the other student groups in the school is

Table 1. Statistics data showing the total number of students and range before and after the application.

	N	Minimum	Maximum	X	SS
Pre-test	76	15.00	80.00	39.60	14.80
Post-test	76	20.00	90.00	51.77	16.36

Table 2. Comparison of SIT achievement pre-test scores of the experimental group students and the other students who do not wear t-shirts through independent t-test.

Groups	N	X	Std. Deviation	Sd	F	t	p
Experimental Group	27	40.18	16.66	74	1.25	.25	.80
Students not wearing T shirts	49	39.28	13.84	74			

Table 3. Comparison of SIT achievement post-test scores of the experimental group students and the other students who do not wear t-shirts through independent t-test.

Groups	N	X	Std. Deviation	Sd	F	t	p
Experimental Group	27	60.00	15.06	74	0.74	3.48	.001
Students not wearing T shirts	49	47.24	15.37	74			

"X = 47.2449". Therefore, it is seen that the SIT averages of the students of these two groups differ from each other, so it can be said that the experimental group is more successful than the other student group in the school. Considering the posttest scores, it can be said that there is a significant difference between them ($t(74) = 3.485$; $p < 0.05$). When the posttest standard deviations of the experimental group and the other student groups at school are analyzed, it is seen that there is a little difference and the standard deviation decreases compared to the pretest.

The comparison of the SIT pre-test and post-test scores of the experimental group with the dependent t-test is presented in Table 4. As a result of this comparison, there is a significant difference between the tests ($t (26) = -6.909$; $p < 0.05$). This difference is in favor of the posttest. According to the pretest success scores, they were more successful in the posttest. Looking at the averages between the two tests, it is seen that there is an increase of approximately 20 points. So, the increase in the scores of the experimental group students was higher than the other student groups in the school.

The comparison of SIT pre-test and post-test scores of the other students who do not wear T-shirts with dependent t-test is presented in Table 5. As a result of this comparison, there is a significant difference ($t (48) = -5.517$; $p < 0.05$) between the tests. This difference is in favor of the posttest. In other words, according to the pretest success scores, the students are more successful in the posttest. Looking at the averages between the two tests, it is seen that there is an increase of approximately 8 points.

Table 4. Comparison of the SIT pre-test and post-test scores of the experimental group with dependent t-test.

Groups	N	X	Std. Deviation	Sd	t	p
Pre-test	27	40.18	16.66	26	-6.90	.00
Post-test	27	60.00	15.06			

Table 5. Comparison of SIT pre-test and post-test scores of the other students who do not wear T-shirts with dependent t-test.

Groups	N	X	Std. Deviation	Sd	t	p
Pre-test	49	39.28	13.84	48	-5.51	.000
Post-test	49	47.24	15.37			

Findings from the interview method

After the t-shirt method with the formula was performed, interviews were made with students and teachers. The interviews with the students and the practitioner teacher on their evaluations of the application were discussed under two subtitles. Interviews were recorded with a voice recorder. In total, 5 questions were asked to 5 experimental group (wearing t-shirt) students and their opinions were received.

Interviews with students

Thanks to the interviews with students in experimental group, it was observed that they were very satisfied with the application in general. They felt belonging to a group and valued. Each student put himself in the shoes of the scientist on the t-shirt he wore, and talked to his other friends about their inventions. Therefore, it was seen that they enjoyed with that situation very much.

Question 1: *You wore the t-shirts for a certain period of time in the school environment and walked around. So how did the people around you and also your friends react to you?*

When the answers given to this question are evaluated by considering the expert opinions, it is understood that the other students at the school were also eager to wear the t-shirts. They wondered what was written on the t-shirts and that they generally read the writings on them. On the other hand, it was observed that the students in the experimental group did not want to wear t-shirts anymore towards the end of the second week and compared to the beginning, their attractiveness decreased. The most important reasons for that case were that the messages on the t-shirts were already transferred and the learned information was not wanted to be read again.

Question 2: *Do you think this activity has contributed to you?*

When the answers given to this question are evaluated by considering the expert opinions, it is seen that the contribution of the activity to the academic success of the students was quite high. Arousing a sense of curiosity in students, it revealed their desire to become a scientist and to make an invention. The power of the visual elements was also at the forefront in that application. This is because the students remembered the pictures of the scientists better by seeing them on the t-shirts and reconciled their friend with that scientist, so their memorability towards that scientist increased.

Question 3: *As you know, there were photographs of the scientists and their scientific studies on t-shirts. Well then, did you ever read these studies during the activity period? What would you like to tell about this matter?*

When the answers to this question are evaluated by considering the expert opinions, it is understood that the students read the writings on the t-shirts and also carefully examined the pictures. Especially the pictures of scientists were more permanent on students. Therefore that revealed how great the importance of visual design elements was. In the study, colored prints were made on the surface of the white t-shirts and features such as the color, font, and letter size of the articles were also taken into consideration. In researches about learning process, it is seen that most of the studies are realized through visual descriptions. Similarly, t-shirts used as materials, embodied the visually abstract concepts and also increased the permanence as a different method in transferring them to long-term memory, in this study.

Question 4: *Do you find the activity entertaining, why? Would you like this to be applied for the learning of other subjects in science or other lessons?*

When the answers given to this question are evaluated by considering the expert opinions, it is seen that the students had a lot of fun during that activity. Looking at the interviews and test analysis results, this method taking away from the expository teaching approach but vigorously centering the students and enabling them to learn by seeing from each other, seemed quite successful. It was observed that the students wanted to use this method in other lessons, especially in mathematics. Especially at maths, where there are many abstract concepts, it is predicted that embodying of the subjects and showing them to students on the t-shirts as materials will increase students' academic success. It will also be cost-effective to have these materials available to the other students in the coming years.

Question 5: *What were the negative behaviors you encountered with you or your friends while you were wearing the T-shirts?*

When the answers given to this question are evaluated by considering the expert opinions, it is seen that the students did not encounter any negative behavior from other people while they were wearing t-shirts. It was also determined that the other students at the school were eager to wear t-shirts and they wanted to do the same activity for themselves. It was observed that the other groups' students who did not wear t-shirts in the school were in touch with the students in the experimental group during the break times. That case inevitably increased the effectiveness of the method much more. The most important negative condition encountered was that the event was held in the Eastern Anatolia Region and in the

winter season. Therefore, it was found that students had difficulties in wearing t-shirts over school uniform. As a result of the interviews, one of the situations determined by us, was that during the break times, however the students wrapped up such winter clothes as coat while going out to the school garden, they did not button up their clothes in order to show the front of the t-shirts. Unfortunately that made them feel cold.

As a result, when the interviews with students of the experimental group (wearing t-shirts) were evaluated, it has been determined that the t-shirt method with formula was generally appreciated and adopted by the students, moreover this method was requested to be applied in other lessons, especially in mathematics. Students felt valuable while wearing the t-shirts. Increasing their own motivation, taking more active role in education and meeting the intense interest of the people around them made them much happier. Thanks to this method, the experimental groups draw intense interest with the curious eyes of other students in the school. Drawing all the attention towards themselves, they took the business more serious and answered the questions by putting themselves in the shoes of relevant scientist. Like so, they both had fun and did learning with a different method.

Interviews with practitioner teacher

In this section, the teacher who participated in the lesson of the experimental group students was interviewed and his opinions about the relevant method were taken. The question "*What are your positive and negative thoughts about the formula t-shirt method?"* was directed to him. The teacher stated that he liked the formula t-shirt method and found it successful. He highlighted that the pictures on the t-shirts delighted the students and they made sentences internalizing his discovery by seeing themselves as that scientist. He also offered that this method would be quite effective especially in teaching the organs in our body. Although the students wearing T-shirts showed signs of boredom at the end of the second week and some of them even did not show enough interest, he pointed out that it was effective on permanent learning in general.

Finally, in line with the answers given by the experimental group students and the practitioner teacher, if we make a general evaluation, it is anticipated that the teaching through the same method both in other subjects and in other lessons will be quite enjoyable and instructive for students. This is a method that actively centers students and turns them into individuals responsible for their own learning. It is also an application, a mixture of peer based learning and social learning. In this process, by making students naturally do mental repetitions what they saw during 10 days, the relevant information was configured in their minds. It was observed by the researcher that the students created a new scheme by comparing the old information with the new information and in this way they encoded the information in their minds. Thus, the "T-shirt method with formula for scientists" was applied and the findings obtained through this method are given as seen above.

Analysis of observations

In order to examine the effect of the developed teaching method on the students' and teachers' interest in the course and subjects, to observe how students' behaviors and communication are and also to collect data supporting the interviews, the observations were made in this study.

An unstructured observation study was carried out for determining the students' behaviors in the learning environment and observing their approaches to the application. Those observations were sometimes recorded with a tape recorder and sometimes with a video camera. It was observed how the students who wore printed t-shirts prepared within the scope of the "formula t-shirt method", were met by other students in their classrooms and at school. Through these observations, it was seen that the students enjoyed the formula t-shirt method very much. As if the writings on t-shirts had belonged to their own studies, some students also adopted the features of the scientist on the t-shirts they wore, so much that they even provided information just to spite to their friends. It was determined that students wore t-shirts excitingly in the beginning but they started to get bored towards the end of two weeks and the interest in t-shirts also decreased.

It was observed that the students in general, were happy with the speeches and behaviors they made towards this study during the activity. It could be seen from the post-test results that there was also an increase in academic success. In addition, whether there were any students who did not come to school and whether the students in experimental group wore t-shirts regularly were followed by the researcher himself during the activity. The activity applied during a two-week period. It was seen that the students wore t-shirts but started to get bored towards the end of two weeks and also the interest in t-shirts decreased.

Students' adopting this method, seeing themselves as a scientist and passing funny time thanks to this method were observed by the researcher. Teaching lessons in a monotonous way can easily stray away the students from the subject, so activating them for keeping their attention alive is necessary.

DISCUSSION

The results of the findings, interviews and observations

obtained in the study are interpreted in this section. In addition, the main purpose of the research and other sub-purpose are discussed in detail under two titles.

Discussion on the main purpose of the research

The main purpose of the research, to investigate whether there is a meaningful difference in the academic success, between the students who are applied the "formula t-shirt method" (experimental group) and the students who are not (in other classes of the school), in the education for the scientists wanted to be taught in the secondary school 5th, 6th and 7th grade science textbooks, is discussed in line with the findings.

Considering the SIT results of students in the experimental group and other branches of the school done before the application, the arithmetic mean is approximately 39.73% in this 20-question and 100-point multiple choice test. The fact that the average of both groups is very close to each other is an indication that there is no significant difference between the groups before the application. As proving this result, considering the results of independent t-test analysis, ($t(74) = .252$; $p > 0.05$) indicates that the successes of both groups are equally achievable at the beginning of the study. Al (2016) in his study on the subject of electricity at 7th grade science lesson, also used the formula t-shirt method and stated that the value between the groups is quite close to each other in the pretest done before the application and so there is no significant difference between them. In both studies, pre-application student achievements are close to each other and it is seen that both studies support each other in this regard.

Looking at the point averages of both groups in this study, it could be said that the levels of readiness before the application were sufficient and they were not at insufficient level on the subject completely.

Prepared as a multiple choice test, SIT's pilot study was carried out in another school. In line with this pilot study, item analysis of the questions was made. After difficulty and discrimination values of the questions were reconsidered, weak distractors were corrected and all necessary corrections were made, SIT was applied as pre-test and post-test in the school where the main study would be performed.

Following the application of the method, post-test was subsequently applied to the students. Looking at the average scores of the experimental group students between both tests, in line with these test results, there is an increase approximately 20%. In other words, the applied t-shirt method gave the desired result in the experimental group. Looking at both test results of other students who did not wear t-shirts at school, there is an increase of approximately 8%. This increase indicates that there is an indirect interaction and learning in the classes where the application is not done. Although this is an undesirable outcome, it is a very important result in terms of indirect learning and social learning, as it performed learning even in individuals where the method had never been applied. In line with the findings obtained as a result of his research, Al (2016) observed that there was a significant increase in the average of the experimental group (application group), while there was a decrease in the control group as an opposite situation. However, in this study, it was observed that there was a significant increase in the scores of other students in the school, too. This is thought to be due to the fact that the pictures and shapes on the t-shirts that Al (2016) used as materials were drawn by the students and this might cause the t-shirts to be visually less attractive. However, in this study, after the prints on t-shirts used as materials prepared in a more colorful and visually enriched form and with more attention to selectivity in perception, were done the t-shirts were presented to the students.

Discussion on the first sub-purpose of the research

The first sub-aim of the research is to determine the positive and negative opinions of the students in experimental group, to whom the formula-t-shirt method was applied and the other students at the school, to whom the formula was not applied. In accordance with this purpose, interviews with both groups and relevant comments are discussed.

In this student-centered activity, it was determined via teacher observations that they loved the prepared t-shirts, they had a sense of responsibility and they carefully protected the clothes. In addition, a sense of "curiosity" emerged among students about what the studies done on scientists were and it was seen that this feeling created a consciousness by directing students to the research process. As a result of interviews with the students who did not wear t-shirts at school, some of them said that they liked the activity and were happy while some disliked it because they thought it was unnecessary. In the study conducted by Al (2016), when the interviews with the students are observed and their answers are examined, similar results are seen in general. The participant students' thoughts were also similar to these results. In our research, it was also a disadvantage for the participants to make the application in the winter season. In that, students usually got bored during the breaks, due to staying in school. However, the t-shirts' being colorful and good looking made both groups highly appreciated and attracted with interest.

Açıkgöz (2003) states that role playing, in a sense, is showing and discussing of the problem with movements. He expresses role playing as displaying that behavior like them by taking on the roles of other people, students or objects. Except for unlimited research, when students act in front of other people, they see themselves more active in the relevant events. In such cases, students can

express and exhibit the behaviors and emotions, apart from their own beahviours and emotions (Posner and Rudnitsky 2001). Through the Formula T-shirt method, as mentioned above, the researcher and the practitioner teacher also witnessed that students wearing t-shirts exhibited such behaviors as role playing and animating by putting themselves in the scientists' shoes who are printed on the t-shirts.

Within the scope of the interview with the teacher, the positive and negative aspects of the method are discussed. He said that there might be also some subjects wanted to be taught via this method. He stated that this method would be very useful for explaining abstract concepts to students with pictures and visuals, and added that it could be used again all the time every year. In respect to that, he stated many concepts and topics such as digestive system, circulatory system, excretory system, structure of the heart, structure of the kidney, support and movement system, structure of DNA and cell. Norooz et al. (2015) in their work "A new approach to body learning with wearable perception and visualization", in order to teach young children to what are the positions and functions of internal organs and systems such as circulation and excretion on the human body, they printed them in three dimensions on t-shirts. It is seen that their method basically made using the human body, also supports the teacher's views.

Discussion on the second sub-purpose of the research

The second and last sub-purpose of the study is to evaluate the formulation t-shirt method in terms of the application teacher at school. He said *"The boards, paintings hung in corridors and many other visual elements at the school are constantly renewed for students to read. In fact, the values education board is renewed every month and the messages to be given to the students are transferred in this way. Bored from the usual situations after a while, students of course look for different, different and interesting topics. In this context, it is seen that the students want to learn by the methods far from ordinariness, and participate actively in this process. Although it is constantly renewed, since the writings on these panels are very intense, the students' interest for them also decreases. The reason for this is that after a while, boards with long articles or other sources such as books, magazines are seen as a mind-numbing thing by the students."* In the light of this information, it is observed that the students' attention was attracted far greater by using the formula t-shirt method, different from the others. According to Sezgin (2016), wearable technologies are tools that do not push human physical limits, but aim to increase their cognitive, sensory and communicative capacity. Therefore, it can be thought that the study also serves this purpose.

New generation students want to be self-learning individuals through seeing, living and actively participating with concise expressions not infogluting. Infographic design which has become an increasingly important subject in recent years, is a resource to help this goal. Because not only transferring the knowledge but also teaching science supported by writing and visuals, are very effective on the social environment. The best example of this may be a photo we see on social media, a picture that attracts our attention on news pages or a visual element we encounter in sources such as newspapers and magazines. Thanks to the short sentences given beside the visuals like these, it can be better understood how much is being told about that subject and what it means.

In his study, Dick (2014) stated that information can be presented with very little explanation thanks to infographic that provides the opportunity to present information in a logical order and includes many factors such as graphics, pictures, flow charts and tables. With this study, which presents scientists' work through t-shirts, it is tried to be shown that a lot can be explained with brief information. So, it also supports the research done by Dick.

According to Smiciklas (2012), the human brain processes all the information consisting of pictures at once, while it processes the texts one by one, which may also support how important the visual elements and such studies are. In this regard, he states that thanks to the infographics allowing the visualization of the information, complex information can be processed easily and quickly. For this purpose, it is pointed out that it is possible to use the infographics in presenting very intense, long to read and boring information with visual elements such as tables, flow charts, pictures and graphics in order to make it more remarkable and permanent (Gülrenk 2015). As stated above, with the use of visual elements and infographics, the permanence of the information presented in the research, was tried to be provided in a more meaningful way.

In this study, it was aimed to save the subject from boringness by placing the pictures of scientists in a way to create selectively in perception on the t-shirts. In addition, a more enjoyable and heart-warming learning environment was created in this way. That situation attracted the attention of the other students who did not wear t-shirts, in the school and in line with the interviews, it was seen that they also wanted the same application to be done for them. Moreover, they wanted it to be applied not only in science but also in other lessons such as mathematics and Turkish. As a result of the interviews conducted, it is predicted that especially, the subject of operations in the mathematics lesson could be learned better by the students thanks to enriching the subject with colorful and visual contents and printing it on t-shirts. While analyzing the interviews of his research, Al (2016) determined that there were students wanting that method

to be applied in different courses. Similarly, as a result of this research, it is seen that both the practitioner teacher and the students wanted this method to be applied in different courses.

In their study, on internal organs and systems subject, Norooz et al. (2015) proposed a new approach, called "BodyVis," an e-textile t-shirt that combines biometric detection and wearable visualizations to reveal invisible body parts and functions, three-dimensionally on t-shirts and shirts. Similarly, the successful results of their research also support this study.

In another study, Doğan et al. (2017) developed a project that instantly measured the temperature, pressure, humidity, air pollution and altitude values of the environment and displayed to everyone there. They did it through a smart t-shirt that the participant students could wear and walk around to examine the weather conditions of their region. Students who had the opportunity to interpret and analyze, also experienced doing research just like a scientist. As a result of the literature review, it can be said that the investigated studies' like that and our research's results are similar and support each other.

There are many ways to present information, but teaching materials including multimedia learning elements are very important while the learning is being performed. It is emphasized that the alternative methods presented by supporting the information with visual elements and enriching the educational environment, should be preferred in the learning process (Yıldırım et al., 2014).

The subjects that had been desired to be gained, tried to be explained to the students after a certain period of time with the wear - walk - explain stage in formula t-shirt method, which made them fun and took them away from the routinized expression. Thus, it was tried to develop a method that would contribute to the learning environment and also parsimoniously economical through the reuse of T-shirts.

One of the reasons for doing this study is the infographic approach, whose importance has increased in recent years. According to this approach, because this increases the attractiveness and perceptual selectivity, visual message and therefore visual learning has a very important place in social media, news sources, newspapers, advertisements and many other communication media. Thus, the requested messages are transferred to individuals by using visual elements and short explanations. As a result of the observations, it is seen that the use of infographic in education both creates a fun environment and makes students active learners by taking them away from the routinized expression methods.

Before the t-shirts' prints were made for this study, and in another school, the inventions and their information of the scientists were transferred to t-shirts as pictures and also students views were received. In line with those ideas, the pictures were arranged in a computer environment and also printed. The purpose of doing so was to determine in advance which image meant "what" for the students, taking into consideration their age and readiness levels. In this way, for academic success, we could progress more accurately towards the result and become more effective. Considering the elements of the communication process, we know that encodings and encryptions should be done for the information to be more permanent in mind. Therefore, by using memory supporting elements with visual elements, concepts could be made more permanent. For example, the students reconciled the scientist on the shirt he was wearing with their own friend, through "loci method". By that way coding was made and so the learning was performed. In addition, during that two-week study, beacuse the students wore those t-shirts, they had to look at that information, even if it's involuntarily, every day. So, open and latent repetitions were provided and then the learning was performed.

RECOMMENDATIONS

1. During the preparation of the materials and the removal of the deficiencies, pilot implementation of the study and accordingly re-preparation of the application according to the opinions of the students and their level are recommended to be done.
2. At the implementation stage, it should be checked with a note daily whether the students are wearing t-shirts and who, if any, does not come to school by the practitioner teacher or the researcher. Therewithal, it should be discussed in the interview that the application teacher should not make a grade assessment for the students or reflect this study on the school report at the end of the application. It is suggested that such important points should be taken into consideration and great attention should be paid to details.
3. Considering the development period of the experimental group students to whom the application is made, the sizes of the t-shirts and the figures, pictures and writings etc. on them should be designed in a sensitive way that may not offend students.
4. It can be suggested that a similar study can be performed not only on different subjects of science lesson, but also on the subjects of other lessons. For example, new scientific studies can be designed on "the lives and pictures of sultans in History lesson", "a brief autobiography of the presidents in citizenship lessons", "learning vocabulary in English lessons", "sets and multiplication tables in mathematics lessons" or "systems in science lessons".

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