Original Research Paper　　　　　　　　　　　**Education**

A Study of Errors and Misconceptions in Science In Relation To Location among Secondary School Students

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ABSTRACT

A descriptive study was conducted on a sample of 912 students studying in ninth class in various schools of Punjab. For the study Concept Achievement Test in Science was constructed and standardized and was administered to identify errors and misconceptions among students of both urban and rural schools. Both boys and girls committed errors due to mistakes, lack of knowledge and misconceptions, but the direction of the results showed rural secondary school students committed more errors in comparison to urban secondary school students. The suggestions for educational implications are also discussed.

Introduction

Science and technology have profoundly influenced the course of human civilization. Science has provided us remarkable insights into the world we live in. The quality of education in secondary schools is an important area of concern particularly in the present era of science and technology. The perusal of research studies on learning scientific concepts, science achievement and identification of errors and diagnosis of misconceptions along with sources of misconceptions is indication of the fact that the focus of researches in science teaching has shifted to diagnostic processes in order to enhance students' understanding and better performance in science achievement. Since there is added emphasis on minimum level of learning at elementary stage to be followed at secondary stage as well, it becomes important to look into the problem of errors and misconceptions contributing to low achievement in science at secondary school stage. The review of related shows many researches about the influence of school environment as a factor to promote the academic achievement among students. McLaughling and Drori (2000) and Mehra (2004) concluded that urban atmosphere was more conductive to better achievement than rural environment. On the other hand Aseema and Gakhar (2004) found rural student to be high achievers. Some researchers found that government, aided and unaided institutions differ significantly in achievement. (Basappa, 2003; Sobhana, 2004 and Manimekali, 2005). The school environment and organizational features have a significant and positive relationship with achievement of students (McLaughlin and Drori, 2000; Devi and Mayuri, 2003; Kalra and Pyari, 2004; and Stewart, 2008).

Errors made by students were identified by some researches affecting the achievement of students (Shook, Linda Jean, 2003; Bataineh, 2005; and Afamasaga, 2007). Many researches were carried out in various school subjects to identify the naive ideas called 'misconceptions' of students that can create learning difficulties for students and ultimately causing low achievement (Driver, 1993; and Palmer, 1998).

Errors and Misconceptions

Barrass (1984) wrote of 'mistakes' and 'misconceptions' or 'misleading ideas'. Eryilmaz and Surmeli(2002), Haki(2005) and Kutuluay(2005) revealed that errors among secondary school students were due to mistakes, lack of knowledge and misconceptions. While identifying errors and misconceptions among students they referred mistakes as the incorrect answers given by the students who have correct scientific conceptions while lack of knowledge as the incorrect answers given by the students who have incorrect scientific conceptions and have no confidence for their wrong conceptions, in case the students have confidence for their wrong conceptions, these were referred as misconceptions. A large number of studies into student's

alternative conceptions have occurred over past 40 years but there is paucity of researches in the area "errors and misconceptions in learning of scientific concepts" in Indian context. So the present study is an endeavor in this direction to provide empirical evidence with regard to problems in learning of scientific concepts with objectivity and scientifically.

Objectives

- To find out the level of performance of secondary school students on Concept Achievement Test (CAT) in science in relation to location.
- To find out the percentage of secondary school students who committed errors and misconceptions on Concept Achievement Test (CAT) in science in relation to location.
- To study the patterns of errors and misconceptions on Concept Achievement Test (CAT) in science in relation to location.

Hypothesis

The rural secondary school students will differ from urban secondary school students in their pattern of errors and misconceptions on Concept Achievement Test (CAT) in science.

Method

A descriptive method of research was used in the conduct of the study. The study was completed in two phases:

Phase 1: Construction and standardization of Concept Achievement Test (CAT) in science by the researcher for the identification of errors and misconceptions to include the concepts of adaptations, habitat, biosphere, ecosystem, food chain and food web, functions of ecosystem, biomass and biodiversity from the PSEB prescribed science text book.

Phase II: Field Work.

The preliminary draft of the test contained fifty three test items to be responded on three tiers. This draft was administered to 220 students of ninth class from various schools in Patiala. On the basis of the indices of the item difficulty and in the view of the experts 23 items were discarded and 30 items were selected. Then that test was administered to 125 secondary school students of Patiala to find out the reliability and validity of the three tier test. First tier included multiple choice items having one right answer and three distracters. The second tier required students to write reason for the response. Third tier asked students about their confidence for the answer in first two tiers. Total achievement score of each student was calculated according to the students' multiple choice item scores, reasoning part scores and the confidence level scores together.

Sample

A sample of 912 students of 9th class studying in high and senior

secondary government schools was selected randomly selecting 33 schools from seven districts of Punjab namely, Patiala, Ropar, Ludhiana, Bathinda, Mansa, Fatehgarh Sahib and Sangrur. Out of 912 students 436 were rural and 476 were urban students.

Tools
Following tools of research were used for the collection of data:
1. Concept Achievement Test constructed and standardized by researcher herself.
2. Interview schedule for identification of sources of misconceptions.

Statistical Treatment of the Data
Descriptive statistics was used to explain the performance of students on Concept Achievement Test (CAT) in science. The percentage and number of students who committed errors for all the seven concepts were calculated and classified to explain the patterns of errors and misconceptions committed by students.

Findings
The major findings of the study were summarized below:
- The achievement of secondary school students of Punjab on Concept Achievement Test (CAT) in science was moderate.
- A large number of secondary school students gave correct answers in the concept area of 'adaptations' , while a majority of secondary school students gave correct answers for the concept areas of 'habitat' biosphere, 'ecosystem', 'food chain and food web' and 'functions of ecosystem' respectively. Few students were able to give correct answers in the concept area of 'biomass and biodiversity'.
- The urban secondary school students have significantly higher performance on Concept Achievement Test (CAT) in science as compared to their rural counterparts. Urban secondary school students have better achievement on Concept Achievement Test (CAT) in science. Similar results were shown by McLaughling and Drori (2000) and Mehra (2004).
- The rural secondary school students committed more errors in comparison to urban secondary school students in the concept areas of 'habitat', 'ecosystem' and 'food chain and food web'.
- Comparatively more number of rural secondary school students' had objectively false conceptions in the concept areas of 'biosphere' 'ecosystem', 'food chain and food web'. While, in the concept area of 'biomass and biodiversity' more number of urban secondary school students' concepts were objectively false. Objectively false conceptions were identified by some researchers in the area of photosynthesis and respiration by Hill (1997), simple electric circuit by Haki (2005), geometric optics by Kutuluay (2005), and genetics by Shaw et al (2008).
- There was no significant difference in the mean misconceptions of rural and urban secondary school students; however, rural students had significantly more misconceptions in the concept areas of 'biomass and biodiversity' while urban secondary school students had more misconceptions in the concept area of 'functions of ecosystem' as compared to their counterparts.
- The urban secondary school students were not significantly different in mean mistakes lack of knowledge as well as misconceptions on Concept Achievement Test (CAT) in science.

Testing of Hypothesis
The formulated hypothesis was accepted as the rural secondary school students committed more errors in comparison to urban secondary school students. It had been pointed out that there was no significant difference in rural/urban secondary school students for sources of errors on Concept Achievement Test (CAT) in science. However, the direction of the results was indicative of the fact that there was a trend in favour of rural students for misconceptions and mistakes as source of errors while in case of lack of knowledge as a source of error, the trend was in favour of urban students.

Educational Implications

In the light of the findings of the present study following implications emerged that can be used by teachers to improve the delivery of science education.

1. The results of the study showed that students made errors, due to mistakes, lack of knowledge or due to misconceptions. These misconceptions resist changing and obstructing the learning process. The teachers are required to take students misconceptions into account. The more the teachers know about their students' misconceptions the more guidance they will be able to provide them to learn. This could contribute to the professional development of science teachers. Smith and Anderson (1993) and Lawrenz (1986) advocated that during (preservice and inservice) teacher education programmes the teachers should be given chances to identify misconceptions held by the pupils in their classrooms.
2. Teachers should provide a forum for students to confront their misconceptions. Use questions and discussion to probe for additional misconceptions. Students will often surprise the teacher with the variety of their preconceptions, so the teacher should be careful to listen closely to their answers and explanations. The teacher can help students by asking them to give evidence to support their explanations and by revisiting difficult or misunderstood concepts after a few days or weeks.
3. The findings of this study could facilitate teachers in their planning and implementation of relevant measures to reduce the incidence of students' misunderstandings about the concept of environment. A teacher should focus on students cognitive level to eliminate misconceptions, because most of the students in high schools and all students in elementary and junior high schools are in concrete levels; therefore, the major focus of instruction for those students should link between concept and concrete experiences and expect difficulties on linking concrete experiences to abstract concepts because any science concept has a relationship with other concepts, so students have to link the ideas and other concepts. When students create this linkage in their mind, they are going to correct their misconceptions and develop meaningful understanding of new concept (Turkman and Usta, 2007).
4. To address and overcome the barriers of misconceptions in effective teaching learning process, the textbooks writers are required to address the prevalent misconceptions of the concepts. This study can give some feed back to the text book editors.
5. The curriculum developers and formulation committees have a significant role in recognizing and overcoming students' misconceptions. This study can be taken into consideration by curriculum developers and remediation techniques of them should be designed.
6. This work has identified new material which can be utilized by science educators both in the classroom and in teachers' pre- and in-service courses, which can help to make improvements in their class room practices to enhance the student learning.

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