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Usability of testing apparatuses about renewable energy resources in constructivist class environment

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Abstract

Students construct their own knowledge based on their experiences which take part in the basis of constructivism. For that reason, curriculums which are prepared according to constructivist approach should contain activities and materials to enable students to learn through exploring. In this study, it is tried to be determined the efficiency of a testing apparatus which enable students to learn renewable energy resources, energy cycle, hydrolysis of water events through exploring in education environments in the direction of teacher candidates. In conclusion, it is anticipated that in addition to its mentioned features, technology product apparatus will broaden the horizons of students in how to benefit from natural resources without damaging the environment with using technology.

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1. Introduction

The constructivist theory which emerged and spread between 1980 and 1990, emphasizes that knowledge is constructed by students' building (Shunk, 2000; Jones, Brader- Araje, 2002). According to this theory, individuals do not accept the knowledge as it is presented to them. They construct and use the knowledge distinctively. While constructing their knowledge, students connect the knowledge they had prior with the ones presented to them to produce new knowledge (Hancer, 2006). However, in this approach, not only connect the old and new knowledge but also individuals' communicating and being interactive with his or her physical environment for active learning is important (Yasar, 1998).

Teachers should have some kind of features in constructivist education programmes. Constructivist teachers should implement creating activities suitable to individual, encouraging learners to communicate both with

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themselves and with each other, emboldening for collaboration, constituting environments in which learners can express their opinions and questions clearly roles (Sasan, 2002). Thus, it can be possible to list the roles of constructivist teacher as follows;

1. Using crude and primitive resources in addition to interactive physical materials,
2. Searching the pre-knowledge and what they understand from the concepts before sharing his or her own means related to that concepts,
3. Using performance expressions like classify, analyse, guess, create in classroom,
4. Emboldening student participation and acceptance,
5. Evaluating students in the context of daily class studies,
6. Giving chance to students for their comparison between their opinions and what they know,
7. Encouraging students to participate in collaboration and group activities,
8. Giving some time to learners after asking questions for them to think
9. Emboldening the students for discussion and for making comparison

(Brooks & Brooks, 1993). All these knowledge shows that education environment should be arranged well by teachers. Basic assumption of constructivism is learning with tools and signs therefore, education environments should be equipped with tools and materials which provide individual to direct their learning (Duffy & Cunningham, 1996). Effective education environments can only be provided with learning materials which draw the attentions of students, help relating the subject with everyday life, give concrete examples to students to produce different opinions.

When primary science and technology curriculum is examined it is seen that the programme which in use since 2000 is student based. Additionally, these programmes suggest students to make researches, experiments, projects to reach knowledge like a small scientist (Akpınar & Ergin, 2005). Thusly, National Education Ministry stated the renewed Science and Technology usage vision as this;

“Whatever may be their personal differences, to make them develop their research-questioning, critical thinking, solving problem, and making decisions skills; to make them individuals who learn throughout life and to make them achieve skills, attitudes, values, comprehension and knowledge which will enable them to keep their curiosity about world around them and to grow them up into Science and Technology literate (MEB, 2004). “

When primary science course's having an important place in students' scientific thinking, critical approaching and developing their creativity taken into consideration, necessary environments should be prepared for them to achieve the related features.

While most of the students stated that they like the science courses, some of them denoted that they get bored since they cannot understand and the subjects they learn is no use in everyday life; that they want the courses to be given with applications, experiments and games (Kaptan and Kusakcı, 2002). From this point of view, the knowledge which assumed to be taught in science courses to students should be of use in daily life (Gomleksiz & Bulut, 2007). In this study, we benefited from a testing apparatus which helps students in learning through exploring and cognize the happenings like energy cycle and hydrolysis events in primary Science and Technology course. In the study, it is tried to be determined the suitability of prepared apparatus to the constructivist class environment in learning-teaching process together with teacher candidates' viewpoints.

2. Method

2.1. Testing apparatus

In the research, a testing apparatus was benefited from to aid students in learning energy cycle and hydrolysis events through exploring and cognizing in primary Science and Technology course, showed in Figure 1. In the apparatus, there is a solar panel, a nanocell which resolves electricity and water, an another nanocell which extricates electricity hydrating with hydrogen, a tube which contains distilled water, small pipes which will connect water and gas, copper cables which will connect electricity and a fan works with electricity. The working principle of the apparatus is as follows: The sunlight which strikes the solar panel is converted into electrical energy by means of solar panel. Through cables, electricity is transferred to nanocell which will resolve water into hydrogen and

oxygen. Nanocell resolves the distilled water coming from tube into hydrogen oxygen and sends back using pipes to the two tubes separately.

Meanwhile, the gases which accumulated in the tubes push the water upwards and provide a good observation opportunity for hydrogen and oxygen amounts. The accumulated oxygen and hydrogen in the tubes are transmitted to the second nanocell employing pipes which will combine oxygen and hydrogen and extricate electricity. While this cell is producing water combining oxygen and hydrogen, on the other hand, using cables, the extricated electricity is transmitted to electricity engine and fan starts to spin with the aid of engine. Nanocell releases water which emanates during this process. Spinning of the fan continues until the oxygen and hydrogen in the tubes runs out. As sun gets powered so does the electricity which leads more spinning of the fan.

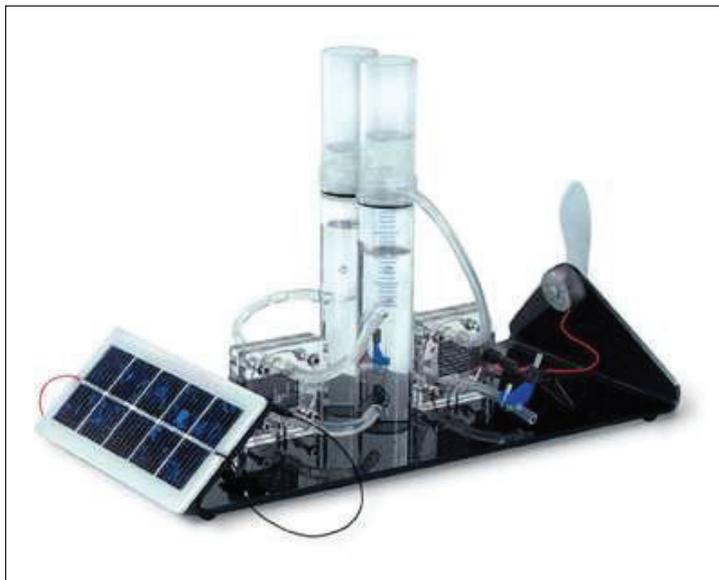


Figure 1. Testing Apparatus

2.2. Research design

The study is paralleled to qualitative research methods and both facts and events were examined in their own environment and through flexible research process. Researcher directly interviewed with participants and tried to investigate the problems in depth.

2.3. Sample

The study was conducted with 37 teacher candidates who are having education in Rize University Cayeli Education Faculty Division of Elementary Teaching as a qualitative study. Participants' opinions were taken by means of semi-structured interviews and the opinions were encoded after being analyzed.

2.4. Data gathering tools and data analysis

In the study semi-structured interviews were benefited from. The data obtained from participants were transcribed and analysed. After these processes data were encoded after being read over and over again. During the analysis of data, researcher tried to stay away from his own prejudices.

2.5. Validity and credibility

Credibility criterion was tried to be provided with data's being read by other researchers. For transmissibility criterion, purposeful sample was chosen in order to obtain the most objective data and research process was tried to be explained in a detailed way to the reader. For the verifiability criterion, crude data, findings, comments, and recommendations were recorded and checked recurrently. Researcher's pre-observations and literature knowledge were only used in the stage of interpreting data.

3. Findings

In the study, related questions were directed to teacher candidates in order to determine the suitability of benefited apparatus to the constructivist classroom environment;

1. Will students' comprehension of energy topic be provided by means of the utilized apparatus?
2. With this apparatus, will it be helped to students in understanding the importance of Science and Technology course in everyday life?
3. If energy topic is taught through this material, will students' learning the topic quickly and actively be provided?
4. With this material, what can be taught related to energy topic?
5. What kind of benefits does this type of apparatuses contribute to science courses?
6. Which kind of features that would be added to this apparatus will inform students better?
7. For which of the topic does this kind of apparatuses be of use?

Participants' comments concerning testing apparatus are shown in Table 1 as themes and sub-themes.

Table 1. Opinions of Teacher Candidates Concerning Testing Apparatus

Number of The Participant	Themes/ Sub-Themes	Opinion (Direct Quotation)
8	Suggestions/Simplification	"Students may have specific knowledge about energy by means of this apparatus; however if a more simplified apparatus is used it would be more efficient."
		"It is scoped which is beneficial for 6th, 7th and 8thgrades. Because a student who is 5th grade is newly starting to comprehend something abstract, more simplified apparatus can be presented."
5	Suggestions/ Enlargement of model	"I think it will be more beneficial if each part of the apparatus is enlarged and the materials which can present detailed knowledge of each energy cycle to teacher are provided."
5	Suggestions/ Pre-knowledge	"However it is necessary for both students and teachers to reach a specific level for this apparatus to be dynamized."
		"They should have sufficient pre-knowledge before understanding this apparatus." "They may not learn completely. In order to achieve this, a good background should be brought to students."
1	Suggestions / Application	"I think what students search and want is this. I believe that if opportunity is given for giving pieces of this apparatus to students and wanting from them to combine it more beneficial results will be achieved."
3	Suggestions / Beneficial Fields	"It can be used in training more efficient students"
		"If we train our students in accordance with Science and Technology Achievements from this grade"

on, our students will be more precise towards this kind of materials and their horizons will broaden.“

According to the Table 1 above, teacher candidates think that testing apparatus is high from the students' levels. Therefore, they suggest presenting more simplified and enlarged model of apparatus. Besides, they approve students' having specific pre-knowledge in order to understand apparatus' function.

In Table 2, themes related to testing apparatus' being suitable to constructivist class environment according to opinions of teacher candidates.

Table 2.Suitability of Testing Apparatus to Constructivist Classroom Environment

Number of The Participant	Themes/ Sub-Themes	Opinion (Direct Quotation)
9	Learning / Meaningful Learning	“Since working on material will provide concrete experiences from first hand, for this kind of education will be student based, active and meaningful learning will be provided.”
8	Learning / Active Learning	“Student sees more than one stages at the same time and he or she will be aware of new technologies as observing these stages.” “Student has all kinds of knowledge about the stages which passes until the energy emerges and participates in active learning process.”
10	Learning/ Quick Learning	“Especially the minds of students' in primary schools are like empty panels, they learn more quickly and they design more quickly for their imagination is more developed from the adults..”
15	Learning / Concretization	“Student can see energy topic in a concrete way. Student can reach science course's achievements more easily.” “In schools where facilities are provided comparatively, and this apparatus' supporting related subjects at issue, apparatus can make students one step further. Because, solar energy, electrical energy and alternations are explained in a concrete way.” “Since our material consists of topics like solar energy, electrical energy which are nested with everyday life, students can relate what they see from this material with daily life. Accordingly, with this apparatus it is easier for students to cognize relation of Science and Technology course with daily life.”
17	Learning / Constructivism	“It directs students to search and come up with different original opinions. For example; students with solar energy at their home can suggest new things considering this apparatus.” “In the same way, thanks to this apparatus, student can understand an energy resource which he or she does not aware of in daily life.” “I think it will be beneficial in discovering students' talents and hereby in commenting on apparatuses like this, developing them or creating different things.”
18	Learning / Attention	“Yes, since apparatus is visual, it has got an interesting feature for children which help learning.”

Teacher candidates think that testing apparatus will provide active, quick and meaningful learning to student in learning process. Utilized apparatus' presenting events in a concrete way to student observation was determined as another feature. The things mentioned in the findings are concepts used in constructivist approach. Therefore, it is understood that testing apparatus is a suitable education tool to constructivist class environment.

Other themes which were created according to opinions of teacher candidates are given in Table 3.

Table 3. Other Opinions of Teacher Candidates

Number of The Participant	Themes/ Sub-Themes	Opinion (Direct Quotation)
4	Cost	"I am of the opinion that if we have facilities it would be beneficial."
		"The facilities should be sufficient. I mean budget here."
7	Defective Aspects	"The topic which they understand in clearest way is decomposition of water. Energy's emergence is not on the front ground."
		"It can be specified as a heavy material when compared to students' levels."
29	The Subjects Which Can Be Taught	"This kind of apparatuses can be of use in Science and Technology and Social Sciences courses while teaching subjects like climate alteration."
		"The importance of energy cycle, energy's not disappearing but it's being in a continuous cycle is taught."
		"Disposition and assurance of future subjects."
		"Obtaining energy without expenditure can be taught."
16	Attitude	"It can be easily used in producing and resolving compounds. Besides, it can be used in electricity subject."
		"Apparatus directs students to search if there is sufficient facility. Students understand that Science and Technology course is not horrible."
		"Students use this technology's benefits in daily life however he or she is not aware of what it means. They may not know how the energy is produced and where it comes from."
		"If this apparatus is taught sufficiently, students' realization of Science and Technology course's importance in everyday life can be provided. "
		"This and other apparatuses which are more simplified that this one can make students like Science and Technology course. They can develop their thinking and imagination."

Materials' being economical in education is an important fact. In accordance with teacher candidates, nano technology's being expensive which exists in apparatus will affect negatively usage of testing apparatus in class environment. However, apparatus' usability in Science and Technology field on various subjects, its helping to students in adapting Science and Technology into their everyday life and in this situation its developing positive attitudes towards science from students were mentioned.

4. Conclusions

Renewable energy can be defined as “energy resource which can be available next day in nature’s own evolution”. Renewable energy resources were added to agenda because of important negations like energy usage based on fossil fuels, foreign-source dependency on fuel, high importation expenditures and environmental problems, in addition to these, quick consumption of world fossil fuel reservations and if problems in hand are solved, it is accepted as the most important energy resource of the 21st century (http://www.obitet.gazi.edu.tr/obitet/alternatif_enerji/yenilenebilen_enerji_kaynakjlari.htm). “Renewable Energy Resources” which found a place in Primary Science and Technology Curriculum, a contemporary and important issue, being gained by students in the aspects of Science-technology-society-environment and scientific process skills is important.

Related to the topic:

1. Observations on objects or events in many ways or through multiple sensations,
2. Comprehension of Science and Technology’s role in human’s benefiting from society’s natural resources effectively,
3. Suggestion of explanations about reasons behind the occurred events based on observations,
4. Knowing renewable and non-renewable energy resources and their importance,
5. Depicting how to use technological products or systems in order to protect natural resources, living beings and habitats,

goals are as above (<http://hydrogen.cankaya.edu.tr/sunum/sunum13.ppt>). Therefore, students are needed to be encountered with suitable education environments and activities analyze topics better, relating them to their lives and constructing knowledge by opining. In the study, opinions of teacher candidates concerning testing apparatus which was benefited from in order to make students observe about renewable energy resources were taken.

In the constructivist approach, students’ constructing knowledge interacting with their environment actively is in question. It is thought that in this way, students learn the events occurring around them cognizing and meaningfully. The impression that testing apparatus which was presented to teachers will give chance to student for their observations and making inferences from these observations on subjects like solar, hydrogen, electronic and mechanic energies and the cycles of these to each other was dominant in accordance with teachers’ opinions. Additionally, thanks to apparatus, students’ gaining advanced cognitive skills was also among the stated opinions. Since all the stated opinions exist within the borders of constructivist approach, it can be said that apparatus can be used as helping material in constructing their own knowledge.

While choosing materials which will be used in class they are evaluated in the aspects of being suitable to student level, size, economy, simplicity and presenting examples from daily life. The apparatus which was used is also evaluated from these aspects. It is stated that it can be developed in simplicity, economy, and being suitable to student level. In this direction, apparatus’ being simplified and made into a size from which students can make better observations were among the recommendations. Thus, it is thought that students will comprehend subject better.

Materials’ being used in different subjects is one of the points to which importance is given in education. Testing apparatus can be used in teaching of different subjects according to opinions of teachers. This situation increases the functionality and economy of the material in a sense. Cost’s being very high in having testing apparatus is a dominant opinion. Presentation of prepared apparatus in computer simulation to students giving chance to make examinations of events may gain ground in terms of cost and transportation.

Since apparatus’ being related to everyday life will increase interests of students to subject, it can be helpful in making students understand the importance of science education. Students are confronted with concrete examples about how nature provide balance of the events so that conscious individuals who are aware of their learning, who knows the universe and the environment which they live in better can be brought up. In addition to the mentioned features, it is assumed that this technology product apparatus will broaden the horizons of students in how to benefit from natural resources without damaging environment.

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