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The effects of a story-telling approach on sixth-grade pupils' values, attitudes and motivation with regard to studies of the human nervous system

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ABSTRACT

The current study investigates the effects of instruction with the storytelling approach on sixth-graders' values, attitudes and motivation in relation to the study of the human nervous system. The instruction consisted of a series of lessons on the human nervous system in which nine stories were included. The study employed a one-group pre-test and post-test design. Twenty-four pupils, all of whom were girls, participated in the study. The Dilemma Cases Form (Inventory), an attitude scale towards science, and a motivation scale for science were administered before and after the intervention. Pre and post-tests were compared using the non-parametric Wilcoxon's Rank Sum Tests. The results indicated that sixth-graders who were exposed to story-telling as part of the instruction improved their scores on the values and attitudes toward science scales but not those for motivation. Based on the results, it is argued that the story-telling approach in the unit on the human nervous system could be a good source of enrichment for sixth graders in science education.

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Introduction

Learning denotes the acquisition of concepts, facts and rules within the cognitive domain; values, attitudes and emotions within the affective domain, and psychomotor domain. An instruction must consider the balance to be achieved among these three core domains (Montague, 1987). The values within the affective domain cover value education and methods that can be used in value education have been discussed in many studies (Erkenekli, 2012; Ghobakhloo et al., 2023; Gribble et al., 2000; Ursekar & Naik, 2023). However, contemporary trends in science education suggest that more research is needed to address school learners' development in the affective domain compared to the cognitive part (Odden et al. 2021).

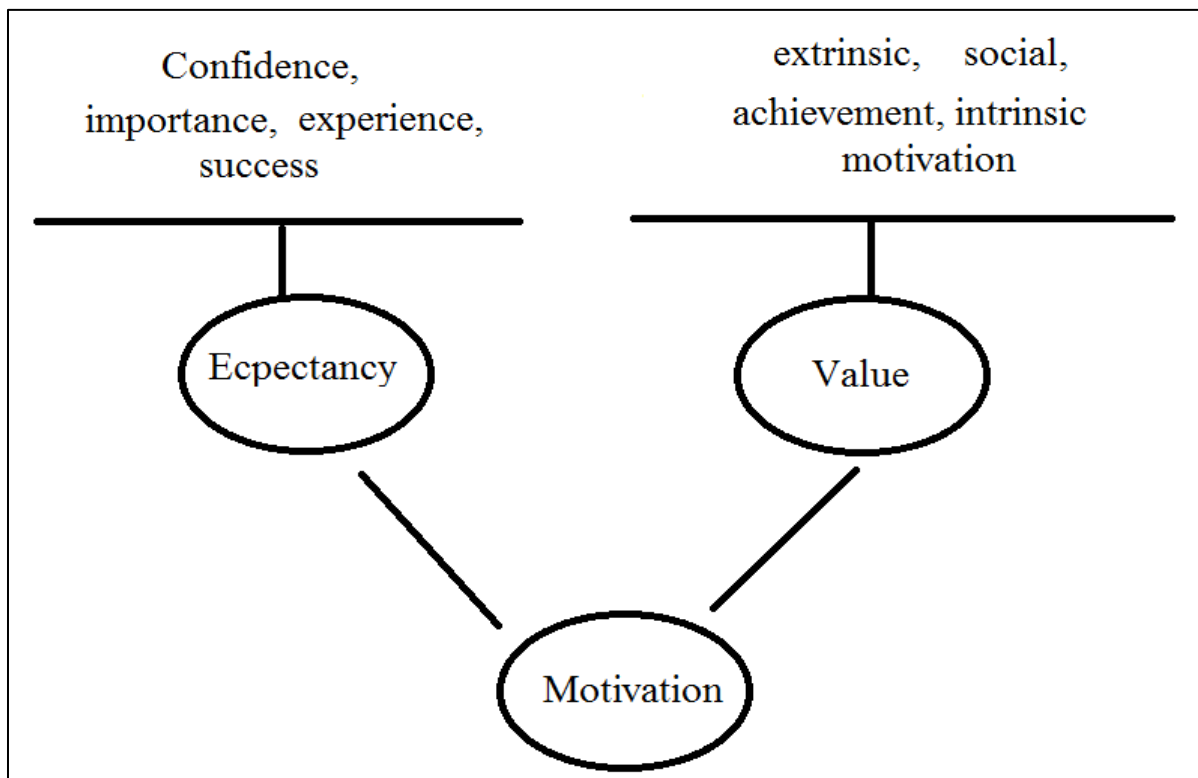
Research on values education in science education focuses on integrating ethical and moral principles into science learning (Davis, 2023; Demiryurek, 2023). The studies examine how to integrate values such as environmental responsibility, honesty and empathy within scientific contexts. This research explores pedagogical methods, curriculum design, and assessment strategies that promote not only scientific knowledge but also ethical decision-making and responsible behavior. This

integration requires consistent and coordinated values education in all schools. Although the courses in which values education will be included are specified in the programs, values education should be approached holistically throughout all courses and the education process. There have been a variety of methods, such as collaborative group studies, movies and interactive simulations aimed at integrating values into science instruction (Demiryurek, 2023). However, there is scant research examining the effects of values embedded story-telling on students' various affective domain outcomes, such as motivation and attitude.

Motivation and attitude are other affective domain outcomes and closely connected to values. For instance, according to Feather's (2021) expectancy-value theory as seen in Figure 1, values has profound effect on motivation.

Figure 1

The Components of Expectancy Value Theory



Note. Feather, 2021

Expectancy value theory refers to a psychological framework that explores the factors influencing human motivation and behavior. It suggests that people's choices and actions are guided by two main factors: their expectations about outcomes and the subjective values they attach to those outcomes. These core concepts exhibit robust interconnections and have a relative influence on one another, including their impact on value.

Research on motivation and attitude in science education often finds that positive attitudes and strong motivation towards science are linked to better academic performance, increased participation in science-related activities, and a greater likelihood of pursuing science-related careers. Conversely, negative attitudes or low motivation can lead to disengagement, lower achievement, and reduced interest in science (Chi & Wang, 2023).

Researchers explore how teaching strategies, curriculum design, and classroom environments impact students' motivation and attitudes. Creating engaging and interactive science lessons, incorporating real-world applications, and promoting can foster positive attitudes and enhance motivation (Izzah et al., 2023).

Overall, research in this area highlights the importance of nurturing motivation and cultivating positive attitudes towards science, as these factors play a crucial role in fostering a lifelong interest in the subject and contributing to a scientifically literate society. Story-telling approaches embedded in values have yet to be examined (Radulović et al., 2023).

This study aims to investigate the effects of blending scientific stories with values on sixth-grade pupils' values and motivation, on the topic of the Human Nervous System.

Methods

The study employed a one-group pretest-posttest design. As elucidated by Campbell and Stanley (1963), this design involves examining one or more variables by conducting tests on a treatment group without a control group. A pre-test is administered before the experiment, followed by the intervention (treatment), and a post-test is implemented to ascertain whether the observed enhancements can be attributed to the treatment (Fraenkel & Wallen, 2009).

Participants

The participants in this study were 24 sixth grade pupils, all girls, studying in a middle school in the Akcaabat district of Trabzon province in Turkey during the second term of the 2018-2019 academic year.

The intervention

The treatment involves nine stories dedicated to teaching the human nervous system unit blended with values such as compassion, perseverance, hard work, tolerance, sacrifice, responsibility, and cultural heritage. The whole unit is an 18-hour class designed for sixth-grade learners. The stories and topics covered in the unit are illustrated in Table 1.

Table 1
Stories and Embedded Values Used in the Intervention

Story number	Topic	Value
1	The human eye, disorders, diseases, and the use of technology.	Compassion and perseverance
2	The skin, disorders, diseases, and the use of technology.	Cultural heritage
3	Human central nervous system.	Hard work and perseverance
4	Human endocrine system.	Hard work, responsibility, and cultural heritage
5	The anatomy and function of the human nervous system.	Cultural heritage, hard work, perseverance
6	Human Nervous changes during puberty and health.	Tolerance and responsibility

7	Human reflex.	Perseverance, sacrifice, and hard work.
8	First aid basics.	Hard work, sacrifice, and compassion.
9	Organ donation.	Sacrifice and compassion.

As an example, the topic of “The Skin: Disorders, Diseases, and the Use of Technology” was covered during a 2-hour session. The lesson followed the 5E instructional design framework. Throughout this course, pupils discussed concepts such as touch senses, their functioning, and related disorders.

In the discovery phase, a story about the discovery of penicillin by Fleming and Avicenna's contributions to this ground breaking discovery was presented to the students. As shown in Figure 2, an illustrative story was distributed which learners were then asked to read. The teacher subsequently elucidated the critical aspects of the stories, including the emergence of penicillin, Fleming's role, and Avicenna's discoveries related to microorganisms in an explanatory setting.

Figure 2


An Example from a Story about Cultural Heritage Illustrates Avicenna's Breakthrough in Microorganisms and Its Contribution to the Discovery of Penicillin

İBN İ SİNAYA VEFA

Atlı kardeşlerin hepteniydi Alexandre. Abileri ve atası, o ve kardeşi doğmadan önce 27 gün içinde ölmüşler. Ölen ailelerini arayışı, 1870'lerin başlarında büyük bir hasta sayılan amansız çönan hastalığı. Annesinden doğuyordu Alexandre ve kız kardeşi Aşina büyük kardeşlerin ölümünü. Göz yaşlarıyla antıyordu. Vücudlarının çeşitli yerlerinde çıkan yaralar gittikçe derinleşmiş ve kardeşlerin ölümüne sebep olmuştu. Unutlamamıştı ancak bir kız ve üç erkek çocuğu. Ölülerinden sonra doğan Alexandre ve Aşina onların acısını biraz olsun hafifletmiş ama unutturamamıştı.

“Babaçığım neredeüz, bana ne oldu?”


Alexandre ve eşi Davina birbirlerine bakıp küçük kızlarının göğüsündeki bendaları açtılar. İnanacak gibi değildi. Yaraların herneyse kasandığını göğüslerinde mutlak gözlenen siltolu sivriyi anı ve baba. Bu mutlak sadece onların mutluğu değil aynı zamanda milyarca insanın mutluğu idi. Çirneli penisilin milyarlara insanı ölümden kurtarmıştı. Penisilin İğnesi sadece çönan değil bakteriyel kökenli pek çok hastalığa da bir çözüldüğü daha sonraki çalışmalarında ortaya çıktı. Alexandre ve 1942'ye Nobel Tıp ödülünü aldı. Adını da tıbbi penisilin muaddi Alexandre Fleming diye atlan hafteler yazdı.



The story of the discovery and development of penicillin by Alexander Fleming (1881-1955) is a remarkable tale in the history of medicine. The 1920s, Fleming already knew certain bacteria were responsible for causing boils. However, it was a serendipitous discovery involving mold that would change the course of medical science.

Fleming noticed that molds could eradicate bacterial colonies growing on a petri dish. This unexpected observation led him to a profound conclusion: the secretions or "juice" produced by the mold could kill the bacteria responsible for causing boils. Through this invention, he was awarded a Nobel Prize for Physiology or Medicine in 1945.

Fleming yıllar sonra kendi hayat hikayesini yazdığı bir kitapta ona çalışmalarına çok tutarı çok önemli bir alimden de bahsetmeden geçemedi. Çalışmalarını temelini oluşturarak bu alim peşine giren insanları gün bugün ve günümüzde hala kitapları tıp fakültelerinde okutulan doktorların sultarı dediği alim Avrupa da AVICENNA olarak bilinen İbn Sina'dır. İbn Sina Orta çağda yaşamış Kur'an fi-Teb'ini (Hekimlik Yasası) adı kitabın yazarı ve kendi çalışmaları temel oluşturmuş Müslüman bir alimdir. Tıp alanında yaptığı çalışmaları birçok hastalığa sebep olan mikroorganizmaları tespit etmiştir. İyice henüz mikroskop bile yokken bu mikroorganizmaların varlığını buçten yaklaşık 800 yıl önce kitaplarında anlattan hekimlerin sultarı İbn Sina'ya bizi ve insanlık çok şey borçludur.



It is important to note that Avicenna (980-1037), a renowned physician of his time, had previously made significant contributions to our understanding of infectious diseases. He had correctly identified germs as the culprits behind various diseases, including severe bacterial infections like boils. Avicenna's groundbreaking work laid the foundation for our understanding of the role of microorganisms in causing illness, establishing germs as the primary carriers of diseases.

In this context, it becomes evident that Alexander Fleming's work can be seen as a continuation of the scientific knowledge inherited from Avicenna. Fleming built upon Avicenna's legacy, using his discoveries as a springboard for his groundbreaking research. This connection between their contributions underscores the importance of scientific heritage and how knowledge is built upon and passed down through generations.

The purpose of the elaboration section, which refers to what they have learned to apply, was to take the knowledge that was gained and use it to address practical, real-life situations. Pupils were assigned questions about skin disorders and microorganisms to assess their understanding. The core concepts covered in the instruction were assessed in the evaluation phase.

Three instruments were administered before and after the intervention as presented in the following section.

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Instruments

Three instruments were used in the study to measure dependent variables of the study: values, motivation and attitude towards science.

Values were assessed using a dilemmas form comprising 11 scenarios, which the first author of this paper developed. These scenarios were adapted from dilemmas employed in previous studies by Herdem (2016) and Kunduroğlu (2010). Pupils were instructed to provide answers regarding the dilemmas presented in the items before the intervention. Subsequently, following the intervention, the same have been administered to a control group who did not get the story-telling dilemma form was administered once again and subjected to analysis. This tool offered three response choices: assigning 3 points for a positive representation of the value, 2 points for uncertainty, and 1 point for the absence of the value.

Motivation was assessed using a motivation scale for science developed by Tuan, Chin, and Sheh (2005), which was subsequently adapted to the Turkish context by Yılmaz and Huyugüzel-Çavaş (2007). The scale comprises a total of 35 items (33 items for the modified scale) and utilises a 5-point Likert-type response format. It encompasses six sub-dimensions: self-efficacy (7 items), active learning strategies (8 items), science learning value (5 items), performance goals (4 items), achievement goals (5 items), and learning environment stimulation (6 items). The internal consistency of the entire questionnaire was assessed using Cronbach's alpha coefficient, which yielded a value of 0.89, indicating a high level of reliability.

Attitudes towards science were measured by "Attitude Towards Science Scale" developed by Benli, Kayabaşı, and Sarıkaya (2012). The scale is a 5-point Likert-type scale comprising 20 items (nine positive and 11 negative). The Cronbach alpha for the entire questionnaire was 0.89.

Data analysis

Since the sample size was less than 30 and did not meet the normality conditions, Wilcoxon signed-rank tests, one of the non-parametric tests, were conducted using the non-parametric Wilcoxon's Rank Sum Tests through the SPSS 22 data analysis program for the pre-test-post-test applications. The data collected from the dilemma situations form, motivation scale and attitude scale were analysed to determine whether a significant difference emerged associated with the intervention.

In the normality test of the dilemma situations form, which was applied to assess the development of values, the kurtosis and skewness values were between -1 and +1. However, since the data in the histogram graph exhibited non-intermittent and non-proportional characteristics, a Wilcoxon test analysis, one of the non-parametric tests, was employed.

Similarly, for the normality test of the responses given to the attitude towards science scale in the research, the kurtosis and skewness values did not fall between -1 and +1. Consequently, a Wilcoxon test analysis, another non-parametric test, was utilized.

Furthermore, in the normality test of the responses given to the motivation scale for science within the research scope, the values of skewness and skewness were not between -1 and +1. Therefore, a Wilcoxon test analysis, another non-parametric test, was applied.

Results

Values

In the study, the values of perseverance, sensitivity to cultural heritage (1), sensitivity to cultural heritage (2), sensitivity to cultural heritage (3), sensitivity to cultural heritage (4), compassion, responsibility, self-sacrifice, tolerance, diligence, and benevolence of the pupils were assessed through pre-test and post-test. The average scores of their responses to the questions asked are presented in Table 2.

Table 2*Total Pre-test and Post-test Mean Scores for All Values*

		Pre-test Average	Post-test Average
1	Perseverance Value	2,75	2,96
2	Sensitivity to Cultural Heritage (1)	2,08	2,33
3	Sensitivity to Cultural Heritage (2)	1,50	2,25
4	Sensitivity to Cultural Heritage (3)	2,00	2,33
5	Sensitivity to Cultural Heritage (4)	2,04	2,46
6	Compassion Value	2,79	2,88
7	Responsibility Value	2,96	3,00
8	Value of Sacrifice	1,96	2,63
9	Value of Tolerance	2,67	2,71
10	Diligence Value	2,92	3,00
11	Benevolence Value	2,75	2,71

When considering the average scores of the pre-test and post-test, it can be observed that 10 out of the 11 values showed improvement, while there was a decrease in the value of benevolence.

Table 3*Values Test Wilcoxon Signed Ranks Test Statistical Analysis Results*

	Post-test/ pre-test	N	Mean Rank	Sum of Rank	z	p
Negative Rank	0	0	0	0	3.84	.000
Positive Rank	19	10.00	190			
Equal	5					

The results of the Wilcoxon signed-rank test indicate that (See Table 3) there is a significant difference between the value pre/post- test scores ($z = 3.84$, $p < .05$) in favour of the positive rankings, representing the post-test scores. Based on these results, it was determined that the interventions made significant differences in the pupils' value development.

Attitudes towards Science

Table 3 presents the Wilcoxon Signed Rank Test analysis conducted to determine whether there were significant differences in attitudes toward science before and after the application.

Table 4*Wilcoxon Signed Rank Test Statistical Analysis Results of Attitudes*

	N	Mean Rank	Sum of Rank	z	p
Negative Rank	6	12.92	77.50	2.28	.022
Positive Rank	19	13.03	247.50		
Equal	1				

Statistical analysis results of the Wilcoxon signed-ranks test are shown in Table 4, examining whether there is a significant difference in attitudes towards science before and after the intervention. The table presents the number of participants, mean rank, sum of ranks, z-score, and p-value. According to the results, there was a significant difference between the pre-test and post-test scores of the pupils participating in the research in favour of the post-test scores. The z-score was calculated as 2.28, with a p-value of less than 0.05, suggesting a statistically significant difference. Therefore, it can be concluded that the intervention made during the study significantly contributed to the improvement of learners' attitudes towards science.

Motivation for Science

Statistical analysis results of the Wilcoxon signed-rank test regarding the pupils' motivation towards science before and after the application are presented in Table 4.

Table 5*Wilcoxon Signed Rank Test Statistical Analysis Results of Motivation levels*

	Mean Rank	Sum of Rank	z	p	N
Negative Rank	10	9.10	91.00	1.15	.249
Positive Rank	12	13.50	162.00		
Equal	2				

According to the analysis results presented in Table 5, no significant difference was observed between the pre-test and post-test scores. Several factors may contribute to this outcome, including the short duration of the study to observe motivation development, the pupils' exposure to the stories.

Discussion

When analysing the data obtained from the dilemma situations form used in the research, it was observed that the stories had a positive impact on the sample group. This is consistent with Kunduroğlu (2010). The study indicated positive effects on teaching various universal values, consistent with findings from other studies in the literature. Herdem (2016) studied the effect of values education activities integrated into the 7th-grade science curriculum on pupils' development of values. That study concluded that the values teaching activities resulted in significant differences favouring the experimental group, demonstrating a positive effect on their value development. Akdemir (2018) conducted a study on the positive effects of story-telling on pupils' academic performance.

Şen-Gümüş (2009) found a positive increase in the science lesson attitude scores of the experimental group who were taught science using stories. However, Gölcük (2017) reported no significant difference in the post-test scores of the experimental group who received science education supported by stories compared to the control group students who received an education based solely on textbook activities. Nonetheless, the study highlighted the positive impact of lessons taught with

stories, such as increasing pupils' interest in science, making lessons more enjoyable and engaging, and fostering curiosity.

In another study conducted by Şaşmaz and Yılmaz (2018), the effects of using concept cartoons and stories on learners' motivation were examined. However, the study again concluded that there was no significant difference in motivation levels. Possible reasons for this outcome include pupils perceiving the lesson as complex, struggling to understand new concepts and topics, insufficient application time, and lack of prior exposure to concept cartoons and stories.

In light of these studies, it has been observed that stories contribute significantly to developing pupils' values in relation to science. In the current study, a different approach was adopted by integrating stories based on the history of science, featuring prominent figures from the local culture, and incorporating values relevant to current needs. This approach enabled pupils to better relate to the stories and quickly identify with the scientists from their own cultural and geographical context.

Akdemir (2018) concluded that in the pilot application of his study, the pupils needed to find the stories containing historical information interesting. They also needed help in understanding the subjects presented in those stories. To address these issues, the narratives in the stories were written using plain language based on daily life experiences, and the number of historical stories was reduced. In contrast, the number of historical stories was not reduced in this study. Instead, the heroes in the stories were inspired by our own culture and civilisation history, and the stories included situations that students could relate to in their lives. By considering Davis (2023) in education, the development of the value of sensitivity to one's cultural heritage was observed, and the historical aspects of the stories energised the children. They found a connection to their own culture and civilisation history, resulting in significant differences in the development of values and attitudes.

The study concluded that science history-based stories and science-based stories integrated with value teaching activities significantly affect value development. When comparing the pre-test and post-test total score averages, there was an improvement in 10 out of 11 values, with a decrease in one value, namely benevolence. The lack of value development in the story "Organ Donation," which covers the value of charity, can be attributed to societal prejudice surrounding organ donation. This prejudice may stem from a lack of knowledge and from cultural biases.

The study also found that stories and value teaching activities in science lessons significantly affect the development of attitudes toward science.

Expressing affective features presents challenges varying from person to person and from society to society. The need for more sufficient studies in this field further contributes to its difficulty. The inconsistency of human nature across life stages poses challenges in defining the affective domain and drawing conclusions. The belief that effective acquisitions should be more critical in school programs, with the responsibility for sensory feelings and beliefs falling within the domain of families and religious institutions. Affective characteristics should not be considered separately from cognitive characteristics, as it is believed that they can be acquired naturally alongside cognitive development. Considering all these factors and viewing individuals as holistic beings, education should not solely focus on academic achievements. As social beings, individuals should also acquire vital skills that facilitate their lives and contribute to personal and societal growth. Enhancing the importance of the affective domain and conducting concrete, identifiable, valid, and highly reliable studies in this field can help address these aspects of education.

Conclusions

The findings from the pupils' dilemma situations form and attitude scales reveal that the integration of value teaching activities with a storytelling approach positively impacted pupils' values development and attitudes. These stories allowed them to connect the presented values to their daily lives, further enriched by the choice of heroes from their own civilisation, resulting in heightened engagement. In addition, pupils held favourable opinions regarding incorporating storytelling in science lessons due to its effectiveness. The utilisation of visual elements within the

story materials successfully captured the students' attention and interest. Moreover, the adoption of science history-based narratives and science-based stories generated curiosity among pupils, prompting them to question the authenticity of the stories and to research the heroic figures independently. Notably, stories focusing on values such as compassion, perseverance, diligence, tolerance, self-sacrifice, responsibility, and cultural heritage sensitivity significantly contributed to developing these virtues. The positive impact was that pupils wanted future course contents to incorporate science history-based and stories related to science across various units and lessons.

Implications for Future Studies

Based on the conclusions, the following suggestions were provided for both practitioners and researchers.

1. Teaching values through stories in science classes can accelerate value development.
2. There is potential to enrich science lessons by diversifying the methods used to present science history-based and science-related stories, making them more attractive.
3. Science history-based stories and scientific stories integrated with value-teaching activities can facilitate the development of values that are challenging to develop directly. They can also aid in the value development of pupils who exhibit negative behaviours without reinforcing them.
4. Values should not be imposed on pupils. Instead, the stories should present heroes who face problem situations and make their own choices based on their internal processes.
5. Textbooks should be enhanced by incorporating not only universal values but also national, moral, and ethical values that resonate with pupils, as well as personalities from the history of their own civilisation.

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