

A STUDY OF SCIENTIFIC ATTITUDE AMONG LEARNERS IN BOTSWANA

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This paper describes the analysis of the scientific attitude of varied sample, including learners from Junior Secondary and Senior Secondary school levels and also a group of prospective science teachers from a college of secondary education in Botswana. The tool used for the study was a Likert type five-point Scientific Attitude Scale (SAS) developed and standardised by the investigator. The tool contained items on six of essential component behaviours of the scientific attitude like open mindedness; belief in truth/facts; appreciation of nature of Science; free from superstitions; curiosity to learn/explore new facts and phenomena; and objectivity. The analysis of the scores indicated that the level of scientific attitude of some of the learners was very low, whereas a good proportion of sample showed an average level. No significant difference was noticed in the attitude of male and female respondents. A need of serious, sound and sustainable planning of the school Science curriculum and its dissemination was reflected by the study. As way forward, the investigator has proposed strategies for enhancing the opportunities for the effective development of scientific attitude by creating an enabling environment of Science learning in the educational institutions in Botswana.

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Introduction

Botswana is a fast developing country of South African region with highest per capita income of the Africa. The government has created excellent schooling facilities in all habitations with the desired infrastructural, material and human resources. There was a shortage of local manpower for teaching of Science, Maths and Design and Technology at all levels of school education. The government even declared Science, Maths and Design and Technology as areas of 'Scarce Skills' and incentives such as one scale-up was given to teachers of these subject areas to attract more talent towards these categories.

For teaching-learning of Science, almost similar set of equipments, apparatus and material is available in all the Community Junior Secondary Schools (CJSS). The same is also true about Senior Secondary schools and Department of Science in colleges of secondary education. The country has envisioned development of a scientific society in Botswana and resources have been created for teaching-learning of Science and concerted efforts are being made to achieve this vision goal.

As we all know that Science is the process as well as product of the process, however, process is more important than the product. Any curriculum on Science is aimed at the

development of scientific attitude through processes of its transaction. The first and foremost aim of Science education is to inculcate scientific attitude among the learners. The scientific attitude is characterised by a number of component behaviours such as: openness in day-to-day life; belief in truth; appreciation of nature of Science; free from superstitions and myths; objectivity in taking decisions; curiosity to learn more; aesthetic sensibility and the like. In other words, scientific attitude is reflected through positive attitudes in all actions in day-to-day life of an individual. The efforts done by the Ministry of Education in Botswana has emphasised on 'Science by Investigation' at the school level and in training of teachers. A context-specific and child-centred Science curriculum for school education is being implemented in the country.

Literature Review

With the advent of new ways of communication and information technology, the teaching-learning of Science has become more interesting. Hence, greater responsibility has to be shouldered by the Science teachers and curriculum developers to plan and organise scientific processes by using multimedia approaches to enhance pupils' learning. Swift (1992, p. 7) has advocated for indigenous knowledge by saying that, greater the indigenous knowledge and less the imported knowledge, the more likely it is that the latter will be assimilated and used. On the other hand, for teaching diverse student populations, a multicultural coursework is recommended by Wiggins and Follo (1999). They felt strongly that "multicultural coursework must move beyond knowledge about other culture, whether that knowledge is from a pedagogical perspective or a historical perspective".

Science educationists have defined scientific attitudes as having the characteristics of "critical mindedness, respect for evidence, objectivity, open-mindedness and questioning attitude" (Mayer and Richmond, 1982, p. 56). Johnston (1997) in his paper has argued about the construction of tools and analyses traditional tools used to measure scientific attitudes in secondary school children and considers their use with younger children and adults. Fraser (1978, p. 510) also discussed types of items in the scientific attitude scale. Further, authors like Weaver (1998) while commenting on the role of teachers and facilitation of learning stated that "teachers may need professional development in order to effectively act as facilitators of learning". Thomas (2012) in his essay on changing landscape of inquiry for a new science of education, also argues that 'scientific' percepts do not characterise scientific endeavour, which is fluid and plural: Science flexes to any angle to answer the questions that are posed in any field.

For the inculcation of scientific attitude and improving achievement of students in Science, studies have been conducted as quoted by Johnston (1997). In the context of Botswana, Miller and Osborne (1998), Solomon (2002), Sutton (1992), Kesamang and Taiwo (2002) have reported the correlates of the socio-cultural background of Botswana Junior Secondary School students with their attitude towards and achievements in Science.

Rationale of the Study

Since a lot of focus had been given for improving the teaching-learning of Science at various levels of schooling in Botswana, during the last two decades, it was thought proper to study the impact of these efforts in developing the

scientific attitude among the learners at all levels and prospective Science teachers. The findings of such a study will reflect upon the effectiveness of these efforts and pedagogical practices in school Science education. The study may have implications in deciding the future course of action about the pedagogical practices of Science education so that country's vision to develop a Scientific Society in Botswana is realised in due course.

Objectives of the Study

The following objectives were kept in mind while carrying out the study:

1. To see the impact of Science learning in developing the scientific attitude among the learners at different levels.
2. To compare the scientific attitude of male and female subjects at each level.
3. To compare the difference in the attitudes of different categories of sample.
4. To suggest measures to improve the level of scientific attitude of subjects.

Methodology

The Tool

A scientific attitude scale developed by the author was used which contained 36 items, including six on each of the six component behaviours of the scientific attitude like open mindedness; belief in truth/facts; appreciation of nature of Science; free from superstitions; curiosity to learn/explore new facts and phenomena; and objectivity. The tool used for the study was a Likert type five-point Scientific Attitude Scale (SAS) developed for the purpose. The scale was subjected to peer review and tried out before its administration to

the sample. The reliability of Scientific Attitude Scale (SAS) was found 0.56 as calculated by using Spearman-Brown formula.

The Sample

The sample included students from Community Junior Secondary School (34 consisting of 18 males and 16 females) and Senior Secondary School (49 consisting of 24 females and 25 males) and also a group of prospective Science teachers (44) from Molepolole College of Education — a college of secondary education in Botswana.

Result and Discussion

The data collected on SAS were subjected to statistical analysis and a comparison of the performance of various groups was done. A comparison of the scientific attitude of the teacher trainees and students studying at senior secondary level of schooling is given in Table 1.

Table 1. Performance of Trainees vs Senior Secondary Students on SAS

Group	No. of students	Mean	SD	SE of SD	't'
Trainees	44	97.57	10.68	6	1.01*
Sr. Sec. Students	49	95.57	8.05		
	N=93 df = 91	Mean Diff. = 2			

*Insignificant at 0.05 and 0.01 level

The results indicate that there was no significant difference in the performance of the groups with regard to their scientific attitude measured by a newly developed Scientific Attitude Scale. The 't' value computed for the groups is insignificant at 0.05 and 0.01 level. This insignificant difference

in the scientific attitude of the two groups may be due to very less difference in their age, qualification and mental maturity. It is worth mentioning here that the teacher trainees' entry qualification was senior secondary (12th Standard).

On comparing scientific attitude of teacher trainees with the students studying at junior secondary school level of education, it was found that the mean score of the teacher trainees is much higher than those of junior secondary students. The analysis of the score and further statistical treatment indicate that there is a significant difference in the scientific attitude of the two groups and prospective teachers have better scientific attitude than the junior secondary students. This difference in the attitude could be attributed to the large difference in the age, level of education and mental maturity of the subjects forming two groups. The statistical data of the groups are given in Table 2.

Table 2. Performance of Trainees vs Community Junior Senior Secondary School (CJSS) Students on SAS

Group	No. of Students	Mean	SD	SE of SD	't'
Teacher Trainees	44	97.57	10.68	6.36	2.89*
CJSS Students	34	91.21	8.71		
	N=78 df = 76	Mean Diff. = 6.36			

*Significant at 0.05 level

Similarly, a comparison of the scientific attitude of senior secondary and junior secondary students was done and a significant difference was noticed in the mean score of the groups

at 0.05 level. However, the difference was insignificant at the 0.01 level. Here also the difference in the attitude may be due to the gap in the level of education, age and mental maturity or exposure to learning of the students in the groups. As we know, senior secondary level is a higher level of education in comparison to that of junior secondary level. Accordingly, the scientific attitude of senior level students is better than the junior level students. The statistical data are given in Table 3.

Table 3. Performance of Senior Secondary Students vs CJSS Students

Group	No. of Students	Mean	SD	SE of SD	't'
Sr. Sec. Students	49	95.57	8.05	1.88	2.31*
CJSS Students	34	91.21	8.71		
	N=83 df = 81	Mean Diff. = 4.36			

*Significant at 0.05 and insignificant at 0.01 level

A comparison of the scientific attitude of the male and female teacher trainees of all the groups was carried out. The analysis of the scores of male and female Science teacher trainees of Molepolole College of Education, indicates that the female trainees have better mean score (100.33) in comparison to their male counterparts (97.71). However, the difference in the mean scores is significant at 0.05 and insignificant at 0.01 level. Thus, the statistical analysis of the scores does not indicate any difference in the scientific attitude on the basis of gender. Thus, it can be inferred that there is no significant difference in the scientific attitude of the female and male teacher trainees as their level of education, age group and mental

maturity level is almost the same and they have acquired same level of education and exposure before entry to the pre-service teacher training. The statistical data are given in Table 4.

Table 4. Performance of Female vs Male Teacher Trainees on SAS

Group	No. of Students	Mean	SD	SE of SD	't'
Female Trainees	9	100.33	8.20	4.01	0.65*
Male Trainees	14	97.71	11.00		
	N=23 df = 21	Mean Diff. = 2.62			

*Insignificant at 0.05 and 0.01 level

In case of female and male students of senior secondary level, it was noticed that the male students have a little higher mean score (97.12) than the girl students (93.96) of the same level. Here also, the mean difference was found insignificant at 0.05 and 0.01 level attributable to the same of level of education, age and exposure to learning. The data showing the comparison are given in Table 5.

Table 5. Performance of Female vs Male Senior Secondary Students on SAS

Group	No. of Students	Mean	SD	SE of SD	't'
Female Students	24	93.96	9.15	2.27	1.39*
Male Students	25	97.12	6.41		
	N = 49 df = 47	Mean Diff. = 3.16			

*Insignificant at 0.05 and 0.01 level

Similarly, no significant difference was found in the attitude of boys and girls studying at junior secondary level, as indicated by the data given in Table 6.

Table 6. Performance of Female vs Male Community Junior Secondary Students on SAS

Group	No. of Students	Mean	SD	SE of SD	't'
Female Students	16	91.56	8.49	2.98	0.22*
Male Students	18	90.89	8.91		
	N = 34 df = 32	Mean Diff. = 0.67			

*Insignificant at 0.05 and 0.01 level

Conclusion

On the basis of the above study, the data collected and analysis — it is revealed that the level of scientific attitude is not very good among all categories of students constituting the sample. The learners at lower levels of schooling need much attention in order to develop a better scientific attitude. The scores of subjects under each category were also compared component behaviour wise and it was found that they have lowest score for appreciating the nature of Science. Hence, there is a need of serious and concerted efforts for planning and implementing school Science curriculum in the country.

As way forward, it is proposed to emphasise on creative hands-on activities during teaching-learning of Science at all levels. Every effort should be made to develop the competencies of Science learning and learners should be exposed to innovative practices of Science teaching and

learning. They should be taught and trained to have a scientific bent of mind while dealing with problems in their day-to-day life. They should be given maximum exposure to understand the very nature and various forms of scientific knowledge as seen in the surroundings. Science curriculum should be developed and disseminated in such a way that it becomes useful for teachers and learners, environment-oriented and local need based.

For making all these efforts, the onus is on the educational institutions and other stakeholders concerned with the development of the child as an empowered future citizen of scientific temperament. There is a need to draw a comprehensive plan and make meticulous efforts for equipping all teachers with desired pedagogical content knowledge through pre-service as well as in-service training in Botswana.

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