

UNDERSTANDING DIFFERENCES IN PHYSICS CLASSROOM: THE INTERPLAY BETWEEN GENDER, LEARNING STYLES AND ACHIEVEMENT

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ABSTRACT

The paper identified the meaning of gender and some associated terms with it. It went further to observe the unfortunate incidence of gender gap in science achievement which inevitably has poised a continuing challenge in the science world. The paper also highlights certain factors, which visibly offer explanations to the issue of gender gap in science achievement. Besides, meaning and profile of learning styles as well as the factor of individual differences as a basis for different learning styles were clearly observed. The paper also identified catalogues of assessments for diagnosing learning styles in a bid to measure its effect on Physics achievement. Moreover, the effect of gender and learning styles were observed vis-à-vis their implication on teaching and learning processes. Conclusion and relevant recommendations were nevertheless made.

KEYWORDS: Gender, differences, learning, learning styles, achievement.

INTRODUCTION

Students according to Felder and Brent (2005) have different levels of motivation, different attitudes about teaching and learning and different responses to specific classroom environments and instructional practices. The more thoroughly instructors (teachers) understand the differences, the better the chances they have of meeting the diverse learning needs of all their students. The effort to provide an equitable education to all students has led to extensive research on the effects of racial and ethnic differences, and of gender, on learning and achievement (Eric Digest, 2003). Across the entire globe, there is the challenge of gender disparity which inevitably has affected enrolment and achievement in science related fields particularly in physics (Simeon and Ojelade, 2011).

Also, with the shift from an instructional to a learning paradigm, there seem to be a growing acceptance that understanding the way students learn is the key to educational improvement (Acharya, 2002). Therefore, to achieve a meaningful and desired learning outcome or achievement in physics, there is the need to provide necessary understanding of different learning styles and their roles in facilitating student's learning vis-a-viz the effect of gender on achievement in physics. The three categories of diversity that have shown to have serious implications for teaching and learning in physics classroom as observed in this paper are Gender learning styles, and achievement.

Gender difference in physics achievement: A continuing challenge

According to Sax (2005), educators since the mid 1970s, have made a virtue of ignoring gender differences. The assumption was that by teaching girls and boys the same subject in the same way at the same age, gender gaps in achievement would be eradicated. That approach according to him, failed. Gibbs (2008) carried out a research on gender differences in educational

achievement in a cohort of 1265 individual students from birth to age twenty-five(25) using the data obtained from Christchurch Health and development division , university of otago . Findings according to him revealed that there was a small but pervasive tendency for females to score better than males on standardized tests. On teachers' rating of classroom behavior, findings according to him revealed that males were more prone to inattentive, restless ,and distractible behaviors as well as aggressive, antisocial and oppositional behaviors than females.

Okeke (2000) in Nwagbara (2003) defines gender as a term which refers to many socially and culturally constructed characteristics, qualities, behavior and role which different societies ascribe to females and males. Also, Nwagbara (2003) confirms that gender is an associated contract which represents the social relationship between man and woman and in which women have been subordinated. She further asserts that discrimination in girls' access to education still persists in many places in Nigeria due to many socio-culturally ascribed roles like early marriage, home-making and early childbirth.

According to Skelton, Francis and Valkanova (2007), the term 'gender gap' is most often used to refer to the differences in performance between girls and boys in standard assessment tasks and other examinations but it is also used to describe differences in the take-up of particular subjects and choice of careers. But gender differences which is often used interchangeably with gender gap is defined in the words of Papalia, Olds and Feldman (2004) as the psychological and behavioral differences between male and female.

Physics Today (2000) – a daily physics News and research source, described in its report on the first international conference on women in physics by asking, 'why are women underrepresented in physics?.'

It was found that the problems facing women in physics depend on the economy and society in which they work but that some problems cut across countries and cultures.

Several studies carried out in the Nigeria context have shown that boys out performed girls in many science skills with the exception for girls in some other areas. For instance, Eriba and Ande (2006) reported in their studies that boys performed better than girls in chemistry problem solving. Also Ukwangwu (2002) reported a modest gender difference in favour of boys that the girls need great attention during integrated science classes. In a study reported Feminist Daily News (2008) on gender gap, study revealed that there are no gender gap in mathematics scores. The report on the study disputes the stereotype that men are innately better than women in mathematics. It established that for over 7.2 million students in grade 2 through grade II that girl and boys performed equally in standardized mathematics tests. The study so reported affirmed that the gender gap in mathematics achievement has closed for high school students but that there still exist a disparity in the field of physics and engineering. In fact, the challenge of gender gap in science education was observed by Science Daily (2007) as it affirmed in its report on the findings of researched at the University of Colorado, Boulder by saying, that there is complexity and challenge of reducing gender-based disparities in science education for different population and circumstances. Eric Digest (2003) further affirms this continuing challenge by saying that the lack of conclusive findings about a gender gap in achievement, as measured by standardized tests, suggests that there is no systematic disenfranchisement of students of either sex, although traditional gender differences in both course selection and subject achievement still persist.

Basis for gender gap in achievement

Skelton *et al*, (2007), enumerated as follows some main explanations that account for gender gap in achievement:

1. Natural differences between the sexes

Boys and girls are naturally different and this explains discrepancies in achievement. In fact, Council for Exceptional Children (2007) established in its report that males tend to be right... brain dominant and female left... brain dominant. Therefore, girls excel in verbal skills like reading and writing while boys trump girls in spatial learning... maintaining advantages in science and mathematics. Also, Kimura (2005) in his research in the biological explanation of gaps in performance suggested that differences in brain structure, hormone production and maturation rates may account for girls greater advantage in school-related tasks. Findings

revealed that the parts of the brain responsible for processing verbal information and permitting the exchange of information between hemispheres were more highly developed in girls.

2. Different learning styles

Skelton *et al*, (2007), observed that differences in approaches to learning among young children contributed to the gender gap in achievement. In the words of Duffy (2003) and May (2004) in Skelton *et al*, (2007), perceived differences in the learning styles of boys and girls is one of the most frequently expressed explanations for gender gap in achievement. The argument according to Gurian (2002) in Skelton *et al*, (2007) is based on the presumption that if boys are naturally different to girls because of their biological make-up, then it follows that they will have different approaches to learning. Also, Murphy (1989) in Skelton *et al*, (2007) affirmed that it is these preferred learning styles which explains why boys are attracted towards science subjects which requires memorization, formulas, facts and abstract responses and girls towards humanities subjects.

3. Feminization of schools

Most frequently, the phrase is used simply to refer to the fact that there are more female teachers than male in schools as well as the delivery of the curriculum, assessment practices and the arrangement and organization of the classroom in a 'feminine' nature (Skelton *et al*, (2007). Moreover, Skelton (2002) in Skelton *et al*, (2007) observed that the notion of the feminized schools, assumes that women teachers do act in 'feminine' ways. For example, women teachers using non-competitive teaching and learning styles, favouring group work. The presumptions inherent in the feminization of schools is the possible assumption that assessment procedures are biased in favour of girls.

4. Masculinised school environment

This is almost synonymous to the case of the feminized school mentioned above, but that it is rather male dominant schooling system instead of the female in terms of teachers, teaching and learning styles, favoring some group work etc. Here, the males are at advantage. When current teaching and school practices are not conducive to girls, in such context the result is low and poor achievement of girls in sciences (physics).

5. Gender biased assessment procedures

Harlen (2004) in Skelton *et al*, (2007), in his review of 20 years of research into assessment procedures found amongst other things that teachers' judgment of boys' academic abilities were informed by their behavior and, as boys tended to misbehave more than girls, they were more likely to lose out on good assessment grades. This gain is a clear basis for gender gap in achievement in science and other subjects.

6. Learners' construction of gender

Skelton *et al*, (2007) asserts the ethos and practices of individual schools and the peer groups that exist influence what kind of being a 'boy' or a 'girl' that is seen appropriate in that setting. Pupils usually sitting same gender group and friendship group tend to be composed of pupils of the same gender so that pupils 'police' the gendered behavior of their peers and punish failure to conform to traditional gender norm. Thus, such pupils' construction of gender produce different behavior which impact on achievement.

Individual differences in personality traits: Basis for different learning styles in physics classroom

Learning according to National Teachers Institutes, NTI (2000) is an individual matter which is achieved by the learner himself at his own pace and in accordance with his own interest, value, competence, state of readiness and available opportunities for study.

Indeed, every learner has a preference for the way they absorb information. Learners take in and process information in different ways. Feldman (2003) asserts that our learning styles is also influenced by our personality. He defined learning styles as that which reflects our preferred manner of acquiring, using and thinking about knowledge. Acharya (2000) in his own words declared that a learners' personality influences how he or she acquires and integrates information. With these it is therefore clear that why different learners have different learning styles may not necessarily be due to their ability but due to their personality and temperamental make-up.

Trait is said to be a distinguishing characteristics, quality or feature while temperament is a characteristics physiological and emotional state of an individual which tend to condition his responses to the various situations of life. It is also defined as the combination of inborn traits that subsequently affects all our behaviours. Personality on the other hand, is the outward expression of oneself, which may or may not be the same as a person's character depending on how genuine the person is.

Lahaye (1993) observed that it is temperaments that provides each human being with a distinguishing qualities that make each individually unique. He therefore classified every human into basically four types of temperament and personality traits as propounded by Hippocrates (460-377 BC) – the father of modern medicine as sanguine (extroverts), phlegmatics (introverts), choleric (active) and melancholics (perfectionists).

Profile and dimension of learning styles

Learning which has various definitions by various schools of thought is defined by Chauhan (2002)

as that which is the means of bringing changes in the behavior of an organism. Lerner (1997) defines a student's learning style as the student's general behavior, attitude and temperament when presented with a learning task. Feldman (2003) observed that we do not have one learning styles. Felder (2002) in a careers skill resource – Mind Tools (2008), affirms that there are four dimensions of learning styles:

1. Sensory and intuitive learning style

a. **Sensory learners:** Prefers concrete practice and procedural information. They look for the facts. Sensors like observation, like to solve problems using well established procedures, don't mind detail work and don't like unexpected twist or complications. Are careful but slow. Favours information that come from their senses. They are less comfortable than the intuitors with symbols. Good at practical fields such as engineering, etc.

b. **Intuitive learners:** Intuitive learners favour information that arises internally through memory, reflection and imagination. They prefer conceptual, innovative and theoretical information. They look for the meaning. Like variety in the work, don't mind complexity get bored with details. Could be quick but may be careless. They major in relatively abstract fields such as mathematics and physics.

2. Visual and verbal learning style: Felder (1993) further asserts that:

a. **Visual learners:** Visual learners get information from visual images (pictures, diagram, graphs, schematics demonstration) than from verbal material (written and spoken words). They have a good chance of retaining something shown to them. They look for visual representation of information. Most science students are visual learners.

b. **Verbal learners:** Prefer to bear or read information. Look for explanations with words.

3. Active and reflective learning style: Again Felder (2002) in Mind Tool (2008) observed that:

a. **Active learners:** Prefer to manipulate objects, do physical experiments and learn by trying. They enjoy working in groups to figure out problems. Most science students fall into this category.

b. **Reflective learners:** Prefer to think things through to evaluate options and learn by analysis, they enjoy figuring out a problem on their own. They learn by introspection.

4. Sequential and global learning style

a. **Sequential learners:** In the words of Felder (1993) and Felder (2003) in Mind Tool (2008), sequential learners absorb information and acquire understanding of material in small connected chunks. They prefer information presented linearly and in an orderly manner. They put together details in order to understand how the big picture emerges.

b. Global learners: On the other hand, these learners prefer a holistic systematic approach. They see the big picture first and then fill in the details. May appears slow or do poorly on home work and test until they grasp the total picture. They take in information in seemingly unconnected fragments and achieve understanding in large holistic leaps.

But in the words of Feldman (2003) the four different types of receptive learning styles are:

- i. Visual/verbal learning style - (preference for written material)
- ii. Visual/non-verbal learning style (favours visual representation)
- iii. Auditory/verbal learning style (favours listening)
- iv. Tactile and kinesthetic learning style (learning by touching and manipulating)

Also, the four learning style as identified and categorized by Kolb (1984) in Orhun an Orhun (2006) are accommodation, assimilation, converging and diverging.

Effects of gender and learning style on physics achievement: Teacher coping strategy

In a study to investigate relationship between learning styles and achievements in physics and calculus course at the Anadolu University Turkey by Orhun *et al*, (2006) using Kolb learning model inventory, findings revealed that there was meaningful relationship between students' learning styles and students' achievements in physics of 72 students. According to them, students on one particular learning style category were more successful than the others. Findings from the student asserts that there was a statistically significant difference between physics achievement of students with the four learning modes. Moreover, study showed that the learning modes during instruction did affect students in the learning and achievement in physics. In his own words, Marzano (1998) found that graphic and tactile representation of the subject matter had noticeable effects on learning outcomes regardless of any attempt to match them with learners' modalities. Again, O'Connor (1997) opined on the effect of learning style on achievement that students will learn better when using preferences in which they are successful. He further affirmed that students will be better learners when they expend their preference (learning styles).

On the effect of gender on achievement, the report from Council for Exceptional Children (2007), observed that brain research had shown that boys and girls learn differently and that girls' brain adjust better to school structure. It is on this note that the report further opined that the understanding of the different learning styles, strengths and weaknesses of boys and girls can help teachers understand and work with students disabilities, gifts and talents. Besides, teachers should know that gender oriented

classroom can improve or mar students' learning and academic achievement.

According to Skelton *et al*, (2007), pupils achievement and under achievement is related to the interplay of social class, ethnicity and gender. It is not simply a case of all girls outperforming (all) boys. Some boys are succeeding very well and some girls are underachieving. This again reveals the effect of gender in achievement at school. They further asserts that although in some schools, teachers have sought to address underachievement in gender stereotype learning styles, there is no significant difference in the achievement of those in single sex classes over schools and pupils in coeducational establishment. They further observed that assessment experts tell us that assessment practices and evaluation of pupils responses in tests need to take into account a range of contextual and structural (gender, social class, ethnicity) factors - implying that gender factor has influence on academic achievements.

Therefore, information about students learning styles is important to both teachers and the students. Teachers with deep understanding according to Orhun *et al*, (2006), can easily adapt their teaching method to students with different learning styles. Besides, a student's style of learning if accommodated can result in improved attitudes toward learning and an increase in academic achievement.

CONCLUSION AND RECOMMENDATIONS

The paper observed the existence of complexity and challenge of gender based disparities in science education particularly in physics for different population particularly as it relates to learning outcomes. Various dimensions of learning styles for girls and boys in a school setting and the attendant effects of both gender disparity (or equality) and learning styles on students' achievements were enumerated. The paper further observed that learners have a preference for the way they absorb information in physics classroom. They take in and process scientific information in different ways and that they have different temperamental, personality make up, different sexes which account for their different learning outcomes. In view of these observations, Physics teachers should adapt their teaching methods, behavioral patterns and class management practices to improve and increase learning outcomes(achievement) in physics.

In view of these, the following recommendations are given:

- Physics teachers should seek to understand the different learning styles, strength and weakness of boys and girls.

Besides, teachers should not promote androcentrism (male centered) societal classes or misogyny (hatred for women) or vice-versa for better achievement and creativity in physics.

- Students should be allowed to utilize their individual learning styles and teachers also should be multifaceted to accommodate a variety of learning styles.
- Lastly, physics teachers should help to breakdown gender stereotypes and help learners to reach their potentials in physics achievement.

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