EFFECTIVENESS OF CONCEPT CARTOONS USAGE ON STUDENTS' ATTITUDES TOWARDS PRIMARY SCIENCE CLASSES

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Abstract

Concept cartoons are visual representations of scientific ideas. The simple cartoon drawings show different points of view on scientific ideas to stimulate students' motivation and interest in scientific topics and their discussion and argument. Previous research has shown that concept cartoons are a highly visual and stimulating approach that helps in the identification and elimination of students' misconceptions, provides students' participation in classroom discussions, motivates and activates students, promotes a better understanding of scientific ideas, has a significant impact on student critical thinking and learning, and contributes to the concept of problem-based learning. Previous research has also shown that the concept cartoon approach minimizes classroom management problems by promoting focused discussions and keeping children on task. This paper analyzes the challenges and opportunities of concept cartoon application in primary science classes and shows the results of research aimed to determine if there is a connection between the use of concept cartoons and the development of students' interests in primary science classes. The quasi-experimental study with initial and final testing of students' interest in primary science classes was conducted for that purpose. The research objective was to investigate the effect of concept cartoon strategy versus lecture-based teaching on students' motivation to learn science. The research involved 114 fourth-grade students. The research results show that, after applying the concept cartoon strategy in teaching and learning primary science, students express an increasing interest and positive attitudes about primary science classes, and that the concept cartoon approach affecting positively on their interests in scientific ideas. Based on the obtained results, it can be concluded that the application of the concept cartoon strategy in primary science should be more frequent.

Keywords: Students' interest, concept cartoons, primary science classes, scientific literacy, problem-based learning.

1 INTRODUCTION

In addition to focusing at students' knowledge and skills, education research frequently analyzes the students' attitudes regarding their experience of education. Students' attitudes about instruction, learning, and classroom activities often have a big impact on their academic achievement. A meta-analysis of educational research [1, 2] supports the idea that there is a significant correlation between students' cognitive domain achievement and their affective dimension which includes their attitudes and interests. Considering the connection between these two domains, teachers should focus their effort during the teaching process on supporting students in developing positive attitudes toward science and science classes as well as guiding the students in realizing their cognitive achievements. Such a strategy will help students develop their personalities and scientific literacy, which includes, in addition to scientific knowledge and skills, students who respect and value science, creative and critical thinking, rational reasoning, and who support the scientific research.

Previous research that includes the examination of students' attitudes also highlighted the significance of students' interest in learning for their personal motivation and engagement in teaching activities [3, 4, 5], which is very important for students' academic success and achieving higher level of learning outcomes of the provided curricula [6, 7]. Interest is characterized by increased attention, concentration, and affectivity. It can be categorized as situational and individual interest. Situational interest is generated by a source outside the individual, while individual interest, which refers to a person's particular interests, emerges on the basis of situational interest and persists as such for a set amount of time. There are four stages that individual interest goes through before becoming well-developed: stimulation of situational interest; maintenance of situational interest; formation of individual interest; and well-developed individual interest [8]. This means that situational interest not only maintains individual interest but also stimulates it.

In an educational context, teaching strategies and methods, instructional materials, and teachers' tasks can serve as environmental stimulants to spark students' situational interest [9, 10]. At the same time, the inclusion of contents that are pertinent to and useful to students' lives, as well as the connection between what students learn and the context of real life, is crucial [11]. Hidi and Renninger [8] emphasize the necessity of using educational strategies, methods, and media that capture students' attention and pique their interest in learning in order to start the early phase of interest development. In order to retain attention and active student participation in educational activities, the second phase (the maintenance phase) requires external elements like the sense of the value and significance of the teaching content.

According to previous research, situational interest is largely influenced by individual interest [12]. For instance, students who have a sustained individual interest in learning science are more likely to develop a situational interest in solving scientific problems [12, 13]. According to Rotgans and Schmidt [12], situational interest accounted for 20% of the variation in students' learning and was a major predictor of learning outcomes. To improve the quality of learning in this situation, it is crucial that students be engaged in a learning environment and that the teacher uses effective teaching methods and approaches [5]. Teaching methods and techniques are important for encouraging students' active participation in classes, for directing students' attention and developing their reasoning abilities and correct understanding and adoption of concepts. In the field of natural science education, it is helpful to utilize teaching strategy which includes implementation of concept cartoons to prevent the development of misconceptions about natural phenomena and processes and to simultaneously promote students' enthusiasm in learning science.

Concept cartoons are visual representations of scientific ideas. Simple cartoon drawings show different viewpoints on scientific ideas to stimulate students' motivation and interest in scientific topics and their discussion and argumentation. They were created in the 1990s to expose students' initial hypotheses about scientific topics, to provoke thought, and to support the growth of their understanding [14]. For the reasons listed above, Koutnikova [14] underlines the value of employing concept cartoons in teaching science, while Naylor and Keogh [15] note out that they serve as catalysts for the growth of argumentation and interaction among students and encourage them to think critically [15, 16]. According to previous studies, concept cartoons are a highly visual and stimulating approach for identifying and correcting students' misconceptions, ensures student participation in class discussions [17], motivates and activates students [18, 19], fosters a better understanding of scientific concepts [15, 20, 21], significantly affects students' critical thinking and learning [22, 23], and contributes to the concept of problem-based learning [24, 25]. Yimlaz [26] consider concept cartoons to be an excellent teaching method that ensures that the teaching process becomes more exciting and interesting for students. The majority of prior studies on the use of concept cartoons show that their implementation in the teaching process results in a higher level of academic achievement for students, especially at the primary level of education [27, 28, 29, 30]. Additionally, the benefits of concept cartoons can be shown in the improvement of students' attitudes toward learning science and in the decrease of students' stress and anxiety [31].

2 METHODOLOGY

2.1 Research aim

In order to ascertain whether there is a correlation between the usage of concept cartoons and the development of students' interests in primary science classes, this study will present the results of a quasi-experimental research. The aim of the study was to determine how concept cartoons compared to conventional teaching methods in primary science classes affected students' interests in primary science. The authors hypothesized that, in comparison to conventional teaching, the use of concept cartoons in the teaching of science in primary level would lead to a rapid growth in the students' interest in this school subject. This hypothesis was based on prior research on the advantages of concept cartoon implementation.

2.2 Research sample

In Croatia's Zagreb and Zagreb County, 114 fourth-grade pupils aged 10 participated in the study. Before students take part in the study, their parents were informed of its goal and their consents for the students' involvement in the study were gathered. The students were divided into two groups - experimental group (N = 58) and control group (N = 56). The groups were comparable in terms of gender, birth year, primary science grade, and third-grade general achievement score. Two schools were involved in the quasi-experimental research, with one experimental group and one control group in each institution. The

teachers were questioned prior to the experiment to assess their prior experience with scientific classes. It was determined that the teachers' experiences with teaching science did not significantly differ from one another. Students at both schools were never given the chance to use concept cartoons in primary science classes. It can be assumed that the students' prior school experience had little to no impact on the outcome of this quasi-experimental study because the examined schools did not significantly differ in terms of how science classes were organized, and their working conditions, and because most of them had not yet encouraged students to participate in activities that required the use of concept cartoons.

There were two stages in the research. Prior to further research and the introduction of the experimental factor in their science classes, the initial testing step involved all students completing a questionnaire about their interests in primary science classes. This provided an estimation of their initial interests. The experimental factor of teaching science was incorporated in the second level (concept cartoons in experimental groups; conventional teaching in control groups). Students had science classes three times each week during the quasi-experiment, which lasted three weeks. Each teacher (N = 4) got specially created lesson plans for each lesson in order to ensure the consistency of the teaching methods used in concept cartoon-based and conventional teaching. In the final testing, the same instrument (questionnaire) was used as during initial testing.

2.3 Dependent and Independent Variables

The independent variable in the quasi-experimental study exists in two different forms: the first is teaching science with the use of concept cartoons, and the other is conventional teaching. Each group of students in the experimental manipulation with parallel groups received one of the aforementioned instructional approaches. Students' interest in primary science classes was the dependent variable in this study, which examined the impact of independent variables.

2.4 Instrument

A questionnaire used in the Astra Zeneca Science Teaching Trust - Leicester City Primary Science Project [32], which was structurally and content-adjusted for the aim and demands of this research, was used to assess how the students' interests in primary science classes have developed by using concept cartoon approach or standard teaching. Questionnaire consisted of 13 items. On a 3-point scale, the respondents indicated their attitudes and interests in primary school classes (1 - strongly disagree, 2 - I am not sure, 3 - completely agree). The use of concept cartoons in primary science classes was examined using the same instrument in both the initial and final testing phases. The internal consistency and reliability of the employed scale (Cronbach's alpha) was at a satisfactory or high level (α= 0.84) in both situations (pre-testing and post-testing).

2.5 Data processing methodology

Multivariate analysis of variance (MANOVA) was used to examine the correlation between the use of concept cartoons and the development of the students' interest in primary science classes. The independent variable in this analysis was the dominant teaching strategy (concept cartoon usage versus conventional teaching), and the dependent variable was the students' interest in primary science classes, which was tested at two levels (initial and final testing). The statistical significance of the results difference in the initial and final tests was also assessed using the t-test.

3 RESULTS

3.1 Initial testing

Table 1 shows that the arithmetic means of the responses from the control and experimental groups in the initial testing situation are nearly equal.

Table 1. A comparison between experimental group and control group students' interest in primary science classes during the initial testing

	Group	***N***	***M***	***SD***	***t-test***	***df***	***p***
Students' interest in primary science classes	Control	56	29.54	4.03	-1.47	112	0.10
	Experimental	58	30.23	3.06			

It can be concluded that students in both groups had equivalent interests in primary science classes prior to the implementation of the experimental factor in teaching primary science because the results of the t-test show that there is no statistically significant difference between students' interest in primary science in the experimental and control groups (t = -1.47; df = 112; p = 0.10).

3.2 Final testing

According to Table 2, the experimental group's and control group's arithmetic mean values for total of the questionnaire's responses differ by a statistically significant amount in the final testing situation.

Table 2. A comparison between experimental group and control group students' interest in primary science classes during the final testing

	Group	N	M	SD	t-test	df	p
Students' interest in primary science classes	Control	56	29.72	4.54	-8.67	112	0.00
	Experimental	58	33.67	3.07			

Table 2 shows that the experimental group of students had a higher arithmetic mean of answers in the entire questionnaire. In the final test situation, students in the experimental and control groups showed significantly different levels of interest in primary science classes, with the experimental group showing a statistically significant difference with a risk of less than 1% (t = -8.67; df = 112; p = 0.00). Based on these findings, it can be concluded that, when compared to students in the control group, students in the experimental group have statistically considerably higher interests in primary science classes.

3.2.1 Comparison of the students' interests in primary science classes in the experimental and control groups

To determine whether there is a statistically significant difference in the students' interest in primary science classes in the final testing situation, a χ^2 test was conducted for each item in the questionnaire. Table 3 demonstrates that on the final test, students in the experimental and control groups expressed their level of agreement with specific questionnaire items in different ways. As a result, the arithmetic means for the two groups range from M = 1.62 to M = 2.65 for the control group and from M = 1.53 to M = 2.85 for the experimental group, with varying standard deviations for the responses to individual particles.

Table 3. Descriptive parameters of the particles that were used to measure students' interest in primary science classes and a comparison of how each particle responded to the responses of the experimental and control groups of students in the final test

Items	Group	M	SD	χ^2
Primary science is a difficult school subject.	Control	1,76	0,75	**15,70****
	Experimental	1,45	0,64	
Primary science is an interesting school subject.	Control	2,50	0,67	**33,16****
	Experimental	2,85	0,39	
Primary science is easy to learn.	Control	2,28	2,56	**12,51****
	Experimental	2,35	0,67	
I like primary science more than other school subjects.	Control	1,62	0,70	**67,43****
	Experimental	2,34	0,75	
Science classes increase my curiosity for nature.	Control	2,52	0,67	**31,15****
	Experimental	2,80	0,35	
Science classes increase my love for nature.	Control	2,55	0,65	**7,91****
	Experimental	2,71	0,50	
Science classes show me the important role of science in human life.	Control	2,51	0,67	**25,64****
	Experimental	2,82	0,38	
We have to study a lot for the science classes.	Control	2,27	0,78	5,84
	Experimental	2,07	0,85	

Three hours of science a week is too much for me.	Control	1,89	0,84	**12,95****
	Experimental	1,57	0,75	
Science classes make me very tired.	Control	1,70	0,76	5,42
	Experimental	1,53	0,66	
Learning about science is very interesting to me.	Control	2,50	0,69	**16,29****
	Experimental	2,77	0,51	
Learning in primary science classes will certainly help me in my future life.	Control	2,65	0,53	**27,16****
	Experimental	2,90	0,33	
I will be able to apply everything I learn in the primary science classes in everyday life situations.	Control	2,59	0,61	**21,73****
	Experimental	2,85	0,35	

It is evident from the results that students in the experimental group agreed more often with statements that reflect a favorable attitude toward primary science classes. Students in the control group, on the other hand, agreed more often with the statements expressing a criticism of the primary science classes (e.g., *Primary science is a difficult school subject, We have to study a lot for the primary science classes, Three hours of science classes a week is too much*, and *Science classes make me very tired*).

With a risk of less than 1%, the students in the experimental group had statistically significantly higher levels of agreement with the following items: *Primary science is an interesting school subject* (χ^2 = 33.16), *Primary science is easy to learn* (χ^2 = 12.51), *I like science more than other school subjects* (χ^2 = 67.43), *Science classes increases my curiosity about nature* (χ^2 = 31.15), *Science classes increases my love for nature* (χ^2 = 7.91), *Science classes shows me the important role of science in human life* (χ^2 = 25.64), *Learning about science is very interesting to me* (χ^2=16.29), *Learning about science will certainly help me in my future life* (χ^2 = 27,16), and *I will be able to apply everything I learn in science classes in everyday life situations* (χ^2 = 21.73), compared to the students of the control group. On the other hand, the students of the control group had, according to statistics, a significantly higher degree of agreement with the items: *Primary science is a difficult school subject* (χ^2 = 15.70) and *Three hours of science classes a week is too much* (χ^2 = 12.95).

This distinction in attitudes suggests that, over the period of three weeks, the experimental group's students gained a greater interest in primary science lessons through the use of concept cartoons than the control group's pupils, who received conventional instruction.

3.3 Comparison of the Initial and Final Testing Data on Students' Interest in Primary Science Classes in the Control and Experimental Groups

Students in the experimental group show a considerably higher degree of interest than those in the control group, according to the findings of a multivariate analysis of variance (MANOVA) (F = 6.31; df = 1; p = 0.05).

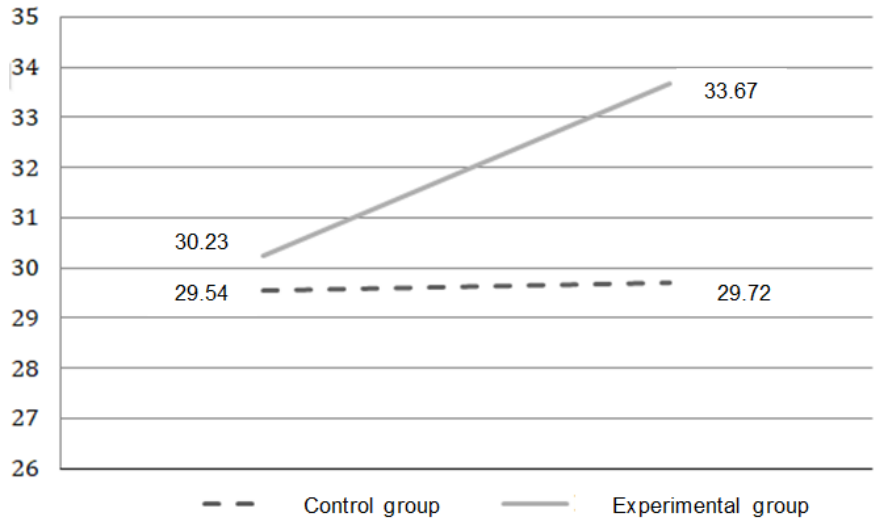

Figure 1. Interaction of the group and students' interests in primary science classes (total results)

In the final testing situation, it was confirmed that interest in primary science among students in the experimental group was higher to a statistically significant degree compared with interest in primary science among students in the control group in the same situation ($F = 6.31$; $df = 1$; $p = 0.05$), as shown in Figure 1. The hypothesis that we have established is supported by these findings, which show that concept cartoons are a more effective teaching tool than conventional instruction for stimulating students' interest in science at a higher level.

3.4 Discussion

This study indicates that the use of concept cartoons in primary science classes increased students' interests and positive attitudes in learning science and that this effect was significantly greater than that of conventional instruction. Based on such results, it has been proven that using concept cartoons in primary science will increase students' interest in the subject matter (in contrast to standard teaching methods). This finding supports and expands on previous research on the benefits of using concept cartoons which were mentioned in the introduction of this paper.

It is crucial to point out that using concept cartoons means a student-centered strategy that emphasizes asking questions, exercising critical thinking, and inferencing. Students actively participate in problem-solving while also drawing their own conclusions about the content they are learning. They are able to build a passion for learning and obtain a deeper understanding than they could by simply remembering and recalling facts. Additionally, using concept cartoons means that students' prior knowledge and life experience are taken into account, which is the core tenet of constructivist learning. Their view of learning science and the value of that school subject for their future selves has largely dictated the beneficial impact of the concept cartoon method.

These findings may be helpful in guiding the development of primary STEM education, which frequently rely on the students' interest in and motivation for learning. It can be assumed that a longer application of concept cartoons would produce even better results, because in this research a short period of three weeks was enough to achieve a statistically significant positive shift in increasing students' interest and positive attitudes.

4 CONCLUSIONS

Based on the obtained results, it can be concluded that concept cartoons should be used more frequently in primary science classes because they are associated with greater students' interest and positive attitudes towards science learning, which indirectly affects their engagement in science. The findings of this study may serve as motivation to incorporate this strategy into the primary science curriculum in Croatia because the potential of this approach has not yet been fully utilized. Such a strategy would encourage students' interest in STEM field from the early grades, which can be important for their decision to pursue a scientific career in the future.

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