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TOWARDS INCLUSIVE NATURE OF SCIENCE (INOS) ACTIVITIES

Mustafa Şahin BÜLBÜL
Middle East Technical University
Ankara, TURKEY

ABSTRACT

Activities in this study which can be used by both blind and sighted students are called as inclusive Nature of Science (iNOS) activities. This study aims to transform some traditional activities about nature of science into iNOS activities and involves the procedure of redesigning and testing. For this purpose three basic iNOS activities were redesigned and views were gathered from three types of groups; blind students, preserves physics teachers and approximately one and a half thousand people during a science fair. To determine and understand the weak and straight ways of these activities by the help of participants' changed perceptions about science after doing iNOS activities, unstructured interviews and a questionnaire were used. At the end of the study, it was seen that these iNOS activities are not only useful for both blind and sighted students but also appropriate activities for both children and adults.

Key Words: Nature of Science, Inclusive Education.

INTODUCTION

It is natural that human needs to understand the events surrounding himself. The way to understanding the universe is defined as "science" from hundred years. All philosophers and scientists tried to understand the universe and tried to build a new structure, model of all understood parts of universe. After years, definition of science changed as "remained from understood parts of universe". This magnificent building - science- was considered that is stable as universe (Hoyningen-Huene, 2007). Lots of formulas, explanations, graphs, laws, theories, etc., were the parts of the model of universe, in other words science. Human gave up understanding the universe and turn to understand science. This short story of understanding our world is continuing with nature of science studies; science is way of knowing about universe (Alters, 1997), not the copy of universe, therefore, nature of science studies are most related with how, where and when scientists work, who scientist and what science is (McComas,1998; Moss, Abrams & Robb, 2001).

In this perspective, educators invent a term reflecting this procedure with saying "science for all" (McComas, Clough & Almazroa, 1998). However, activities designed to explain the nature of science are not adequate for all. For instance, a blind student may have some difficulties to understand current Nature of Science (NOS) activities in science education literature. The aims of this study was depended on this gap; we live in the same universe and science should be for all, therefore, NOS activities should be for all or in other words; inclusive. It is effective and creative activity from Lederman and Abd-El-Khalick (1998) which includes some figure of pugs that generally viewers reach a conclusion that there was a struggle for life. This picture may be useful material to discuss what data is and what is inference; however, it is only a paper for blind students. Tactual or smelt materials may be more helpful for blind students to understand this kind of NOS activities. Furthermore, different gender or age or other different type of categorized science learners should take advantage of iNOS when it was called as inclusive. The transformed type of NOS like the example will be named as iNOS during this study and the main problem of this research is to investigate whether adapted activities should be called as iNOS or not.

METHOD

Apart from suggesting iNOS activities, this study gives an example about what kind of procedure may be followed by a science teacher or researcher before calling the activity as iNOS. Generally the selected way of examining student conceptions about nature of science is going on through tenets (Moss, 2001). Nonetheless, this approach presents a misconception based view not a holistic view about science in students mind. To reveal the holistic view of students about science a questionnaire were prepared and applied before and after doing iNOS activities.

Research design

Data collecting instrument were both used before and after iNOS activities. Participants were all volunteers and completed all three iNOS activities from beginning to end. Different type and large number of participants with their changed views about science were used as an argument that suggested NOS activities are inclusive.

Data collecting instrument

There is a good formula which generally is used by journalists and explains what to ask to learn general information about something; 5W1H (where, why, who, what, when and how). Data collecting instrument was designed according to this formula and added another dimension that explains the paradigm shift in science. There are seven dimension and 18 items in the questionnaire with "true or false" choices in appendix 1 with original (Turkish) version. This questionnaire reflects the comments of two experts who have a published more than one article about nature of science and was used to identify in which dimensions participants change their view about science.

Participants

There were two totally blind inborn students, one boy and one girl, who were attended at 9^{th} grade high school. For 9^{th} grades physics course with nature of physics unit is compulsory in Turkey. Additionally, their schools were also different.

Other participant group was selected to inject expert views. Twenty pre-service physics teachers who passed a course including nature of science issues answered questionnaire and did iNOS activities.

The last group was contained participant from seven to seventy. They were volunteers living in Izmir, one of the biggest cities in Turkey, and came for a science fair (Figure 1). From the morning to the late night more than one thousand and a half participants were listened, answered and discussed during iNOS activities.

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Figure 1. Some students who participate iNOS activities

Activities

There were three main activities which totally take approximately 10 minutes. Activities were about analyzing tracks on dough, predicting the structure of enwrapped flexible pipes and number of objects in iron or transparent boxes (Figure 1, 2).

Figure 2. One of blind students is doing iNOS activities.

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For the first activity the main idea was conserved, participants analyzed tracts. Additionally making the tracts on dough let blind students to understand the event by touching. This tactual material has tree parts. First part there is two different tracts which are similar to scooter and car tracts. These tracts are not parallel, so with the second part, there is only car's tract; tracts give the impression of an accident. The last part includes car tracts again and a collapsed area. Generally participants think that that tract belongs to scooter. After telling the story they have reached by following tracts, science teacher should ask a question; why don't you think that that collapsed area occurred because of a meteor and after the accident scooter is going on the car? This question explains that inference about any event may be differing although data is same. In the science fair, a huge model was presented. In that model a toy of goat was used instead of scooter and with some leaf model was become more realist.

Second activity was about paradigm shift. Generally participants easily conclude that there are five flexible pipes enwrapped with a paper. Some pipets can easily pass though the inner of these flexible pipes. The structure tested with small glass ball whether they may pass though the inner of these flexible pipes was simple, according to participants. After many times they generally gave up testing and insist that there are just five flexible pipes. By chance, small glass ball sticks earlier, then they starts to think that there is something different. For this activity, four long and two short pipes were enwrapped as there were five. It is similar as science that sometimes only one data change all over the literature (paradigm shift).

The last activity was simple as others; there was a box and participants tried to understand what else is in it. Some sticks, magnets, rope and other small tools were given to the participants to use during the activity. There was a hair dryer and participants used it to put ping pong ball on air in the box. They had to use three different method together to find the correct answer. This activity is designed to help participants to understand the important of mixed methods, there is no only one effective method for all cases. For instance, in Cern, the CMS experiment -well known experiment- includes different colorimeters to identify the particle.

At the beginning of the third activity, we generally asked which of the nine boxes participants may surely predict the material in the boxes (figure 3). Sighted participants had chosen all transparent ones but they saw that scented box is not an empty box and they need a reference point to aware the difference. Blind students also had mistaken about last two transparent boxes but they said that all the boxes are similar for them without shaking.

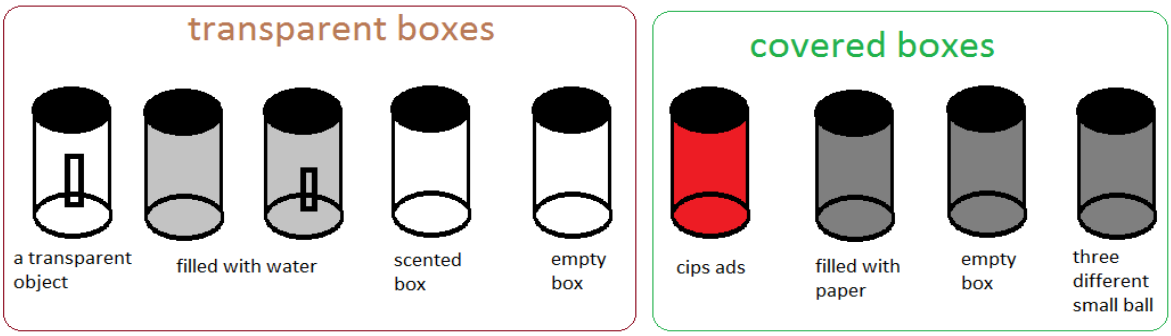

Figure 3. Different type of boxes designed for iNOS activities.

Participants cautiously approached the box which has a cips ads by saying there should be something different from cips. At that point we emphasize the importance of probabilities and why scientists use frequently. Additionally, participants wanted to touch another covered boxes before deciding on the box filled with paper. They grasped the importance of the comparison in short time.

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Data analysis

Only number of people who changed their view and some dialogues with those are used to investigate the change before and after the iNOS activities according to the answers of questionnaire. Descriptive statistics in terms of changed ideas were used and verbal expressions are used to verify the inclusiveness of activities.

RESULTS

All collected data are placed to the table 1. It is easy to see the item and in which group there had been a changed in terms of science perceptions. According to table 1, all items changed in some groups with different number of participants. This number should be evaluated according to the total group number. For instance, whether two participants changed their view in first group (blind students) is meaningless number for the third group (participants from science fair). Shown numbers in Table 1 are correct marked alternatives.

able 1. Questionnare items and number of participants marked that item.

5W1H About Science	Item ID	Blind students (N=2)		Pre-service Physics Teachers (N=20)		Science Fair Participants (N=1572)	
		Before activities	After activities	Before activities	After activities	Before activities	After activities
when	A1	2	2	10	16	577	767
	A2	2	2	12	14	523	1025
	A3	0	2	13	16	456	555
who	B1	2	2	9	18	416	1012
	B2	2	2	11	13	689	880
	B3	1	2	11	12	346	1004
	B4	2	2	10	14	233	455
How	C1	0	1	8	20	289	1045
	C2	1	2	11	11	343	432
	C3	0	0	9	19	299	998
Where	D1	1	1	12	15	654	765
	D2	0	2	9	13	410	1022
Why	E1	2	2	7	19	456	563
	E2	0	2	12	16	187	940
	E3	1	1	13	16	280	1034
Be influenced by	F1	1	2	11	20	299	1100
	F2	2	2	13	16	589	721
	F3						

There are also some expressions of all participants given below. The common point of all selected expressions is about appropriateness of activities for all. These selected expressions are noted during the activity process, so missed or more similar sayings were not written. Because of the fact that there is no negative expression about inclusive way of activities, it wasn't mentioned continuation of the study.

P1: "…discussing science is easier than doing science" (a student participant)

P2: "In order to do these activities you do not have to be sighted…"(one of blind participant)

P3: "In any activity we do not use our smelling sense but with this activity (third one and for scented box) I used my nose" (a teacher participant)

P4: "what happened there, what is in the box, and how many pipe is here…these are very basic questions and develop your thinking skills" (a director of children research center)

P5: "I believed that I can do science,…" (elderly female participant)

P6: "Before these (iNOS activities) science was rules for me, now science is to demonstrate the possibilities…"
(an elementary student)

DISCUSSION

As a result of examination of the answers to the questionnaire and expressions gathered from participants, all three activities are seemed to be deciding their inclusive way. Different kind of participants with their expressions of praise and number of correct responses of all participants' questionnaire are some of evidence that three suggested activity may be given as an example of inclusive nature of science activity.

Although these activities are not the only way of transforming known NOS activities into iNOS, followed procedure makes these activities more applicable and meaningful for all. This article also supports without being noticed that being blind is small barrier of learning; the main barriers are in our brains appearance as "impossible" (Bülbül, 2010).

BIODATA AND CONTACT ADDRESS OF AUTHOR

M. Şahin BÜLBÜL is a research assistant and PhD candidate at Middle East Technical University. He got his master degree from Kafkas University in high energy physics field with data from CMS experiment in Cern. He is member of The Turkish Science Education and Research Association (SERA) and is in founders and executive board of The International Scientific Association (ISCASS). His first book's name is "chaos and education" additionally, his other books named as "Some materials about physics courses for blind students" and "drama, creativity and chaos in physics education with a new perspective" are respectively published.

M. Şahin BÜLBÜL
METU Üniversiteler Mah. Dumlupınar Blv. No:1
06800 Çankaya Ankara, TURKEY
msahinbulbul@gmail.com

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APPENDIX 1

Yaş : **Bilimin Doğası: 5N1K** Cinsiyet:

A. NE ZAMAN BİLİM YAPILIR?

1. Her zaman bilim yapılabilir.	Doğru	Yanlış
2. Bilim merkezlerinin belirli zamanlarda bilim yapılabilir.	Doğru	Yanlış
3. Çalışılan konu ile ilgili herşeyi öğreninceye kadar o konuda bilim yapılmaz.	Doğru	Yanlış

B. KİM BİLİM YAPAR ?

1. Herkes bilim yapabilir.	Doğru	Yanlış
2. Bilim insanı ünvanı olanlar bilim yapar.	Doğru	Yanlış
3. Tek başına bilim yapamayan, bilim insanı sayılmaz.	Doğru	Yanlış
4. Bilim insanları başarısız olabilir.	Doğru	Yanlış

C. NASIL BİLİM YAPILIR ?

1. Bilim yapmanın basamakları bellidir ve bu basamaklar dışında bilim yapılamaz.	Doğru	Yanlış
2. Bakılmamış bir veri, tüm bilimsel bilgi birikimini değiştirebilir.	Doğru	Yanlış
3. Aynı bulgulardan her bilimsel çalışma aynı sonuçları çıkarır.	Doğru	Yanlış

D. NEREDE BİLİM YAPILIR ?

1. Her yerde bilim yapılabilir.	Doğru	Yanlış
2. Bilim yapmak için özel aletlerin bulunduğu özel mekânların olması gerekir.	Doğru	Yanlış

E. NEDEN BİLİM YAPILIR ?

1. Bilim, insanlık için yapılır.	Doğru	Yanlış
2. Bilim, bilim insanının merak duygusunun giderilmesi için yapılır.	Doğru	Yanlış
3. Bilim mutlak/değişmeyen doğruyu bulmak için yapılır.	Doğru	Yanlış

F. BİLİM NELERDEN ETKİLENİR ?

1. Bilim insanlarının ön yargıları çalışmalarını etkiler.	Doğru	Yanlış
2. Bilim insanlarının hayal güçleri ve yaratıcılıkları, yaptıkları bilimsel araştırmaları etkiler.	Doğru	Yanlış
3. Bilimsel bir çalışmanın sonucunu, aynı anda uygulanan yöntem sayısı etkileyebilir.	Doğru	Yanlış