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ASSESSING GENDER DIFFERENCES IN A-LEVEL BIOLOGY STUDENTS' PERCEPTIONS OF LABORATORY ENVIRONMENTS IN ZIMBABWEAN SCHOOLS

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Abstract

This study assessed gender differences of Zimbabwean A-level students' perceptions about their actual and preferred biology laboratory environments in relation to cohesiveness, openness, integration between theory and laboratory work, management of laboratory work and the material environment. The Science Laboratory Environment Inventory (SLEI) was used to collect data from a total of 68 students (40 male and 28 female) attending metropolitan High Schools. Results obtained indicated that both female and male students prefer less cohesiveness than there is in current laboratory environments. Both sexes would however prefer more openness and a more conducive material environment. The situation is more pronounced for girls. Females prefer more integration and less controlled management of activities than male students.

Introduction

Learning environment in education typically refers to the overall climate and culture of the classrooms, including communication patterns, the design, feel, and organisation of physical space and the teacher's ability to manage students in the classroom. The classroom environment needs to be supportive of all persons so that students will learn to respect all other individuals and respect their ideas. The classroom environment also needs to be supportive in such a way that it enables all students (female and male) to acquire learning that is meaningful to them.

Fraser (1989) estimated that during primary and secondary schooling children spent about 15000 hours in the classroom. According to the syllabus which students now follow in Zimbabwe, (Zimbabwe School Examinations Council, 2001), A-Level biology students spend about 225 hours in the classroom, of which not less than 98 hours should be spent in the laboratory. Such vast

amounts of time mean that the quality of life in these classrooms is of great importance. Students' behaviours, knowledge and skills are likely to be influenced to a large extent by the prevailing nature of the classroom environments.

Studies of science laboratory environments have largely been done in Europe and very few have been done in African countries. No studies that compare gender differences in perception of laboratory environments appear to have been done in most Southern African countries.

Research Problem and Significance of the Study

It is important that the learning environment in the laboratory be conducive to meaningful learning for both female and male students. The interaction of various factors in the laboratory (both physical and human) must be in such a way that everyone feels confident to engage in authentic scientific activity. Hegarty-Hazel (1986) argues that the method and spirit of inquiry in science are learnt in the laboratory. Because of this, laboratory work is regarded as the unique feature of science that distinguishes it from other disciplines. If laboratory work has this important role in science, it is therefore important to investigate whether students feel that the environment in which they do laboratory work helps them to effectively engage in scientific inquiry. Students' perceptions are likely to have a significant impact on how they learn in the laboratory. They are also likely to have an impact on how the students work in different scientific disciplines after leaving school. In Zimbabwe a visibly low number of female students take up science subjects at A-level, and consequently the number of females employed in science related fields is significantly low. It is therefore important to collect data regarding students' perceptions of learning environments in science as these are likely to influence female and male students' involvement in the subjects.

It would be important to assess gender differences in students' perceptions about their actual laboratory environments in relation to helping or providing an enabling environment for them to learn science. This can then be compared with students' perceptions of their preferred laboratory environments so that adjustments that help students learn more meaningfully can be made. In Zimbabwe, and probably in many other countries, it is rare to find situations in which students are given the opportunity to express their views about the conditions under which they would like to learn. Such information is however important as it would help teachers and science curriculum developers organise learning environments in such a way that they present an atmosphere that allows students to learn more effectively.

Purpose and Research Questions

This study sought to assess Zimbabwean A-level female and male students' perceptions of their actual and preferred biology laboratory learning environments. The study assessed the laboratory learning environments in relation to student cohesiveness, openness of laboratory work, relationship between laboratory work and theory lessons, classroom management and the material environment of the laboratory. More specifically the study addresses the following research questions:

1. What gender differences exist in A-level biology students' perceptions of their actual laboratory classroom environments?
2. What gender differences exist in A-level biology students' perceptions of their preferred laboratory classroom environments?

Literature Review

Introduction

Laboratory work constitutes a major part of students' instructional time in science. In secondary school science laboratory work is regarded as an essential part of the science curriculum and is central to the teaching of the subject.

This paper reviews research that has been done on learning environments in science. The nature of learning environments will be discussed as well as how learning environments tend to impact on learning. Special focus is made to gender related issues in learning science.

Learning Environments

According to Salomon, quoted in Nishinosomo (1992) the idea of a learning environment refers to "...a complex mix of variables that are interconnected. An environment is an entire amalgam of roles, activities, goals, relationships, interactions, conditions, circumstances and influences that combine to provide the conditions for growth or learning of the individual". (p. 1)

The learning environment is therefore not simply made up of human and physical factors, but also all the psychological, attitudinal and relational factors that in one way or the other may affect the learning process. Because of the varied nature of factors influencing learning, it is often difficult to come up with a single or prescriptive definition of a learning environment. With the current moves towards more student-centred forms of learning, it becomes even more

difficult to have a single definition since "an environment that is good for learning cannot be fully pre-packed..." (Wilson, 1995). The difficulties encountered in trying to define learning environments should however not mean that instructional designers should not endeavour to plan and design learning environments. The need for learning environments that are supportive to learning by both female and male students is necessary if we are to ensure that all students get access to the necessary information and tools that enable them to learn meaningfully. Educators need to ensure that the learning environment has proper support, guidance, resources and tools that can be used by learners of both sexes in a flexible way as learning needs arise.

Though this paper mainly focuses on classroom (laboratory) based learning environments, it should be noted that there are different forms of learning environments which include, constructivist learning environments (Wilson, 1995), technology-based learning environments (Vosniadou, De Corte, & Mandl (1992), adaptive learning environments (Jones, M., & Winne, P., 1992), and computer based learning environments (De Corte, Linn, Mandl, & Verschaffel, 1992).

Learning Environments and Learning Science

It is apparent that the science learning environment (the laboratory in particular) has a masculine image. According to Head (1985) this is evidenced by students' perceptions of science and scientists as having a masculine nature. Such a perception is likely to discourage female students from choosing to continue with science subjects.

In recent years moves have been made to create "rich classroom learning environments." (Perkins, 1991). According to Perkins (1991) in such classroom environments students are given more control of the environment. The learning activities in which students engage are of a varied nature so as to allow them to pursue their varied learning goals and interests. Because students pursue multiple goals there is need for varied degrees of guidance from the teacher. The relinquishing of control over content, pacing of the lessons and activities requires a corresponding increase in decision making and performance support. If such learning environments are poorly planned they are likely to result in failure as lack of support may result in students feeling stranded and faced with unreasonable performance expectations. The problem is also further complicated by the fact that learners differ dramatically in their need for support.

A number of research findings indicate that students' perceptions about the

situations under which they learn accounts for an appreciable variation in learning outcomes. The variation was found to be even greater than that attributed by students' background characteristics. (Fraser and Wubbels, 1995). This therefore would imply that if students perceive the conditions under which students learn as conducive, learning is likely to be improved. Research carried out by Haertel, Walberg, and Haertel (1981), as quoted in Fraser and Wubbel (1995), found out that "better achievement on a variety of outcome measures was found consistently in classes perceived as having greater cohesiveness, satisfaction, goal direction and less disorganisation and friction." (p. 129). Fraser and Fisher (1982) also studied the effects of learning environments on students' outcomes and their results supported the fact that there was a strong correlation between improved learning outcomes and environments that students perceived as conducive to learning. According to their research, order and organisation appeared to have a positive impact on student achievement of a variety of aims. Such environments would be especially supportive to female students who tend to prefer learning environments, which engender a sense of community.

Fraser, McRobbie and Giddings, as quoted by Fraser and Walberg (1995), used the SLEI to investigate science laboratory environments and found out that in classes which had higher scores on the integration (i.e. more link between the theory lessons and laboratory work), both the cognitive and affective outcomes were greater than in those classes with lower scores on integration. Environments that are more co-operative, less competitive and participatory in nature appear to enhance the learning of science by girls. Effective learning environments according to Collins, Brown and Newman (1989) should provide students with problem solving strategies and give them a chance to observe, discover and invent things in their own context. Factors that influence learning may probably vary from one context to another, hence the need to carry out research in different contexts to see if this is true.

Methodology

This section gives a description of the participants and setting, the procedure and instruments used, and how data were collected and analysed and presented.

Participants

A total of 68 A-level biology students attending metropolitan high schools were involved in this study. These consisted of 40 male and 28 female students aged between 17-19 years. All students were in their first year of A-level (form five).

Instruments and Procedure

This explanatory and interpretative study used the Science Laboratory Environment Inventory (SLEI), to collect data about students' perceptions. (Fraser 1995). The instrument is short and economical in terms of administration and scoring, while at the same time the openness of questions allows the gathering of data from several dimensions.

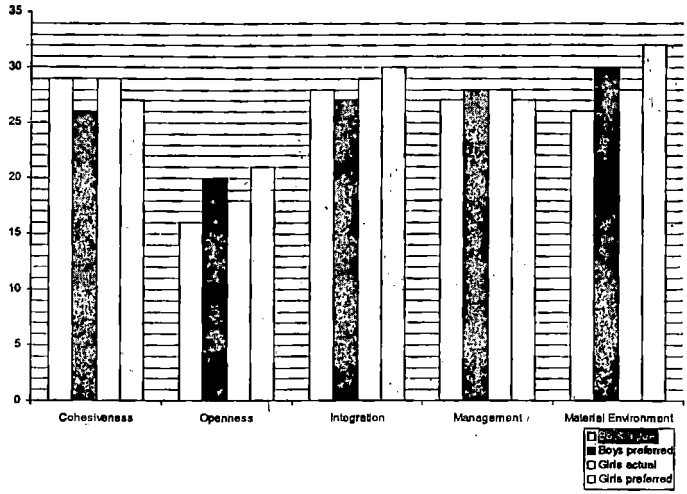
The SLEI has five scales and the response alternatives for each item are: Almost Never, Seldom, Sometimes, Often and Very Often. Two forms of the SLEI were used; the *actual* and the *preferred* forms. The actual form was used first to probe students' perceptions of actual or existing laboratory classroom environments. The preferred form was administered a week later and it measured students' perceptions of the laboratory environment which they would ideally like.

Students' responses were hand scored and mean scores were used to construct the profiles shown in Figure 1. In scoring most of the questionnaire items, one (1) was given for the *almost never* responses, two (2) for the *seldom* responses, three (3) for the *sometimes* responses, (4) for the *often* responses, and five (5) for the *very often* responses. Reverse scoring was however used for a few of the items. Omitted or incorrectly answered items were given a score of 3. The total score for a particular scale was thus simply obtained by finding the sum of the five items belonging to the scale.

Results and Discussion

This section summarises and discusses the profiles that represent the means of students' actual and preferred environment scores from both the actual and preferred forms of the SLEI.

Figure 1: Profiles of Mean Classroom Environment Scores for Female and Male Students



Cohesiveness

For both male and female students the mean score for the preferred environment is lower than that for the actual environment. The score for the actual form is the same for both sexes. While both sexes prefer less cohesiveness, the situation is more pronounced for male students. Research published by Haertel, Walberg and Haertel, (1981) however indicated that students achieved better on a variety of outcomes in those classroom environments that they perceived as having greater cohesiveness. The apparent need to be more individualistic and to work in isolation probably results from the fact that at A-level, students are normally expected to work as individuals with their own apparatus. This is also how they would be expected to work in the final practical examination. Because of this, students therefore get accustomed to working alone and tend to shun sharing with other students in the laboratory.

Openness of Laboratory Work

Both female and male students indicated that their actual biology laboratory

environment is not as open as they would like or prefer it to be. Compared to male students, female students perceive the current laboratory environment as more open but they still prefer more openness. Given the importance of more open laboratory work as discussed in the literature review, creating laboratory environments that are more open could therefore encourage students of both sexes to learn science. The preference of more openness by girls could be attributed to the need by females to work without pressure from their male counterparts and also to have time to think more carefully about issues.

Integration

In relation to integration, male students feel that the current laboratory environments have more integration than they would otherwise prefer. This is unlike female students who prefer more integration even though they still perceive the current environment as more integrated than males. The slight differences between the actual and preferred scores for both sexes may be indicating that in current laboratory environments there is substantial integration between theory and practice. The preference for more integration by girls may relate to the need by female students to consolidate content learnt in class where males are usually dominant. Girls might see the more independent work in the laboratory as an opportunity to work with little interference from their male counterparts. On the other hand male students may not see the need for much integration, as they would have had opportunities in class.

Management

Minor differences were obtained for scores relating to classroom management by both sexes. Students are therefore probably not too unhappy with the way the current laboratory environment is managed. Students in Zimbabwe are used to a system that is highly prescriptive and they feel that the teacher should give them directions and/or instructions all the time. The Zimbabwean culture also appears to promote the idea that young children should follow the rules that adults lay down. As a result of this, in class students feel that the teacher plays the role of a parent whose instructions they should follow. This however contradicts the nature of effective classroom environments as argued by Perkins (1991) where students have more control of what happens. Compared to males, females however prefer environments with less stringent rules and this relates to their preference for more open work.

Material Environment

Both male and female students indicated that they would prefer that the laboratory set up and materials used in the laboratory be enhanced. The amount of space and resources available in the biology laboratories also appear to be the main factors influencing the carrying out of open laboratory work. Very little resources are often available, making it difficult to explore and investigate things. For female students the preference for a more conducive material environment appears to be more salient. In current laboratory environments male students often monopolise the few available resources leaving the female students with little opportunity to actively engage in activities

Conclusions

This research has found out that both female and male students prefer less cohesiveness than there is in current laboratory environments. Both sexes would however prefer more openness and a more conducive material environment. The situation is more pronounced for females who prefer more integration and less controlled management of activities.

Improving the laboratory environment can enhance appreciation of science by both male and female students and their learning in the laboratory. As indicated at the beginning, students spent considerable amounts of time in the laboratory. This time influences their life in a variety of ways. Educators need to ensure that these laboratory environments influence students' behaviours and practices in positive ways. so that the students can make positive and meaningful contributions to real-life contexts regardless of their gender differences.

Laboratory environments that suit male and female students' characteristics and learning styles need to be created. In-service training for teachers on how to set up more appropriate laboratory environments could be used to improve the execution of laboratory work. A more contextualised curriculum which both students and teachers relate to could also help in the carrying out of more open laboratory work. Assessment procedures for such a curriculum would need to accommodate more open kinds of assessment rather than the current examination oriented curriculum.

More research in an African context needs to be carried out in order to inform educators about the impact of Zimbabwe's existing laboratory environments on students' learning of science. In this way, interventions geared towards improving the learning of biology and indeed other sciences and subjects can be made. There is need to be more innovative and come up with learning

environments that can offer genuine and authentic scientific experiences that mould students into better observers, better planners, and more creative thinkers who are more oriented towards solving real life problems.

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