SELF-EFFICACY, PERCEIVED IMPORTANCE, ATTITUDES, AND ACHIEVEMENT IN PHYSICS AMONG TANA HAIK COMPREHENSIVE SECONDARY SCHOOL MALE AND FEMALE STUDENTS: A PATH ANALYSIS

Yalew Endawoke*

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I. Introduction

1.1. Gender Differences in Physics Achievement

In today's world having strong background in science subjects, specially in physics, seems very crucial in getting into many careers and occupations such as engineering and technology-oriented areas. In the advancement of science and technology, in this rapidly changing world, the role of physics is highly pronounced. Emphasizing the importance of science in the present and the future world, Koval & Staver (1985: 49) commented that "Academically-oriented students are not the only ones who need science courses...[since] the employment picture is changing, and the coming decades are going to be different [where there will not] be jobs that demand no science." Therefore, everyone needs to take some doses of science courses.

However, since girls do not like to take science and science-related courses, either at high school or tertiary level, their number in technical and/or scientific courses is marginal (Atsede, 1991; and Levin, 1985). Atsede (1991:109) claimed that "It is highly unlikely for young girls to have the opportunity or encouragement to pursue studies in the fields of science and technology."

Over the last many decades a large body of research has been conducted on investigating gender differences in science achievement, attitudes, and many other corroborative factors that deemed to be causal variables among elementary, junior, secondary, and higher learning institutions.

The results found by various researchers showed that boys and girls achieve almost equivalently in the elementary level (e.g., Megarry, 1984); however, when they are transferred to the junior, secondary and tertiary levels, performance variations between girls and boys come to light (Davis & Fossy, 1985; Doherty & Dawe, 1985; Hilton & Bergland, 1978; Hadden & Johnstone, 1983; Comber & Keeves, 1973; and Kelly, 1978).

Regarding this, Megarry (1984: 15) concluded that "once [they came] out of the primary school environment, females under-achieve in a variety of subjects, especially in physical sciences, engineering and technology-related subjects."

Similarly, although the major intent of their study was not directly related to examining gender differences in achievement, Archer & McDonald's (1991) study has demonstrated that there is marked variation in applying physical concepts between boys and girls in favor of boys.

Almost all researchers maintained that beginning from secondary schooling, boys' interest in physics seems to flourish while that of girls' diminishes. This could be reflected in enrollment, confidence, attitude, and achievement variances in boys and girls in physics.

Many investigators indicated that science, particularly physics, is viewed as a realm of masculine endeavor (Kelly & Smail, 1986; Chambers & Andre, 1995; Kahle, et al., 1993; Archer & McDonald, 1991; Bell, 1991; Megarry, 1984). Megarry (1984: 15) extending this idea argued that "The masculine image of science as presented in schools made physics a particularly difficult choice for adolescent girls who were striving to achieve a feminine identity. Once girls have fallen behind, feedback loops within the school tend to increase the boys' lead." Furthermore, Kahle, et al. (1993) contended that since science is viewed as a masculine image, it is considered hard, cold, and an analytical discipline. Girls do not anticipate higher performance in science subjects. Even teachers and parents do not expect girls to attain high scores in science and technology-related fields such as physics and electricity. These important figures do not also encourage them to pursue the study science. It is perceived as contradictory to feminine role.

In their massive international study on science achievements of boys and girls, Comber & Keeves (1973) found that in all countries boys excelled girls in science subjects, the difference being small in Biology, intermediate in Chemistry, and very large in Physics. The surprising findings of these researchers were that in all the 19 countries where the study was conducted boys consistently outsmarted girls in physics. These results were also later confirmed by other researchers (e.g., Kelly, 1978). Similarly, very recently, a news broadcasted by the Amharic Program of the Voice of Ethiopia National Service reported that a study conducted in 43 countries revealed that 13-year-old boys surpassed their same age girls in physics, math, and chemistry (Ethiopian Radio, Wednesday, November 20, 1996). In support of these results, a meta-analysis of almost 300 studies done by Matone & Fleming (1983) presented comprehensive research reports which addressed that boys achieve higher than girls and had higher positive attitudes towards science.

boys achieve higher than girls and had higher positive attitudes towards science. The effect size (0.34) was large in junior than elementary level where the effect was almost negligible (0.04). Generally, these research outcomes explicate the effect of gender on achievement of girls in physics. This could make girls to become more discouraged than boys about low science grades (Bridgham, 1972).

Besides, with regard to differences in choice of physics as field of study, Bell (1991) showed that proportionally the number of girls was minuscule compared to their male counterparts. This was true in all levels of ability groups although the case was more pronounced in the low ability category.

The repercussion of such achievement variations resulted in discrepancies in the number of female and male students who enrolled in science and science-related courses in higher institutions. One study that was done by Atsede (1991) tried to reveal the discrepancy of male and female students' rate of enrollment in Science and Science-related colleges in the country.

1.2. Gender Differences in Self-Efficacy and Attitudes toward Physics

Self-efficacy and attitude are presumed to be pervasively influential in affecting academic achievement of boys and girls. The importance of self-efficacy in explaining performances of individuals in different activities has been given due consideration by social cognitive theorists. In this field, the forerunner is Bandura (1977, 1986, & 1989). According to Bandura (1986: 391), self-efficacy is "people's judgments of their capabilities to organize and execute courses of action required to attain designed types of performance." Bandura (1986) posited that self-efficacy -- the perceived competence of an individual -- determines the strategies students employ to attain the level of performance they expect, the nature of goals they set to reach, the amount of effort they exert on the task, the amount of time allocated to challenge the given task, their steadfastness in engaged activities, and their vigilance to exercise the task.

Bandura (1989: 1176) further propounded that "People's perceptions of their efficacy influence the types of anticipatory scenarios they construct and reiterate. ...Perceived self- efficacy and cognitive stimulation affect each other

plays a preponderant role in performance accomplishments of tasks. Its central significance in academic settings has been supported by many other researchers (Hackett & Betz, 1989; Pajares & Miller, 1994; Pajares & Kranzler, 1995; Schunk, 1991; Schunk, 1987).

Investigators disclosed that strength of goals people set, the extent of their commitment to attain and the nature of decisions they make will be fostered or beset by the magnitude of their self-efficacy (Locke, et al., 1984; Bandura & Wood, 1989; Wood & Bandura, 1989; Schunk, 1987; Schunk, 1985, Schunk, 1990). Evidences indicated that people with strong perceived self-efficacy to solve problems were found to remain highly efficient in their analytical thinking in complex decision-making situations, but those individuals who believe that they lack the competency to tackle the problem and have self-doubts manifest bewildered thoughts (Bandura & Wood, 1989; and Wood & Bandura, 1989), and the "Quality of analytic thinking, in turn, affects performance accomplishments." (Bandura, 1989: 1176). Similarly, Dembo (1994) indicated that students' performance motivation is influenced by the level of their self - efficacy.

In general, Bandura (1989: 1175) maintained that "Self-efficacy beliefs affect thought patterns that may be self-aiding or self-hindering." He argued that it influences the cognitive, motivational, and affective processes of individuals in the course of their academic endeavors. Schunk (1987: 233) also stated that "Self-efficacy can affect choice of activities. Students who have a low sense of efficacy for learning cognitive skills may attempt to avoid tasks, whereas those who judge themselves more efficacious should participate more eagerly."

In this regard, since females are found to have low self-efficacy level as compared to males (Yalew, 1996; Ewers & Wood, 1993; Randhawa, et al., 1994; Pajares & Miller, 1994) in many subjects, specially in those of masculine-oriented subjects, their motivation to learn and their performance accomplishments will be at a decline. Collins (1982), as cited by Schunk (1987), pointed out that irrespective of ability differences, students with higher self-efficacy level outperformed those with low level of self-efficacy. This was further supported by Pajares & Kranzler (1995). They found that self-efficacy was as a strong predictor as ability.

On the other hand, attitude toward physics was found another variable that could impair the choice, effort to be expended, the motive to deal with the tasks, and the

On the other hand, attitude toward physics was found another variable that could impair the choice, effort to be expended, the motive to deal with the tasks, and the achievement to be attained by students. One's propensity towards certain activities will indubitably impinge his/her engagement in those tasks. Studies conducted on gender differences in attitude towards physics reported almost consistent findings that boys seem to have positive while girls to have negative attitudes. In a meta-analysis study of gender difference in science motivation, Steinkamp & Maehr (1984) found that girls were less likely than boys to identify with science, to choose science-related tasks, and to select science as a career. Furthermore, although the motivation of boys and girls shows an increment in its level compared to the last few years, boys' motivation to learn science was found much more than the girls'. Walberg (1991) has also confirmed these results.

Kahle and his colleagues (1993: 380) pointed out that "gender effect influences girls' attitudes toward science, their self-confidence in performing scientific tasks, their achievement levels in science, and their motivation to continue to study science." These and many other researchers (e.g., Keeves, 1973; Nevin, 1973; Kelly, 1978; Aiken, 1974) expounded that female students were handicapped by negative attitude towards physics. Thus, this condition could be manifested in poor physics performances.

Albeit its persuasiveness in determining performance accomplishments and the concurrent variables (for example, motivation, time allotment, strategy use, choice, etc.), it is reported that attitude is mainly mediated by self-efficacy. That is, self-efficacy was found a robust predictor of the effect of attitude (and other variables treated) on achievement (Pajares & Miller, 1994; Pajares & Kranzler, 1995; Bandura, 1986 &1989; Hackett & Betz, 1989; Randhawa et al., 1993). This means when other variables were controlled it was indicated that self-efficacy contributed significantly to the variance of performance. Bandura (1986) argued that more than any other variables, self-efficacy was found a reliable predictor of performance behavior. This may lead to the conclusion that people will develop positive or negative attitudes on the basis of their own perception of the capacity they think they possess to carry out a task. Or to put it in another way, what people think they are competent and confident about certain tasks and activities may serve as a base for developing negative or positive attitudes.

In sum, in their conclusions, Randhawa, et al. (1993: 47) stated that "Girls, as a group, because of their significantly lower perceptions of mathematics self-efficacy, are thus at a greater risk than boys." In other words, the lower academic performance of girls was accounted for by low level of self-efficacy perceptions (Pajares & Miller, 1994; and Hackett, 1985).

Since there is a view that female students are failing in physics more than boys, have negative attitudes (Kelly, 1978; Kahle, et al., 1993), and show low confidence of their abilities and success (Reyers, 1985; Leo-Rhynie, 1983; Yalew, 1996), it could not be a surprise if females' participation in science stream is marginal. They will eschew tasks related to physics.

Although Atsede's (1991) study vividly portrayed representational disparities of males and females, the causes for such discrepancies were not well discussed. The factors were presented in their nutshell under one umbrella term: Traditional sex role stereotype. It is, of course, difficult to overlook the impinging effect of this factor on the academic behavior of both sexes. However, more specific factors that could bring about differences in academic achievements of male and female students must be succinctly investigated to introduce the desired intervention programs. Thus, the purpose of this study was to assess those climacteric variables that are empirically found consequential in the academic endeavors of male and female students. The study attempted to probe into those factors that could make female students' participation limited in the academic stream of science. Hence, it is tried to examine whether there exist gender differences in self-efficacy, perceived importance, attitudes, and achievement of boys and girls in physics.

As discussed earlier the major reasons for such low rate of female students' enrollment in those fields of study could probably be their lowered perceptions of self-efficacy, negative attitudes, lowered perceived value they attached to physics, and poor performance in physics, which in turn could hamper their choice of physics.

Despite all these worldwide efforts that have been done in investigating gender effects and other collaborative factors on physics achievement, local researches on this area are scant. Therefore, researching out this type of problem seem to be timely and crucial to figure out the effects of gender and those corroborative factors on science, particularly on physics, achievements so that the concerned

authorities may take measures that directly focus on females' problems rather than leaning on haphazard and presupposed variables that deemed to be important. Studies of this sort will help to encourage female students' participation in many male-dominated subjects and, in the long run, in masculine-image careers and occupations.

The study is generally aimed at examining the following leading research questions.

1. Do gender, self-efficacy, perceived importance, and attitudes have direct and indirect effects on achievement in physics? If so, which has the highest direct, indirect or total effects on achievement?
2. Does self-efficacy have a mediational role between gender and the other variables, as well as a predicative role to perceived importance, attitude, and performance?
3. Are there significant gender differences in self-efficacy, attitudes, perceived importance, and achievement in physics?

2. Design of the Study

Subjects

A total of 227 Tana Haik Comprehensive Secondary School grade 11 Science Stream students (135 boys and 92 girls) chosen randomly from their sections were the subjects of this study. Although the questionnaires were administered to equal number of boys and girls (150 from each), many girls (58) and some boys (15) did not fill the questionnaires properly and they were excluded from the study and this made the number of the two genders unproportional.

Procedure

All the questionnaires were group administered. They were administered while the students were attending their regular classes. First perceived importance, self-efficacy, and attitude scales were given to the students to fill. They were oriented

how to fill the questionnaires and illustrations were provided to them. They were also instructed to read the instructions carefully, to answer all questions, and to give their authentic responses. After they completed the three scales, the test was handed out to the students to work on it. The time allotted to complete the test was 35 minutes. To avoid cheating among the students while taking the test, the classroom teachers, the researcher and two assistants were assigned as invigilators. The test was administered before one week from first semester final examination. The attitude and perceived importance scales were prepared in Amharic to avoid language difficulties among the students.

Variables

Physics Performance. This was a test developed by one of the physics department member of the Bahir Dar Teachers College who has been teaching the subject for more than 12 years in high schools and 5 years in the college. A 30-item- multiple choice test (each item with 5 alternatives) was first constructed. The test was developed from grade 11 physics textbook on the basis of the curriculum and syllabus. After the test was developed, it was given to the classroom teachers for comments on the content representation of the sampled items. Based on the teachers' comments, some items were discarded, some were revised and some others were added. However, when correcting the papers two items were found defective and were discarded. This situation reduced the number of items in the test to 28. Thus, these 28 items were used for the analysis of item-total correlation to select good items that measured the "true" ability of the students. As a result, 16 items with point biserial correlation (r_{pb}) ≥ 0.39, $t \geq 2.160$, $p < 0.05$, were retained for the final analysis of the study. The internal consistency reliability of the test as estimated by KR20 was 0.76 with standard error of measurement (SEM) of 1.731. The interitem correlations were all positive.

Physics Self-efficacy. The instrument for assessing the students' physics self-efficacy was constructed in the same way as developed by Dowling (1978) and used by Pajares and Miller (1994), and Pajares and Kranzler (1995) to measure math self-efficacy. The items involved in this scale were those items used for the test without their alternatives. The students were asked to rate their confidence of providing the correct answer for each item on a 6-point scale that ranged from 1

(not at all confident) to 6 (completely confident). All the 28 items were used in the instrument. But item-total correlation, Person r, revealed that one item failed to be significantly correlated at α=0.05. This made the number of items to be 27 with $r \geq 0.40$, $t \geq 2.225$, $p < 0.05$. Interestingly all the interitem correlation's were positive and more than three-quarter of them had strong relation. The coefficient alpha of the test was 0.90 with SEM of 8.34.

Physics Attitude. This scale consisted of 17 items some adapted from Eccles & Jacobs (1992) and others developed by the researcher. The instrument was designed to assess the students' attitude towards physics. Students react to each statement whether they strongly agreed, agreed, disagreed, or strongly disagreed. Some items were phrased negatively and scored in reversed direction, the rest were worded positively. When students indicate "strongly disagree" to a negatively worded statement they will get a weight of 4, if the statement was positive they will get a score of 1. The alpha reliability of the total score was 0.83 with SEM of 3.176.

Perceived Importance of Physics. The measure consisted of 9 statements some adapted from Eccles & Jacobs (1992) and others developed by the author. This instrument was used to asses students' perception of the importance of physics in achieving future careers and other life goals. The students were asked to rate on a 4 point scale their perception of the importance of physics, ranging from 4 (very important) to 1 (not important at all). The reliability of the test as estimated by Cronbach alpha was 0.64 with SEM of 1.885.

Data Analysis

The major purpose of this study was to examine the effects of gender on perceived importance, attitude, self-efficacy and performance; the predictive and mediational role of self-efficacy; and the effects of self-efficacy, perceived importance, and attitude on performance. To do this, the appropriate statistical technique was the path analysis model. The path model was constructed in the same way as Pajares and Miller (1994) used. They proved the model's appropriateness in investigating this type of problem. They based their model on theoretical, empirical, and statistical frame works.

In addition, to determine the standardized (or path) coefficients, the β's, multiple regression analysis, was used. To examine gender differences among the variables treated, t-tests were computed.

3. Results

Results of descriptive statistics for the total group were presented in Table 1. Means, standard deviations, and intercorrelations of the variables are indicated in the Table. All the correlation coefficients were significant ($\alpha = 0.001$) and positive.

Table 1: Means, Standard Deviations and Zero-order Correlation Coefficients of the variables in the study for the total group (N = 227) [Sex codes were 0 = female, 1 = male]

Variable*	M	SD	Gender	PSE	PPI	PAT
Gender	-	-	1.000			
PSE	114.559	26.360	0.298	1.000		
PPI	30.661	3.142	0.220	0.240	1.000	
PAT	57.370	7.702	0.272	0.470	0.290	1.000
PER	8.846	3.533	0.374	0.503	0.265	0.439

*All r's $p<0.001$

Note: PSE = Physics self-efficacy, PPI = Physics perceived importance, PAT = Attitude toward Physics,
PER = Physics performance.

Intercorrelations of the variables for boys and girls are presented in Table 2. Except the correlation between PPI and PER ($r = 0.149$, $p > 0.05$) for girls which was nonsignificant, all others were significant ($\alpha = 0.05$). Another interest of the study was to examine gender differences in the variables dealt with in the study. To do this, a t-test was computed.

Table 2: Correlation Matrix of the Variables for Boys (n=135) and Girls (n =92).

Variables	PER	PSE	PPI	PAT
PER	---	0.428^{***}	0.149(ns)	0.225^{*}
PSE	0.453^{***}	---	0.210^{*}	0.406^{***}
PPI	0.242^{***}	0.170^{*}	---	0.300^{***}
PAT	0.484^{***}	0.437^{***}	0.199^{**}	---

$^{*}p< 0.05$, $^{**}p< 0.01$, $^{***}p<0.001$, ns = not significant at p = 0.05.

Note: PSE = Physics self-efficacy, PPI = Physics perceived importance, PAT = Attitude toward Physics, PER = Physics performance. Correlations above the main diagonal are for girls and below the diagonal are for boys

As shown in Table 3, boys significantly scored higher means than girls in all the variables, $p< 0.001$. To avoid specious differences between the two genders, t-values were adjusted using Dunn's test ($\alpha = 0.0025$). All results proved that boys and girls showed significant differences in the variables treated in the study in favor of boys.

Table 3: Gender differences on the variables treated in the study

	Male (n=135)		Female (n = 92)			
Variables	M	SD	M	SD	t-test	p-values
Self-efficacy	121.022	24.725	105.076	26.935	4.634	< 0.0005
Perceived importance.	31.230	2.281	29.826	3.320	3.380	< 0.001
Attitudes	59.096	7.137	54.837	7.837	4.241	< 0.0005
Physics performance	9.933	3.408	7.250	3.094	6.043	< 0.0001

Since the major purpose of the study was to investigate the effect of gender on self-efficacy, attitude, perceived importance, and performance, and the predictive and mediational role of self-efficacy in physics-related constructs and performance, a path analysis was employed. Path analysis is a statistical method used to study the direct and indirect effects of the variables on other variables.

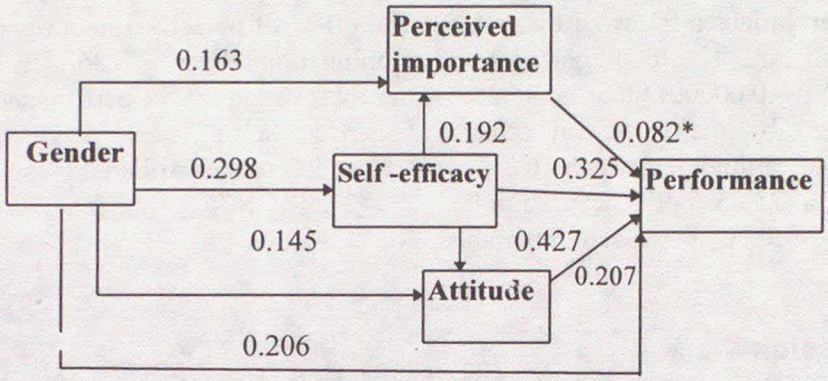

Figure 1. A Path Model that Represents the Effects of Physics-Related Factors on Performance (*p>0.05)

As indicated in Figure 1, the effects on performance of gender ($\beta = 0.202$, $t = 3.501$, $p < 0.005$), self-efficacy ($\beta = 0.325$, $t = 5.184$, $p < 0.000001$), and attitude ($\beta = 0.207$, $t = 3.282$, $p < 0.001$) were all positive and significant. But the effect of perceived importance of physics on performance was not significant ($\beta = 0.082$, $t = 1.435$, $p < 0.05$). Moreover, the path revealed that self-efficacy was the strongest predictor of attitude ($\beta = 0.427$, $t = 7.098$ $p < 0.00001$), and had moderate effect on perceived importance ($\beta = 0.193$, $t = 2.949$. $p < 0.004$). Furthermore, the effects of gender on attitude($\beta = 0.145$, $p < 0.001$), self-efficacy ($\beta = 0.298$, $p < 0.0001$), and perceived importance ($\beta = 0.163$, $p < 0.001$) were moderate to high.

Table 4: Direct and Indirect effects of the variables on Physics performance

Effect	r	Direct	Indirect	Total
on performance				
of gender	0.374*	0.202*	0.171	0.373*
of self-efficacy	0.503*	0.325*	0.104	0.429*
of perceived importance.	0.265*	0.082(ns)	0.000	0.082(ns)
of attitude	0.439*	0.207*	0.139	0.349*

*p<0.001, ns = not significant at p = 0.05

Table 4 provides the direct and indirect effects of the variables on performance.

The results depicted that the direct and total effects of self-efficacy were stronger than the other variables followed by attitude. The effect of perceived importance was not significant. The total coefficient of determination (R^2) was 0.352, (F 4, 222 = 30.14, $p < 0.000001$) that is, 35.2% of the total variability in performance was explained by the combined effects of gender, self-efficacy, perceived importance, and attitude, of which 16.3% (46.31% of R^2) was contributed by self-efficacy, 9.1% (25.85% of R^2) by attitude, 7.6% (21.59% of R^2) by gender, and 2.2% (6.25% of R^2) by perceived importance.

4. Discussion

The aim of this study was a twofold: The first and the major one was to investigate the effects of gender, self-efficacy, attitude, and perceived importance on physics performance; as well as the mediational and predictive role of self-efficacy between gender and physics performance, and attitude and physics performance, respectively. The second purpose of the study was to examine gender differences in the variables treated in the study.

As the results revealed, gender differences were evidently apparent in all the variables dealt with in the study. Boys had higher levels of physics self-efficacy and attitude than girls. The mean scores of boys on physics performance was also higher than their female counterparts. Furthermore, boys seemed to perceive physics as an important subject for their future career goals and every day life activities. These results were in consonant with the existing literature (e.g., Kahle, et al., 1993; Comber & Keeves, 1973; Kelly, 1978; Ethiopian Radio, 1996).

Results obtained from correlational analyses indicated that gender, self-efficacy, attitude, and perceived importance had strong positive relationships to performance. This means that in both gender groups students who scored high in these variables obtained higher scores on physics test than those who showed low level of those physics-related factors. Besides, the results discerned that boys surpassed girls in all the variables in the study. In addition, separate correlational analyses were performed for boys and girls. The results unraveled that, in the case of boys, self-efficacy, attitude and perceived importance were strongly and positively related to physics performances. Although similar trend was observed

for girls, the case was not true for perceived importance. The correlation between perceived importance and performance was not significant. This may indicate that girls' perception of physics as an important subject for future career goals may not probably be affected by the scores they deserved. Their perceptions may rest on individual female students' own interests rather than the scores they procured on the subject.

Regarding the effects of gender, self-efficacy, attitude, and perceived importance on physics performance, the path model portrayed that, except perceived importance which was not significant, the other variables had moderate to strong positive effects, the effect of self-efficacy being the preeminent one.

As can be seen from Table 4, the direct effect of self-efficacy was the strongest of all the other variables (β=0.325), gender and attitude had equivalent moderate direct effects on performance, β=0.202 and β=0.207, respectively. However, gender had much indirect effect on performance as compared to the other variables. Generally, the direct and total effects of self-efficacy were significantly stronger than gender and attitude suggesting its predictive and mediational role between these two variables and the realm of academic arena. These results were in agreement with the reports of many researchers (e.g., Pajares & Miller, 1994, Pajares & Kranzler, 1995; Randhawa, et al., 1993; Pajares, 1996a; Pajares, 1996b; Hackett, 1995; Pajares, in press, Bandura, 1989). These researchers maintained that the level of self-efficacy students possess will either enhance or stunt their academic motivation and thereby their performances.

Although much of the effect of gender on performance was direct, its indirect effect was also modest, much of which was contributed by self-efficacy (0.097). This condition may suggest that girls may conceive physics as male-dominated subject (Kahle, et al., 1993; Megarry, 1984), or may not be encouraged to get into those fields related to physics (Atsede, 1991). The nature and essence of physics is more theoretical and mainly divorced from interpersonal relations. If this is so, since females usually do not like to engage themselves in theoretical concepts and subjects that demand abstract reasoning but are usually preoccupied with interpersonal interactions (Gilligan, 1982), their detachment from the activities of physics could not be a surprise. Concerning such variation what Bandura (1986) contended seems viably logical. He indicated that one source of feeling of

competence is observation of similar-others. Because girls fail repeatedly in this subject more than boys, they might have developed learned helplessness (Breen, Vulcano & Dyck, 1979) which could impair their self efficacy and attitude. Kimball (1989), as cited in Randhawa, et al (1993), stated that gender differences could be attributed to different experiences of boys and girls outside of the classrooms. This situation, therefore, can best be enunciated by the inclusion of stereotypic perceptions of the students to physics in future studies.

Generally, however, Pajares & Miller (1994: 201) posited that "if self-efficacy beliefs are major mediators of behavior and behavior change, then counseling interventions designed to change behavior are useful to the degree that they increase the self-efficacy beliefs related to the behavior in questions." The importance of counseling in enhancing self-efficacy was unequivocally supported by almost all researchers who did study on this construct and related variables. Thus to encourage girls' enrollment in science and technology-related subjects, school counselors, teachers, and other educational practitioners should focus on the relative importance of self-efficacy in academic settings. Randhawa & his associates (1993:47) maintained that "Confidence in doing a task and the confidence in one's ability in an area of endeavor are critical factors for motivation and persistence." Choice, perseverance, effort expenditure and attitudes [illegible] tasks to deal with are all determined to a large extent by one's p[illegible] competence (Bandura, 1986, Schunk, 1991, Pajares, in press). If this is [illegible] girls' lowered level of efficacy feeling could lead them to reduced [illegible] performances.

Finally, it is important to note that future studies should focus on the i[illegible] effects of sex-role stereotypes on self-efficacy so that prompt measures [illegible] taken to reduce, if not avoid, gender differences in enrollment and performance in physics and related subjects.

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