INFLUENCING FACTORS FOR SECONDARY ONE STUDENTS' ENGAGEMENT IN PHYSICS LESSONS, EDUCATIONAL AND CAREER ASPIRATIONS AND THE IMPLICATIONS

Loganantham Kuppan
Centre for Research in Pedagogy & Practice, National Institute of Education,
Nanyang Technological University, Singapore

Munirah Shaik Kadir
Centre for Research in Pedagogy & Practice, National Institute of Education,
Nanyang Technological University, Singapore

S. K. Foong
Natural Sciences and Science Education, National Institute of Education,
Nanyang Technological University, Singapore
Department of Physics, Nagoya University, Nagoya 464-8602, Japan

Alexander See Shing Yeung
Centre for Educational Research, University of Western Sydney
Educational Excellence & Equity (E^3) Research Program

Paper presented at the 4th Redesigning Pedagogy International Conference
May/June 2011, Singapore

Abstract

This paper reports on crucial factors that could influence students' learning of Physics at three different stages of their lives: 1) lower secondary school, 2) post-secondary school or tertiary education, and 3) career. A sample of 275 secondary 1 students in a school in Singapore responded to several survey items on a six-point scale (from disagree strongly to agree strongly). The factors derived from the survey items include students' interest, self-efficacy, competence, and parents' expectations as internal and external factors, which may influence outcomes such as engagement, future educational aspiration, and career aspiration in physics. By determining the influencing factors and the seriousness of the implications, educators and parents could play their role effectively in cultivating the necessary characteristics in students for their optimum benefit.

Introduction

In our research project PbI1@School as described in the overview (Lau et al., 2011), the participants were secondary 1 students. It is our hope that we have developed a curriculum that is not only effective in improving the functional understanding of the students but also in developing positive attitudes towards learning physics among the students in both short and long terms. In this paper, we intend to first identify some of the factors that describe students' attitudes towards Physics, and then examine their influences on some important outcomes at different stages of the students' life.

The life pyramid of a secondary 1 student, in a simplistic manner, can be divided into 3 stages namely: 1) the lower secondary level, 2) tertiary education and 3) career as shown in Figure 1. The students' engagement in lesson and their achievement score are two of the important elements that define good learning. Students' engagement promotes student learning which may be measured in terms of students' achievement score. By determining the factors that influence students' engagement in class and their achievement score, it will help educators and parents to maximize students' learning.

The transition after lower secondary is upper secondary and tertiary education. Knowing the factors that affect students' upper secondary and tertiary educational aspiration will help educators and parents to guide the students' educational aspiration to be in line with their potential. Similarly, the next stage upon the successful completion of tertiary education is a desired career. Aspiration to have a desired career is important to motivate students to work towards their career goal. For example, the aspiration to have a career related to physics motivates students to work towards the goal by doing well in school and being involved in

science-related activities extending beyond curriculum time. Identifying the factors affecting students' career aspiration will give the educators and parents an idea on how to nurture students' career aspiration according to the students' potential and according to the social needs. Based on our findings, we then discuss the possible consequences arising from these influences and how these consequences might affect the current social order.

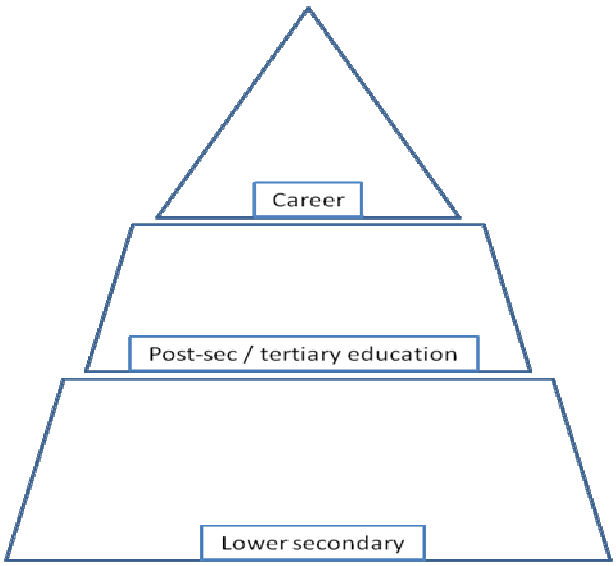


Figure 1: Typical Life Pyramid of a Student. The size of the base of each block represents the diversity of subjects needs to be handled (the amount of specialization) at each level. The vertical movement of each block, from bottom to top, represents time. Each block that carries the other block/s symbolizes the necessary foundation for successful transition from one level to another level. The figure is not drawn to scale.

Methodology

Participants

The participants of the survey were Secondary 1 (7th grade) students from a secondary school in Singapore (N = 275; median age = 13 years old). There were 100 boys and175 girls involved in the study. All the students were ethnic Chinese, the largest ethnic group of the nation

(>75%). Although the students were from a Chinese origin, 143 of them used English as a major spoken language at home. English is the medium of instruction in all government schools in Singapore, and all students formally start learning English in 1st grade. All participants were of above average ability with Primary School Leaving Examination (PSLE) score of about 240.

Instrument

The research instrument used for this study was a research-validated survey on 7 factors, each consisting of 4 or 5 statement items, totaling 30 items whose order on the survey form was randomized. The students were asked to rate their agreement with each item on a scale of 1 to 6, from strongly disagree (1) to strongly agree (6). The survey was conducted online at the end of the school year. The seven factors in the survey are:

Self-efficacy. This factor assesses students' belief in his ability to master the skills taught in physics classes. The items were adapted from Pintrich, Smith, Garcia, and McKeachie (1993). An example is: "I can do almost all the work in physics if I do not give up."

Competence in physics. This factor assesses students' belief in his competence in physics. This is a cognitive component of physics self-concept. The items were adapted from the Marsh (1992). An example is: "PHYSICS is one of my best school subjects."

Interest in physics. This factor assesses students' sense about their interest in physics. This is an affective component of physics self-concept. The items were adapted from the Marsh, Craven, and Debus (1999) and Elliot and Church's (1997). An example is: "I think it's great that I learn all sorts of things in PHYSICS."

Perceived parent expectation. This factor assesses students' perception of their parents' expectation of their future studies in physics. The items were created for this survey. An example is: "My parents think that I should take an advanced science course in future."

Engagement in physics. This factor assesses students' sense of individual engagement in physics in terms of their attention and participation in class. The items were adapted from Steinberg, Lamborn, Dornbusch, and Darling (1992). An example is: "I listen carefully when the teacher explains something about physics".

Aspiration to learn physics. This factor assesses students' aspirations to pursue physics courses at advanced levels in future. The items were adapted from Yeung and McInerney (2005). An example is: "If I can choose after secondary school, I will study physics in college/university".

Career aspiration. This factor assesses students' aspiration in a physics related career in future. The items were adapted from Yeung and McInerney (2005). An example is: "I want to have a career that applies physics to solve real life problems.

The seven factors, the items used, and the coefficient of reliability (Cronbach's alpha) are given in Table 1. The high values of α ranging from 0.85 to 0.94 imply that the items are reliable in establishing the factors.

Table 1: Variables and their reliability in the study

Factors	Items	Alpha
Self-efficacy	I am sure I can learn physics well.	0.85
	I can do the hardest work in physics if I try hard enough.	
	I can do almost all the work in physics if I do not give up.	
	Even if the work in physics is difficult, I can learn it.	
	I am capable of doing difficult work in physics.	
Competence in physics	I am good at PHYSICS.	0.94
	I have always done well in PHYSICS.	
	PHYSICS is one of my best school subjects.	
	I learn things quickly in PHYSICS.	
Interest in Physics	I enjoy doing PHYSICS.	0.91
	I am really interested in PHYSICS.	
	I think it's great that I learn all sorts of things in PHYSICS.	
	I find PHYSICS interesting.	
Perceived parent expectation	My parents think that I should take an advanced science course in future.	0.90
	My parents think that I should do science in school.	
	My parents encourage me to do science in my future education.	
	My parents want me to choose science as a major subject.	
Engagement in physics	I pay attention during PHYSICS lessons.	0.87
	I am attentive to my work during PHYSICS lessons.	
	I listen carefully when the teacher explains something about PHYSICS.	
	I try my best to complete my work in PHYSICS.	
	I try my best to answer PHYSICS questions.	
Aspiration to learn physics	If I could do exactly what I wanted, I would like to study PHYSICS in future.	0.85
	We can't always do what we want to, but I think I can actually learn PHYSICS in college/university.	
	My parents believe that I can take a PHYSICS course in future.	
	If I can choose after secondary school, I will study PHYSICS in college/university.	
Career Aspiration	A job related to physics would be interesting.	0.92
	A career in physics would be interesting.	
	I want to have a career that applies physics to solve real life problems.	
	I want to have a job that has to do with physics.	

We also looked at the effects of these factors on students' achievement score. The *achievement score* is an important outcome which was obtained from students' physics examination results in school.

Result

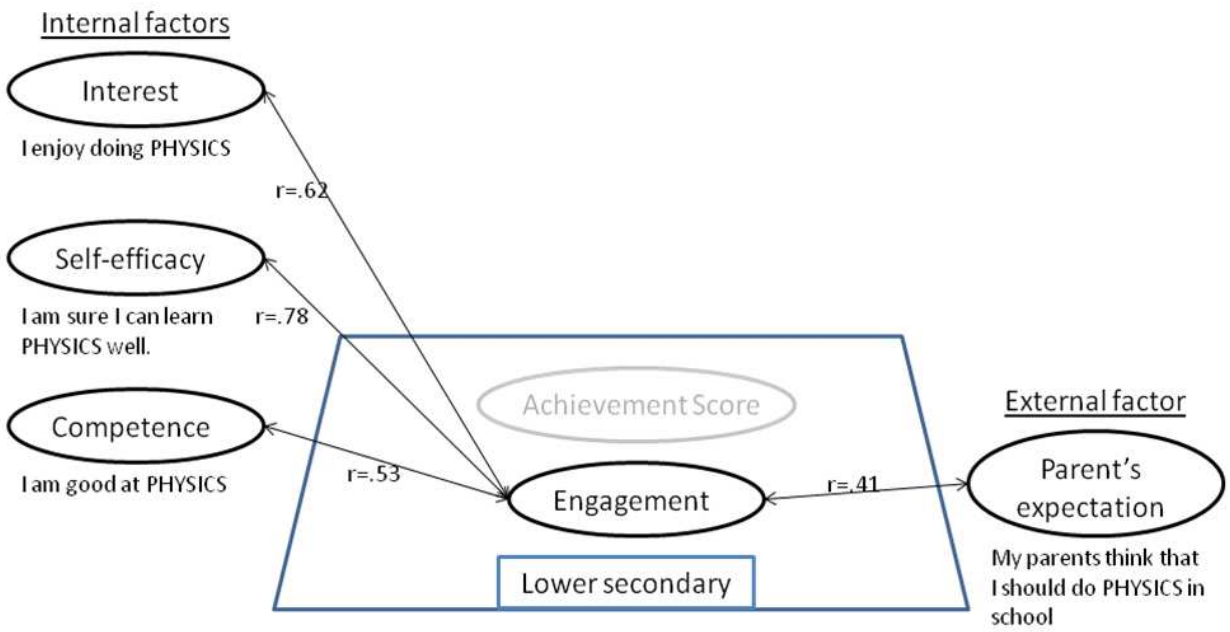
Factors and their Relations

Seven factors were derived from confirmatory factor analysis. The model fit was good (TLI > .9) and the factor loadings were reasonable (>.5). The main purpose was to identify the strength of the internal factors (self-efficacy, competence and interest) and external factor (perceived parent expectation) pertaining to students' attitude toward learning physics in relation to outcomes (engagement, educational aspiration and career aspiration) at different stages of life. The "internal factors" are characteristics possessed by the students leading to self-belief while the "external factors" are the factors outside of students' control that influence them. The results will give us an idea of the impact of the factors at various stages of students' lives. We describe the findings in three Parts.

Part 1: Lower Secondary Level

In this study, the first part of a typical students' life that we looked into was the lower secondary level where the student participants were in at the time of the study. We are interested in finding out the factors influencing students' engagement in class and in subject-related work, and students' scores in their tests and examinations.

We noticed that *competence*, *self-efficacy* and *interest* are the internal factors that play an important role in determining whether a student pays attention in class since these three factors have positive correlations with the factor of "engagement". The factor with the highest positive correlation (0.78) with the "engagement" is "self-efficacy" (see Figure 2). This means that students who feel that they can do well in physics tend to be more engaged during their physics lessons. Following behind is the factor "interest" with the next highest positive correlation of 0.62. Students who are interested in physics also have the tendency to be more engaged during physics lessons. The factor "competence" is correlated to "engagement" with correlation of 0.53. Students who believe that they are good in physics tend to engage more during physics lessons and in tasks related to physics.



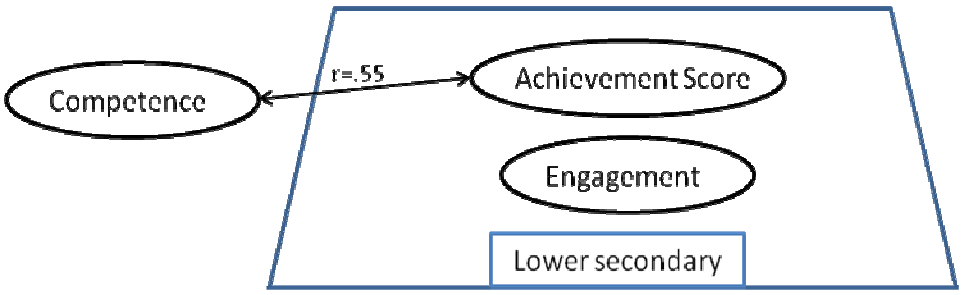


Figure 2: Factors affecting students' engagement and achievement score at lower secondary level

A major form of valuable outcome as a result of successful physical science education includes positive learning behaviours and engagement in scientific endeavours (see Martin, 2008; Steinberg, Lamborn, Dornbusch, & Darling, 1992). Students' engagement in learning tasks keeps them involved in learning that requires continuous effort, determination, and perseverance, and these are crucial for improving achievement outcomes (Fredricks, Blumenfeld, & Paris, 2004). That is, students' sense of competence is likely to lead them to higher levels of engagement because they have the confidence to do well. Their interest in physics will also lead to higher levels of engagement because interest provides a driving force for them to persist in learning tasks and activities that may seem to be difficult (Elliot & Church, 1997).

In addition to those internal factors, we also noted that the external factor, "perceived parents' expectation", influences students' "engagement". When there are indications (direct or indirect) from parents that they want their child to do physics in school, whether at the present moment or in the future, this perceived expectation influences the students to be more engaged in their physics classes. It implies that if the students were not aware of their parents' expectations (probably because parents did not indicate them) students' engagement in their physics classes would be less. Another possibility that we speculate is that when parent's expectation is opposite

to the student's interest, a mental conflict might arise in student's mind and that will result in a negative effect on their engagement in Physics.

Students' perceptions of support and care from parents, for example, can have great influence on their engagement in schoolwork and academic achievement (Allocca & Muth, 1982; Bempechat, 1990, 1992, 1998; Connor, 1994; Ford & Harris, 1996; Harter, 1996; Jordan & Nettles, 1999; van Etten, Freebern, & Pressley, 1997; Walters & Bowen, 1997). Indeed, research has indicated that parental involvement in the education of their children is a good predictor of student learning and success (Fantuzzo, Tighe, & Childs, 2000; Hill, 2001; Hill & Craft, 2003). In general, parent-school involvement appears to improve children's social behaviour and interactions among peers and may be positively associated with rule compliance and sociability. In Physics, we may expect that students who perceive parental support in studying physics would be more engaged in physics learning activities and would be more likely to choose to study physics in their future studies.

As can be seen in Figure 2, the factor "competence" is positively correlated to students' "achievement score". This implies that students who feel that they are good at physics tend to do well in physics and those who do well in physics feel that they are good at the subject. The findings here are consistent with the findings of Marsh, Byrne, and Yeung (1999). The reciprocal effects model proposed by Marsh, Byrne, and Yeung (1999) maintains that achievement and self-concept are mutually reinforcing such that higher achievement would lead to higher self-concept and higher self-concept would further lead to even higher achievement (also see Marsh & Craven, 2006; Marsh & O'Mara, 2008).

Part 2: Post Secondary / Tertiary Education

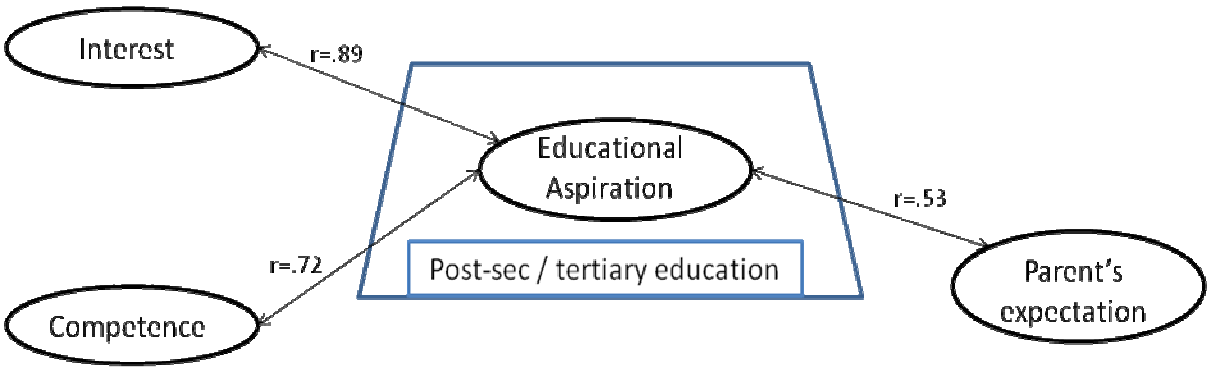


Figure 3: Factors affecting students' educational aspiration

The survey reveals that there are several factors that affect students' decision on the subject that they would consider studying at the tertiary education level. As shown in Figure 3, the factors "interest" and "competence" have high correlations of 0.89 and 0.72 with educational aspiration and thus appears to influence strongly student's educational aspiration to learn physics-related subjects in college or university. The factor "parent's expectation" plays an important role as well. Among these three factors, "interest" apparently has the strongest influence on educational aspiration.

Students who are interested in Physics aspire to take up physics-related courses when they pursue their studies at the college or university level. The external factor that affects students' decision is the "perceived parents' expectation". If there are indications to the students that their parents expect them to study physics at school, whether at present or in the future, these students would aspire to do physics related courses at the tertiary level.

If students' interest and perceived parents' expectation are on the same subject, then students' educational aspiration gets strengthened. Therefore, in our opinion, parents should be careful about imposing their expectations on their children. It is best to know the child's interests

and academic abilities before encouraging them to pursue a field instead of blindly placing their expectations on their children.

In contrast to the behavioural outcome such as “engagement”, which may be apparent in the short term, students’ selection of further studies in physics is probably one of the most important long-term outcomes of physics education. Based on previous research, we may expect that students’ beliefs and attitudes towards science predict their intentions to enroll in science classes in future (e.g., Gardner, 1975; Koballa, 1988; Crawley & Coe, 1990; Crawley & Black, 1992; Reid & Skryabina, 2002). Hence a student who finds interest in physics is more likely to choose physics in further studies. However, compared to personal interest in physics, a students’ sense of competence in physics may or may not have a strong role to play in the long-term decision process. Indeed, as some researchers have suggested (e.g., Jenkins & Nelson, 2005; Kim & Song, 2009; Sjøbeg & Schreiner, 2005), students’ may hold conflicting self-beliefs and attitudes simultaneously, and they may have different impacts on different outcomes.

Part 3: Career

Based on the results of students’ perceptions, we found that “self-efficacy” plays a prominent role in affecting students’ “career aspiration”. Students who feel that they have the ability to do well in physics have the tendency to aspire to have physics-related career in the future (see Figure 4).

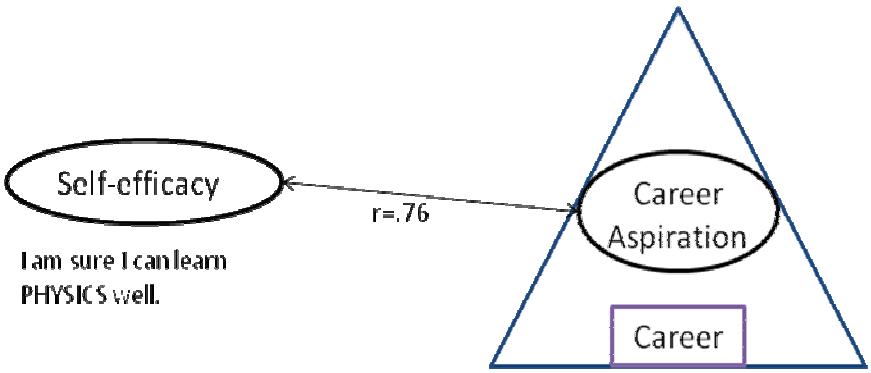


Figure 4: Factors affecting students' career aspiration

Having said that, we have found that there is a gender difference in the self-efficacy between male and female students (see Table 2). In terms of confidence, Meece & Jones (1996) indicates that girls report less confidence than boys in their ability to perform well on science tasks in the classroom. Similar findings were also reported in other studies (e.g., Anderman & Young, 1994; Licht, Stader, & Swenson, 1989; Simpson & Oliver, 1990; Steinkamp & Maehr, 1984). Even though some boys do not achieve higher scores than girls in science-related subjects, they tend to have higher self-perceptions of their science ability than girls in the same class (see KlappLekholm & Cliffordson, 2009; Marsh & Yeung, 1998). In other words, some boys may overestimate their abilities whereas girls often underestimate their abilities (Melallidou & Vlachou, 2007). Particularly for curriculum areas that are seen as masculine (e.g., physics), gender stereotypic perceptions may lead to boys overestimating and girls underestimating their abilities (Usher & Pajares, 2008). This kind of stereotypic perceptions may be further magnified as children grow up.

Table 2: Means and (Standard Deviations) of 5 Factors in 2 Gender Groups and MANOVA Results

Factor	**Boys' Mean(SD) (n=99)**	**Girls' Mean(SD) (n=176)**	**F(1,273)**	**MSE**	η^2
Self-efficacy	4.54 (0.78)	4.17 (0.75)	15.30**	0.58	.05
Career Aspiration	3.92 (1.06)	3.35 (1.07)	17.88**	1.14	.06

Note: N = 275. ** p< .001. Students responded to survey items on a 6-point scale (1-6) with higher scores reflecting more favorable responses. For the MANOVA, Cochran's C and Bartlett-Box F statistics were not statistically significant (p > .05).

The positive correlation between "self-efficacy" and "career aspiration" suggest that students with higher self-efficacy in physics tend to have higher aspiration towards careers related to physics. Hence the gender difference in "self-efficacy" gets translated into gender difference in their "career aspiration" as well. The lack of aspiration for girls to choose a career in physical science may be partly due to their relatively lower sense of competence in that subject area, and partly due to their greater interest in other non-science and non-masculine areas in which they find a better sense of competence, action possibilities, and more achievable goals. There may also be stereotypical expectations from socializers, including parents (see Yeung et al., 2010), which keep girls away from physical science.

In terms of aspiration to pursue a career in science, boys seem to be more positive. Comparing students from the USA and Australia, Kahle et al. (1993) found a consistent pattern showing that boys were more positive than girls, although there may be some cultural difference such that students from the USA were more positive towards science-related careers irrespective of gender. Nevertheless, when they were asked to give explanations for their choices, there were more similarities than differences. Overall, the positive responses tend to reflect on students'

interest in science or belief in their ability to do science whereas the negative responses reflected the opposite. Both boys' and girls' explanations were similar across the two cultures. Hence, the aspiration to pursue a career in science is probably related to a positive sense of competence and interest in science, irrespective of gender. An interesting finding is, however, boys were more likely to say that they were good at science, whereas girls were more likely to say they did not know much about science or that they were not good at it. Perhaps the under-representation of females in advanced physics courses and physics-related careers is due to a combination of a lower sense of competence, less interest, and lower performance in science-related subject areas.

The under-representation of females in the field of physics has been a long-term issue worldwide. In the USA, although more attention to physical science has led to a general increase of faculty members in the physics discipline, female physics faculty members only amount to 13% in degree-granting physics departments in tertiary education and only 9.5%in major research universities (Nelson, 2007). Recent statistics showed a huge gap between the percentages of males (80%) and females (20%) joining the physics faculty in the USA (AIP Statistical Research Center, 2006). The gap for the full professor grade was even greater (90% vs. 10%). In Sweden, there is a similar imbalance where female physics faculty members are about 20% only (Viefers et al., 2006). Hence in general, males dominate faculty positions in the discipline of physics compared to females. The reason for fewer females taking up physics-related careers may be complex, but from the literature about gender differences and the gender imbalance in the job market, we may speculate that girls generally have lower self-efficacy in physics and lower aspiration for pursuing a future career that is related to the physical science.

These gender differences would have important consequences. The gender imbalance in the job market of physics-related professions has become increasingly noticeable (see AIP Statistical Research Center, 2006; Hacker 1991; Kelly 1988, Taber 1992; Vieferset al., 2006), and the stereotypical phenomenon will continue to repeat itself as more stereotypical expectations prevail. There is an urgent need to unveil the crux of the problem and to counter this stereotypical phenomenon of the workforce.

Summary

The factors namely interest, self-efficacy and competence ("internal factors") and perceived parents' expectation ("external factors") are positively correlated to student's engagement. The factor "competence" also influences students' achievement score. We have noted that "interest", "competence" and "perceived parents' expectation" influences students' "educational aspiration" with "interest" taking the prominent role. Self-efficacy contributes in students' career aspiration. There exists notable difference in male and female students' self-efficacy and therefore in their physics related career aspiration as well. Educators and parents should try to find means to cultivate factors that have significant influence on students at different stages of their life.

References

AIP Statistical Research Center (2006). *Academic Workforce Survey*. United States: American Institute of Physics. Retrieved 1 June 2010 from http://www.aip.org/statistics

Allocca, R., & Muth, R. (1982, March). *School culture and academic achievement: A cross-gender, cross-cultural study*. Paper presented at the annual meeting of the American Educational Research Association, New York.

Anderman, E. M., & Young, A. J. (1994). Motivation and strategy use in science: Individual and classroom differences. *Journal* of *Research in Science Teaching, 31,* 811-831.

Bempechat, J. (1990). *The role of parent involvement in children's academic achievement: A review of the literature.* Trends and Issues No. 14.Washington, DC: Department of Education, Office of Planning, Budget, and Evaluation.

Bempechat, J. (1992). The role of parent involvement in children's academic achievement. *School Community Journal, 2,* 31-41.

Bempechat, J. (1998). *Against the odds: How "at-risk" children exceed expectations.* San Francisco: Jossey-Bass.

Connor, M. J. (1994). Peer relations and peer pressure. *Educational Psychology in Practice, 9,* 207-215.

Crawley, F. E., & Black, C. B. (1992).Causal modeling of secondary science students' intentions to enroll in physics.*Journal of Research in Science Teaching, 29,* 585-599.

Crawley, F. E., & Coe, A. S. (1990). Determinants of middle school students' intention to enroll in a high school science course: An application of the theory of reasoned action. *Journal of Research in Science Teaching, 27,* 461-476.

Elliot, A. J., & Church, M. (1997). A hierarchical model of approach and avoidance achievement motivation. *Journal of Personality and Social Psychology, 72,* 218-232.

Fantuzzo, J., Tighe, E., & Childs, S. (2000). Family involvement questionnaire: A multivariate assessment of family participation in early childhood education. *Journal of Educational Psychology, 92,* 367-376.

Ford, D. Y., & Harris, J. J. (1996). Perceptions and attitudes of Black students toward school, achievement, and other educational variables. *Child Development, 67,* 1141-1152.

Fredricks, J. A., Blumenfeld, P. C., & Paris, A. H. (2004). School engagement: Potential of the concept, state of the evidence. *Review of Educational Research, 74,* 59-109.

Gardner, P. L. (1975). Attitudes to science. *Studies in Science Education, 2,* 1–41.

Hacker, R. G. (1991) Gender differences in science-lesson behaviours. *International Journal of Science Education, 13* (4), 439–445.

Harter, S. (1996). Historical roots of contemporary issues involving self concept. In B. A. Bracken (Ed.), *Handbook of self-concept* (pp. 1-37). New York: Wiley.

Hill, N. E. (2001). Parenting and academic socialization as they relate to school reading: The roles of ethnicity and family income. *Journal of Educational Psychology, 93,* 686-697.

Hill, N. E., & Craft, S. A. (2003). Parent-school involvement and school performance: Mediated pathways among socioeconomically comparable African American and Euro-American families. *Journal of Educational Psychology, 95,* 74-83.

Jenkins, E. W., & Nelson, N. W. (2005). Important but not for me: students' attitudes towards secondary school science in England. *Research in Science & Technological Education, 23*(1), 41–57.

Jordan,W. J., & Nettles, S. M. (1999). *How students invest their time out of school: Effects on school engagement, perceptions of life chances, and achievement.* Report No. 29.Washington, DC: Office of Educational Research and Improvement.

Kahle, J. B., Parker L. H., Rennie L. J., & Riley D. (1993). Gender Differences in Science Education: Building a Model. *Educational Psychologist, 28*(4), 379-404.

Kelly, A. (1988). Gender differences in teacher-pupil interactions: A meta-analytic review. *Research in Education, 39*, 1–23.

Kim, M., & Song, J. (2009). The effects of dichotomous attitudes toward science on Interest and conceptual understanding in physics. *International Journal of Science Education, 31*(17), 2385-2406.

KlappLekholm, A., & Cliffordson, C. (2009). Effects of student characteristics on grades in compulsory school. *Educational Research and Evaluation, 15*, 1-23.

Koballa,T. R. (1995). Children's attitudes towards learning science. In S. M. Glynn (Ed.), *Learning science in the schools: Research reforming practice* (pp. 59-84).Mahwah, NJ: Lawrence Erlbaum.

Lau, C.Y., Foong, S. K., Shaik Kadir M., & Wong, D. (2011, June). *PbI1@School: Developing and implementing an Inquiry-based Curriculum for Speed and Density.* Paper presented at Proceeding of the 4th Redesigning Pedagogy: Transforming Teaching, Inspiring Learning International Conference, Singapore.

Licht, B. G., Stader, S. R., & Swenson, C. C. (1989). Children's achievement-related beliefs: Effects of academic area, sex, and achievement level. *Journal of Educational Research, 82,* 253- 260.

Marsh, H.W. (1992). *Self-Description Questionnaire II: Manual.* New South Wales, Australia: University of Western Sydney, Macarthur, Faculty of Education, Publication Unit.

Marsh, H. W., Byrne, B. M., &Yeung, A. S. (1999). Causal ordering of academic self-concept and achievement: Reanalysis of a pioneering study and revised recommendations. *Educational Psychologist, 34,* 155-167.

Marsh, H. W., & Craven, R. G. (2006). Reciprocal effects of self-concept and performance from a multidimensional perspective: Beyond seductive pleasure and unidimensional perspectives. *Perspectives on Psychological Science, 133-163.*

Marsh, H. W., Craven, R., & Debus, R. (1999). Separation of competency and affect components of multiple dimensions of academic self-concept: A developmental perspective. *Merrill-Palmer Quarterly, 45,* 567-601.

Marsh, H. W., & O'Mara, A. (2008). Reciprocal effects between academic self-concept, self-esteem, achievement, and attainment over seven adolescent years: Unidimensional and multidimensional perspectives of self-concept. *Personality & Social Psychology Bulletin, 34,* 542-552.

Marsh, H. W., &Yeung, A. S. (1998). Longitudinal structural equation models of academic self-concept and achievement: Gender differences in the development of math and English constructs. *American Educational Research Journal, 35,* 705-738.

Martin, A. J. (2008). Enhancing student motivation and engagement: The effects of a multidimensional intervention.*Contemporary Educational Psychology, 33,* 239-269.

Meece, J. L., & Jones, M. G. (1996). Gender differences in motivation and strategy use in science: Are girls rote learners? *Journal of Research in Science Teaching, 33,* 393-406.

Metallidou , P., &Vlachou, A. (2007). Motivational beliefs, cognitive engagement, and achievementin language and mathematics in elementary school children. *International Journal of Psychology,42,* 2-15.

Nelson, J. D. (2007). *A national analysis of minorities in science and engineering faculties at research universities.* Retrieved 1 June 2010 from http://cheminfo.ou.edu/~djn/diversity/Faculty_Tables_FY07/07Report.pdf

Pintrich, P. R., Smith, D. A. F., Garcia, T., &McKeachie, W. J. (1993). Reliability and predictivevalidity of the motivated strategies for learning questionnaire (MSLQ). *Educational and Psychological Measurement, 53,* 801-813.

Reid, N., &Skryabina, E. A. (2002).Attitudes towards physics. *Research in Science & Technological Education, 20,* 67-81.

Road to PSLE (2010). Your free resource to better PSLE (Primary School Leaving Examination) scores. Retrieved on Jan 11, 2010 from http://road-to-psle.blogspot.com/2007/11/ how-psle-aggregate-and-t-scores-are.html

Simpson, R., & Oliver, J. S. (1990).A summary of major influences on attitude toward achievement in science among adolescent students. *Science Education, 74,* 1-18.

Sjøbeg, S., & Schreiner, C. (2005). How do learners in different cultures relate to science and technology? Results and perspectives from the project ROSE. *Asia Pacific Forum on Science Learning and Teaching, 6*(2), 1-16.

Steinberg, L., Lamborn, S. D., Dornbusch, S. M., & Darling, N. (1992). Impact of parenting practices on adolescent achievement: Authoritative parenting, school involvement, and encouragement to succeed. *Child Development, 63,* 1266-1281.

Steinkamp, M. W., &Maehr, M. L. (1984). Gender differences in motivational orientations toward achievement in school: A quantitative synthesis. *American Educational Research Journal,21,* 39-59.

Taber, K. S. (1992) Girls' interaction with teachers in mixed physics classes: Results of classroom observation. *International Journal of Science Education, 14* (2), 163–180.

Usher, E. L., &Pajares, F. (2008). Self-efficacy for self-regulated learning. A validation study. *Educationaland Psychological Measurement, 68,* 443-463.

vanEtten, S., Freebern, G.,&Pressley, M. (1997). College students' beliefs about exam preparation. *Contemporary Educational Psychology, 22,* 192-212.

Viefers, S. F., Christie, M. F., &Ferdos, F. (2006). Gender equity in higher education: why and how? A case study of gender issues in a science faculty. *European Journal of Engineering Education, 31(1), 15-22.*

Walters, K., & Bowen, G. L. (1997). Peer group acceptance and academic performance among adolescents participating in a dropout prevention program. *Child and Adolescent Social Work Journal, 14,* 413-426.

Yeung, A. S., Kuppan, L., Foong, S. K., Wong, Kadir, M. S., D. J. S., Lee, P., &Yau, C. M. (2010).Domain-specificity of self-concept and parent expectation influences on short-term and long term learning of physics. *New Horizons in Education, 58,* 55-73.

Yeung, A. S., &McInerney, D. M. (2005).Students' school motivation and aspiration over high school years.*Educational Psychology, 25,* 537-554.