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SCIENCE IN SOCIETY AWARENESS AMONG INDIAN AND RUSSIAN STUDENTS: EMOTIONAL ASPECTS

Shashi Kumar[1],
Dimitri Nertivich[2]
[1]M. Sc., Secondary Education, India
[2]M. Sc., Primary Education, Russian Federation

Abstract:
700 students from India and 700 from Russia in three age groups 12, 16 and 21 years were given a questionnaire assessing their science in society awareness. In both groups anxiety, anger, unhappiness were high, but hopelessness and indifference were rejected. Readiness to engage in pro-science behavior was also vary strong. Indian students had stronger feelings and were more ready to engage in pro-science behavior than Russian. Nevertheless, the age causes decrease of the level of their science in society awareness. Females of both groups had higher levels of science awareness than males. This difference was more pronounced from age 16. Differences between both national groups were explained in terms of different cultural and social contexts.

Keywords: sciences in society awareness, emotional aspect, Indian and Russian students

1. Introduction

The science in society awareness is defined as a social construct composed of science knowledge, emotions and attitudes towards science issues and questions. This also includes values, which are referred to the science (Borden & Schettino, 1979; Cvetković & Stanišić, 2015). It is obvious that we cannot study and interpret science awareness out of the context of a concrete society. As a social construct, science awareness, expresses the interpretations of a society about science, and, its problems. Individual's awareness of science problems is socially mediated, as it mainly derives from the information presented in the mass media, from the socially dominated attitudes to the science and technology, from the educational systems and the naïve representations of concepts and phenomena, from the way science information, problems and the related risk is understood and communicated within the social groups rather than from immediate

personal experience of the science and/or the science crisis (Douglas & Widavsky, 1982; Lowe, Phillipson & Lee, 2008; Phillipson & Lowe, 2008; Ravanis & Boilevin, 2009; Toomey & Domroese, 2013). Such information is factual as well as evaluative and certainly affects the establishment of the science awareness. We know from international research, that children and adolescents received their knowledge and information about the situation of the science in society from the mass media and the socially dominated attitudes and ideas about the science. This was the major source of information, with a large degree of sensation. School subjects were another source, however of less importance (Blum, 1987; Carbonero, et al., 2015; Galo, 2016).

Under the conditions mentioned earlier, we can - at a first glance - explain the difference noted at the access to knowledge as well as in the standards of the science education between India and Russia. Although in Russia, discussions about science problems begun after 1980, and, the science education was introduced to primary and secondary schools just at the end of 1970's beginning of 80's, science problems have been an important topic in the public discussions. This is not the case in India, where science issues still are of a minor priority and also science education has not yet an important place at school (Shabaeva, 1973; Kinelev, 1995; Kala & Ramadas, 2001; Hassard & Dias, 2009; Khokonov, 2004; Sarangapani, 2014; Sumatokhin & Kalinova, 2016; Kumar & Singh, 2017).

Given these conditions we may expect differences in science in society awareness between Russian and Indian students. This is the central aim of this study. In our research we have concentrated on emotional and behavioural aspects of science awareness for a number of reasons: while most of the articles and studies concerning the area of the science education with students or teachers advocate the acquisition of knowledge towards and about the science (Arun, 2017; Ravanis, Zacharos & Vellopoulou, 2010; Sotirova, 2017), it can be contended that positive feelings and a stressed positive behaviour to the science are more prevalent in the minds of children and adolescents (Gabel, Kagan & Shierwood, 1980; Cvetković, Ristanović & Gačić, 2018). At this point, it is very important to focus on the question of how children construct the scientific concepts and phenomena in their thinking before going to the question of science in society. The question of the construction of children's representations occupies an important place in the framework of research in Science Education. Of course, this importance is recognized by many of the researches devoted to the study of mental representations of students in relation to certain concepts of science (Castro, 2013; Ravanis, 2013; Voutsinos, 2013; Rodriguez & Castro, 2014; Fragkiadaki & Ravanis, 2015). Therefore, given that the representations through which the student approaches the world of physical phenomena are in opposition and/or incoherence with the scientific models, the researches in Science Education aim at the realization of the teaching sessions likely to foster the construction of scientific thought (Kampeza & Ravanis, 2009; Grigorovitch, 2014; Nertivich, 2016; Rodriguez & Castro, 2016; Ravanis, 2017).

Examining the international literature related to the views of students and teachers participating in science education programs (Dedes & Ravanis, 2009; Arun,

2018; Castro, 2018; Mabejane & Ravanis, 2018), we identified that emotions and pro-science behaviour were of a very important concern (Brígido et al., 2013; Davila-Acedo et al., 2014; Petersen & Dohn, 2017). But what is "pro-science" behaviour? According to a modern view that we accept "*….it means an appreciation of the importance of carefully studying the natural and social worlds, a mature understanding of the role of reason in the life of faith, and an openness to—if not full acceptance of—the scientific consensus on matters for which I lack expertise*" (Ambrosius, 2014). Moreover, other research studies and approaches showed that emotional and behavioural aspects of the science education are strongly connected as emotional issues have been found to be powerfully related to pro-science tendencies (Perkes, 1973; Coelho, 2017). In many research studies, for example, on international level dealing exclusively or including emotional aspects of science awareness, "emotional dimension" appeared as a global and undifferentiated construct. Also, it remained unclear, which specific emotions were referred. Only two emotions are mentioned systematically: anxiety and fear about future survival and the science destruction and about nuclear war. The fear, linked to hopelessness based, on a generally pessimistic view of the future and anxiety were often not tested explicitly (Raundalen & Finney, 1986; Thearle & Weinreich-Haste, 1986).

In this study, we would like to detect the emotions involved in the science in society awareness, and, if there is a differential agreement between these feelings and the forms of science behaviour, so we can differentiate between some specific kinds of emotions such as unhappiness, anxiety, anger concerning the destruction and progress of the society, hopelessness about the state of the society and indifference about ecological problems. In accordance with other studies on international level, we conceptualised indifference as a general lack of emotionality about science issues and we distinguished between willingness to engage in personal pro-science activities and political pro-science activities (Buechler & Carroll, 1980; Boilevin & Ravanis, 2007; Petri et al., 1986; Raudalen & Finey, 1986). Based on modern quests, that examined the relations between emotions and attitudes towards science issues, we were interested in this research to examine how the level of anxiety, unhappiness and anger is related to the presence or not of hopelessness and indifference in the two countries. We also wanted to know, if there was a differential agreement to anxiety, unhappiness and anger.

Moreover, we were interested in our research for two more factors having influence on science behaviour: age and gender. As far as the age is concerned studies with adults have shown that the younger subjects the more they were concerned about science (Lyans, 1983). We wanted to examine these conditions among the students of the two nations and assumed that children and younger adolescents would be more sensible to science issues than older ones. That was a result based on international studies and on our study with university students. Such an assumption could be reasonable, because the sensitivity to the science in society may decline as the age increases, while the capabilities and the everyday needs, as well as the use of various materials and the consuming behaviour grow.

Although the belief that women, because of their gender, are more sensitive to the environment and its protection, derives from a socio-cultural processes and it is not a biological characteristic of women, many research studies show that women generally have more positive emotions for science and behave towards it in a pro-science way. Consequently, we were interested in the differences between males and females or our research population of both countries.

2. Methodological Framework

2.1. The sample

In the research we are presenting in this article, we used a written questionnaire, which was filled in by the members of the sample of the research. The sample consisted of three age groups with the same number of males and females for each country (12 years: 130 males - 100 females, 16 years: 95 males - 130 females, 21 years: 105 males - 140 females). The Indian sample was a random sub-sample of a total of 1500 drawn to match the Russian sample.

The Indian participants of the ages 12 and 16 come from 10 primary and 8 secondary schools of the city of New Delhi. The individuals of the age 21, residents also in New Delhi, were students at the university or various departments. All Russian participants were residents in Moscow and the ones of ages 12 and 16 came from 13 primary and 8 secondary schools. The individuals of age 21 were also students at universities in Moscow.

Due to the fact that there are no big differences in the orientation of the educational system (about the same tracks) of both countries and that all participants were residents in urban centres of their cities, we can allege that the samples in the two countries were as far as possible equivalent.

2.2. The questionnaire

The questionnaire consisted of statements about emotions, which referred to the following dimensions: relation to nature, environmental destruction, the importance of science in everyday life, evaluation of the relationship between adult human behaviour and science. In order to investigate the specific emotions, we used the following scales, which in terms of content were related to the above mentioned dimensions and included a small number of items so that the instrument of the research wouldn't be large: personal pro-environmental actions, anxiety about future destruction of the society, unhappiness about things destroyed by the pollution, anger at the responsible for pollution and environmental destruction, hopelessness about the state of the everyday life, indifference about society problems. The subjects of the research should give numerical scores for their agreement or disagreement with each item on a 5-point scale (1= strongly agree, 5= strongly disagree). Statements from different dimensions were mixed up in the questionnaire, so that there were positive and negative items in each scale. For each subject an average score was computed for each scale.

The content validity of the instrument was achieved through review of the instrument by a group of experts consisted of an Indian and a Russian researcher and three professional science teachers from high school level. These group examined the content of the instrument to see if it was representative for the specific content area and verified that the instrument measured what it was intended to measure. Certainly content validity is subjective, yet the expert group was chosen for its knowledge referred to the emotions, ethics and science in society research, expertise in measurement and methodology and familiarity with the target group. The group members were sent a draft of the instrument asking them to assess item content and clarity, representativiness of items for content area, appropriate use of scales, length of the instrument and overall appearance. Face validity, which pertains to clarity, wording thoroughness and appropriateness, was also examined by a field test of the instrument by two schoolteachers and two university researchers.

The reliability of the instrument was also established through a pilot study sent to 40 participants (20 participants all three groups from each nationality) randomly selected and using the Gronbach's Alpha criterion, which was used for the confirming the reliability of the scales too.

3. Results

Using the alpha coefficient (Cronbach a) we checked the reliability of our scales which referred to the above mentioned specific emotions for Indian and Russian respectively with the following scores: hopelessness = .4, .36, unhappiness = .65, .71, anxiety = .68, .64, personal activities = .71, .68, political activities = .73, .81. The reliability of scales was satisfactory despite the small number of items on the emotion scales. Interactions among scale, gender, age and nationality: with a 4-way MANOVA we noted significant main effects for age ($F(2,1198)=6.5$, $p<.002$), for gender ($F(1,11198) = 86.71$, $p<.002$) and for culture ($F(1,1198)=39.99$ $p<.003$).

The age to gender and age to nationality 2-way interactions were also significant ($F(2,1198)=8.62$, $p<.001$) and ($F(2,1198)=9.06$, $p<.001$). All 2-Way interactions involving the within - subjects factor scale were significant, age to scale ($F(12,7217)=17.04$, $p<.003$), gender to scale ($F(6,7212)=43.16$, $p<.001$), nationality to scale ($F(6,7212)=95.01$, $p<.001$).

According to the calculated mean and standard deviations for each scale connected with age, gender and nationality (Table 1), there was high agreement to anxiety, anger and unhappiness, whereas hopelessness and indifference were rejected. The results are presented in the following paragraphs.

Table 1: Mean (M) and standard deviation (SD) score of agreement to pro-science feeling and behaviour per age group and culture

Scales	Indian			Russian		
	12 years	16 years	21 years	12 years	16 years	21 years
Anxiety	5.10 (.66)*	4.95 (.70)	5.11 (.69)	5.03 (.68)	4.23 (.59)	5.14 (.58)
Unhappiness	6.29 (.59)	5.01 (.70)	4.96 (.61)	4.88 (.67)	5.00 (.70)	4.98 (.72)
Anger	5.22 (.59)	5.10 (.62)	5.3 (.61)	4.77 (.79)	5.04 (.68)	4.72 (.69)
Hopelessness	2.38 (.4)	2.79 (.71)	2.71 (.63)	2.86 (.75)	2.73 (.65)	2.79 (.63)
Indifference	1.90 (.57)	2.09 (.68)	2.27 (.66)	2.47 (.61)	2.19 (.70)	2.22 (.65)
Personal actions	4.98 (.64)	4.90 (.71)	4.32 (.64)	3.68 (.79)	3.72 (.84)	3.87 (.81)
Political actions	5.03 (.69)	4.56 (.88)	4.07 (.81)	4.69 (.80)	4.42 (.71)	4.50 (.77)

*: standard deviation in parenthesis

3.1 Effects of culture and age

In all age groups Indians were significantly more sad and angry and rejected indifference more intensely than Russians but the levels of anxiety and hopelessness in the two cultures differed only for the 12-year old children ($t>2.08$, $p<.03$). In this case Indians showed more anxiety and less hopelessness. Indians participants also had significantly higher levels of agreement to personal actions than Russian participants at all age levels ($t>5.42$, $p<.001$). However, regarding the political actions Indian's level of agreement exceeded that of the Russians only at the age of 12.

Indian 12-year old children agreed to unhappiness and both types of pro-environmental action more strongly than 16- and 21-year old and they rejected hopelessness and indifference significantly more strongly than 16- and 21-year old ($t>5.41$, $p<.05$). Agreement to anxiety did not change with the age and the agreement to anger was reduced only in the ages of 12 and 16. As far as the Russian students are concerned, it was found out that in the ages of 12 and 16 they showed greater rejection and especially as far as the political activities and indifference was concerned.

3.2 Effects of age and gender

Females differed from males significantly in and indifference and in political and personal actions, that is females showed significantly higher levels of agreement and rejection ($t>2.11$, $p<.002$). All ages presented differences as far as anxiety, unhappiness and personal actions are concerned, while as far as anger, political actions and indifference is concerned, a difference was showed after the age of 16. In males, the agreement to anger, unhappiness and political actions as well as the rejection of indifference was significantly stronger at the age of 12 than at the age of 16 and 21

(t>2.01, p<.001). For the personal actions, this difference was significant between age groups 12 and 16. The males showed changes with the age. While the females showed smaller changes. The latter showed agreement to political actions and rejected hopelessness significantly less strongly from the age 12 to age 21.

3.3 Effects of scale within the national groups

According to the question of our survey concerning differential agreement to emotions and behavioural tendencies we compared three scales with one another: 1) anxiety, and anger, 2) personal and political actions, 3) the emotion agreed the least and the activities agreed the most within each nation (t>2.86 p=.001). Table 2 presents the mean ratings of emotions and pro-environmental actions among the members of the two nations.

Table 2: Mean (M) and standard deviation (SD) ratings concerning agreement towards science emotions and pro-science behaviour per culture

	Indian (N =700)		**Russian (N =700)**	
	M	**SD**	**M**	**SD**
Emotions				
Unhappiness	5.10	.71	4.80	.76
Anxiety	5.03	.79	5.12	.67
Anger	5.21	.61	5.10	.68
Behaviour				
Personal	4.76	.85	3.57	.76
Political	4.59	.84	4.58	.82

p = .001.

Indians on the other hand, showed more anger for the destruction of the environment than anxiety. On the other side, Indians showed significantly stronger anxiety than anger and unhappiness. In both nations, political actions were agreed significantly more strongly than personal actions (t>5.01, p<.001). Agreement to emotions was stronger than agreement to behavioural tendencies in both nations the level of political actions been lower than the level of sadness for Indians and the level of anger for Russians (t>2.68, p<.01). Another relevant result was that Indian students, in comparison to Russian students, showed higher degree of anger, unhappiness and personal actions (t>6.70, p<.001), however, as far as anxiety and political actions are concerned no differences between children and adolescents of both cultures were recorded.

With the use of correlation coefficient Cramer's V, correlations were calculated between a specific emotion and each type of behavioural action separately for each sample of both nations (Table 3). Positive correlations were recorded in both nations for anxiety, unhappiness and anger, while negative in hopelessness and indifference although the negative correlation was weaker from the side of Russians.

Table 3: Scores of correlation coefficients between pro-science emotions and types of behaviour per nationality

Emotions	Indians (N =700)		Russians (N =700)	
	Political behaviour	Personal behaviour	Political behaviour	Personal behaviour
Anger	.56	.53	.61	.47
Unhappiness	.66	.67	.66	.52
Anxiety	.54	.53	.58	.38
Hopelessness	-.17	-.15	-.32	-.33
Indifference	-.69	-.66	-.74	-.64

p = .001, (Coefficient be used: Cramers' V)

5. Discussion & Conclusions

One first important result of our research was that children and adolescents, young people in general, of both countries showed a high degree of emotional concern about the science in society problems. The specific differentiated emotions, we searched beyond anxiety, were anger and unhappiness for the environmental destruction. They also rejected indifference to the environmental problems as well as hopelessness for the condition Russians, showed higher degree of anger, unhappiness of the environment. These results show that the widely spread view that the high degree of anxiety of young people for the existence of the planet and the condition of the environment implies emotions of despair for the life on the planet as well as their own life, can be disputed (Petri et al., 1986).

Students showed a strong will for engagement to subjects concerning the salvation of the environment in personal as well socio-political level. However, Russian children and adolescents showed a weaker will especially for personal action. This tendency is recorded in all Eastern Europe countries, as the comparative research data confirm. The results showed that in both nations, in spite of the different culture, anxiety, anger and unhappiness are positively related to the wish for action in personal as well as political level. A positive relation was also shown between the emotions and the behaviour towards the science in society, at such an extent, that the lack of emotional concern or the indifference to problems created by the applications of science was related to a decrease of the wish and readiness for pro-science action.

Considerable were the results of the research about the differences of children and adolescents as far as culture, gender, age as well as type of emotion and behaviour is concerned. The Indians showed stronger feelings towards the environmental destruction in relation to Russian. They also were angrier, unhappier, less indifferent and showed a stronger will to get personally involved in pro-science actions. Russians showed strong anxiety for environmental destruction in relation to other emotions, but at a lower degree than the Indians.

Starting from the well-established view through a large volume of research work, which indicates that the emotional concern and the wish for pro-science behaviour are fundamental components of the science in society awareness, we could claim-according to our research results- that culture generally influences science in

society awareness, at the same time differentiating emotions (Bedford, 1986; Lewis, 1989). While Russians show a high degree of anxiety regarding environmental destruction, they seem to have a low degree of readiness for undertaking pro-science actions. According to discussions with Russian teachers, who helped in the research, and the data from international comparative research work, such an attitude could be justified by the relatively low degree of importance regarding environmental protection and the type, quantity and quality of information available concerning environmental aspects. Only during the last years information on environmental matters is offered by the mass media. According to Russian teachers, young people and the population in general had a very limited knowledge about the nuclear reactors problems in neighbouring Ukrania or about the pollution of the coast in the Black Sea, or about the air pollution in the large cities or even about Chernobyl. The information on the environment apart from being a "new" event, is often presented in a devastating manner. This easily is causing anxiety.

Apart from what has been mentioned above, and keeping always to the framework of the culture influence on the science in society behaviour, it could be presumed that the limited readiness of children and adolescents in Russian, for personal pro-science action, is due to the fact that, compared to India, first the ecological movement is not well developed and secondly the environmental education at school is not only has been introduced recently, and, also the environmental consciousness of the people is not well developed. Therefore, there is no social support in the young people's ecological concern and anxiety.

No important differences were observed between Indians and Russians in the pattern of agreement in various emotions and behaviours. The high environmental feeling of Indians and their tendency for action can be attributed to the priority – though, not high enough, compared to other countries - given by the Indian society to science matters, but also to the information level offered regarding environmental destruction.

Indians appeared to have a higher environmental consciousness than Russians. As far as age is concerned, 12-year old children seem to have the highest environmental consciousness. This can be attributed to the fact that in this age, the children's emotions about the environment do not conflict with consumer tendencies and values which appear during the adolescence phase. This finding may interpret the fact that age does not seem to influence the science in society behaviour of the young Russian students. A conflict among environmental and consumer values would hardly arise as a realistic perspective for the young Russians, especially in the last years (political changes, political instability, war).

Concerning the aspects of the science in society consciousness investigated, differences between the two sexes were recorded, irrespective of the culture. Females of all ages from both countries mentioned more intense emotions towards the environment and the tendency for the undertaking of action. Given that, according to the results of our research, the level of emotions towards science in society and the

readiness for science in society behaviour declines in males after the age of 16, the differences between the two genders become more intense.

The more intense emotions of girls towards science in society should be attributed, in the general, to the tendency of females, especially in the age of childhood and adolescence, to express their emotions more intensively than boys (Wintre et al., 1990). This aspect, although it is not generally accepted as a characteristic of the female gender, cannot explain why females showed, in our research, more readiness to engage with pro-science behaviour. An interpretation of this tendency, the investigation of which was beyond the objective of this research, would come from the consideration of the pro-science behaviour as pro-social behaviour, which includes a caring attitude to human, non-human things and to the nature. As women, as it can be seen from general research results, express a pro-social attitude more than men do, we think that it is reasonable to inquire as to the interpretation of the results of this research in the framework of gender differences regarding the pro-social attitudes.

In this work, which, as far as we know, is the first of this kind for both countries, we focused on the emotional elements of the science in society consciousness of young people, trying to spot specific emotions and their connection with types of science in society behaviour. The study enables us to examine the science in society feelings of the adolescents more adequately and in more detail than previous studies, which were concentrated on the global construct "emotional concern". The cross-national approach gave the possibility to spot differences in emotion and behaviour towards science in society, which are considered as an indication for the social construction of the science in society awareness. However, the question of emotions for science cannot be considered independently of the construction of scientific knowledge, that is to say, by students' representations about the concepts and phenomena of natural sciences and the corresponding transformation of scientific knowledge into school knowledge (Shulman, 1987; Kansanen, 2009; Vellopoulou & Ravanis, 2012). Because the creation of emotional states can only be properly assessed if students handle representations in a way that is compatible with scientific knowledge. In this direction we are orienting our research.

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