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Gender Dimensions of Secondary School Students' Perceptions about Physics and Physics-related Careers

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ABSTRACT *The study examined the gender dimensions of perceptions about physics and physics-related careers held by 402 Form Five (O' level) physics major students in Botswana senior secondary schools. The results of the study revealed that the male subjects were more positively disposed towards physics and physics-related careers than their female counterparts and that both groups perceived physics as a masculine subject with the boys holding a stronger view about the subject matter. The results of the study also showed the same trend in the subjects' perceptions about physics-related careers with boys being more positively disposed towards the subject matter than their female counterparts; and in this case too, it was found that both the male and female subjects stereotype physics-related careers as belonging to the male domain. Furthermore, the findings of the study revealed that a low but significant positive relationship existed between the subjects' gender-stereotypic perceptions about physics and physics-related careers. Deriving from the findings of the study and relevant literature, pertinent implications for i) the science curriculum developer, ii) the educational administrator and iii) other stakeholders, such as parents, were highlighted.*

KEY WORDS: *Students' perceptions, physics-related careers, gender dimension*

Introduction

According to the 1993 Botswana National Commission on Education, "a key factor in the application of science and technology for economic development is the availability of skilled manpower which is a critical factor in transforming physical resources into wealth" (p.25). For this to happen, it goes without saying that skilled manpower should be produced in sufficient numbers and in the critical scientifico-technological areas. And to get the required critical mass of skilled manpower both sexes would have to be attracted into the critical fields in good numbers. However, to date, the participation of Batswana girls in school physics and of Batswana women in physics-related careers is low even though females make up a little more than 50% of the country's population. For example, of the 2229 students enrolled in physics in year 2000 in Botswana senior secondary schools only 864 (38%) were girls; and the trend was repeated in 2001, 2002 and 2003 school years. The enrolment figures in physics by gender to date in the only university in the country were sharply skewed in favour of the masculine gender, as indicated in Table 1.

The under-representation of girls in physical science programmes and of women in physical science careers has long been a pre-occupation of researchers

Table 1
Enrolments in the Department of Physics (Faculty of Science: University of Botswana) at Year 4, by Gender, between 1996 and 2004.

Year	Physics Department Enrolments N(%)				
	Male		Female		
	No	%	No.	%	**Total**
1996/97	17	*94.4*	1	*5.6*	**18**
1997/98	28	*96.6*	1	*3.4*	**29**
1998/99	43	*81.1*	10	*18.9*	**53**
1999/00	33	*86.8*	5	*13.2*	**38**
2000/01	20	**90.9**	2	**9.1**	**22**
2001/02	08	**80.0**	2	**20.0**	**10**
2002/03	11	**100.0**	0	**0**	**11**
2003/04	20	**87.0**	3	**13.0**	**23**
Total	**180**	**88.2**	**24**	**11.8**	**204**

Source: Physics Department. University of Botswana, 2004.

(Farenga & Joyce, 1999; Roger & Duffield, 2000). On this score, one question that readily comes to one's mind is: 'Why do males predominate in physics classes as well as in physics-related careers in many countries?' A number of theories have been advanced to explain the situation. Some suggest that the problems, models and approaches presented in physics do not match the interests and experiences of girls and are at odds with the characteristics that the society values and encourages in girls (Baird, 1997). Some researchers posit that the nature of physics is in sharp contrast to the way girls have been socialised (Brickstone, Lowery & Schultz 2000; Britton, 2000; Gillbrand, Robison, Brown & Osborn 1999; Kahle & Mere, 1994; Keniway & Annette, 1998; Kleinman, 1999; Roychoudhury, Tippins & Nicholus 1995 & Zonneveld, 1995). In like manner, several studies (Nauta, Epperson & Wagger 1999; Rennie & Dunne, 1994) have revealed that historically, the world over, the representation of women in non-traditional fields (eg engineering and other careers in the physical sciences) has been very low. There is, therefore, a disproportionate low number of women in many scientific careers especially at the higher echelon of such professions. In fact, the percentage of men entering physical science fields is many times higher (for example 3.5 times in the technical and 9.5 times in engineering areas) than that of women (Butter & Maizone, 1980 in Chooka 2002). This is, however, not surprising as there is a one-to-one correspondence between subject choices at school and future chosen careers.

The literature on the subject matter (Baird, 1997; Dirasse, 1989; Kahle & Meece, 1994) contains a comprehensive thesis on the factors that could be responsible for the observed disparity. Such factors include attitudinal variables, socio-cultural variables, home and family variables, educational variables and genetic variables between males and females (Kahle and Meece, 1994). However, of all these factors, gender-role socialisation in general in the society (home, schools etc) had been seen as the most pervasive and significant one impinging on

the development of the child's self-belief system (Dirasse, 1989; Farenga and Joyce, 1999 & Roger and Duffield, 2000). This in turn exerts considerable influence on the child's perceptions about science and science-related careers. This is probably very true of the situation in Botswana where the average 'Motswana child's thought processes like those of his/her other African counterparts are shaped by the goings-on in his/her traditional society (Kesamang & Taiwo, 2002) which is typically patriarchal. And like in any patriarchal society, the day-to-day social life of Batswana is regulated and sanctioned by cultural norms that reinforce differences between males and females (Sathyamoothi, 2004) resulting in males being more valued and females being regarded as 'minors.'

The earlier observations about the disparity between Batswana males' and females' participation in physics and physics-related careers may not be unconnected with females' perception about physics and physics-related careers as it is generally believed that perceptions are influential in shaping one's attitudes and interests which may consequently influence one's future career preferences. Or how else could one interpret common statements like "girls can't be engineers'? It is the realisation of the centrality of one's perceptions about subject choices and subsequent career choices that underscored the need to further examine students' perceptions of gender stereotyping of physics and physics-related occupations in this study.

The study was, therefore, carried out to find answers to the following research questions:

a) Are there gender differences in Botswana Form Five physics students' perceptions about physics?

b) Are there gender differences in Botswana Form Five physics students' perceptions about physics-related careers?, and

c) Is the relationship between the students' perceptions about physics and their perceptions about physics-related careers gender specific? No, 'a' deals with the perceptions about physics, while 'b' deals with the perceptions about physics-related careers and 'c' with the relationship between them.

Methods

Details of the research methodology strategy adopted for this study are as follows:

Research design: The survey technique was adopted for data collection since the study samples were neither manipulated in any manner nor subjected to any treatment. . In particular, a comparative survey method which allowed both the qualitative and quantitative comparisons of the perceptions of the two groups of the study about the subject matter was employed. This was carried out with a view to obtaining pertinent data from the study samples and presenting the - study emerging findings without the manipulation of the study subjects (Cohen and Manion, 1994).

Population and sample selection: The population of the study was made up all the students in the thirty six (36) public senior secondary schools in Botswana in 2003 school year. Public schools in Botswana are, to a large extent, at par in all its ramifications as both non-human (equipment) and human (teachers) resources

are centrally deployed by the government. In the light of this fact, convenient sampling technique was used to select fourteen (14) easily accessible senior secondary schools from the public senior secondary schools in the country. The state capital, Gaborone (naturally the biggest city) and the second biggest city (Fracistown, about 400 kilometres from the state capital) served as the focal points for the selection of the 14-member school sample. All the fourteen schools selected were within 100-kilometre radius of the two cities. Stratified random sampling technique employing proportional representation by gender was used to select fourteen (14) male students for every fifteen (15) female students in each of the schools sampled. This resulted in a selected sample size of 406. But due to the non-participation of one (1) female and three (3) male students originally selected for the study, the study sample comprised 193 male and 209 female subjects. The ages of the study subjects ranged between fifteen (15) years and twenty-two years with the ages of a significant majority (77%) of them clustering around the seventeen-and-eighteen-year age bracket.

Instrumentation: A self-completion questionnaire patterned against a host of other instruments used in earlier studies (Jones, Howe & Rua, 1999 & Wheldon & Smith, 1988) was constructed by the researchers and used for data collection for the study. The instrument comprised three sections, viz:

i) Section A - which is essentially a biographical section.

ii) Section B – which is essentially a Likert-type scale meant to solicit the subjects' opinions of their perceptions about physics and physics-related careers, and

iii) Section C – which is concerned with the subjects' gender stereotyping of physics-related careers on a five-point scale of their suitability for a) men only b) mostly men c) both men and women d) mostly women and e) women only.

The instrument is contained in the appendix for ease of reference.

Instrument validation and reliability determination: The research instrument was face-validated by nine senior secondary school physics teachers and three science educators for clarity of expression, relevance to the thrust of the study, readability of its items, adequacy of the coverage of the research questions by its items etc. The instrument was further refined by pilot-testing it on twenty students in two senior secondary schools in Gaborone and its environ which were not part of the study schools. The piloting exercise served two purposes, viz i) further validation and ii) reliability determination. Further validation of the instrument involved seeking and receiving assurances from the student sample that they understood what all the careers listed in questionnaire were. The reliability of the twenty items of the research instrument specifically dealing with perceptions about physics and physics-related careers (see parts 'a' and 'b' of Section B of the instrument) was determined by using split-half technique. A value of $\bar{r} = 0.85$ was obtained for the internal consistency of the two halves of Section B of the instrument. A more robust 0.92 reliability coefficient value was obtained for that section of the instrument on the application of Spearman-Brown correction formula. Yes, the figures appear rather high. But this was the case from the analysis of the data obtained. The only extra thing done here was the rounding up of 0.9189189 to 0.92.

Data collection: Data for the study were collected by face-to-face administration of copies of the research questionnaire by one of the researchers in all the fourteen senior secondary schools sampled. This was of course done after necessary permission had been sought and obtained from relevant authorities to conduct the study.

Data analysis: Data for study were subjected to both descriptive and inferential statistical analyses. Because of the robustness of the data collected, data analyses for the study were carried out with the aid of a statistical computer package popularly referred to as SPSS (Statistical Programmes for Social Sciences). In particular, t-test analysis was employed to resolve research questions one and two in order to determine if there were gender differences in the subjects' perceptions about physics and about physics-related careers. Pearson's product-moment correlation and chi square analyses were used to resolve research question three in order to determine both the extent and the significance of the relationship between the subjects' perceptions about physics and physics-related careers.

For students' responses to items requiring students' gender-typing of physics-related careers (see Section C), a career was considered to be gender-stereotyped as 'male' if more than 50% of the student respondents categorized it as, 'suitable for men only ' or 'mostly men'. On the other hand, a career was considered to be gender-stereotyped as 'female' if more than 50% of the respondents categorized it as 'suitable for women only ' or 'mostly women'. If more than 50% of the respondents categorized a career as suitable for both men and women, then it was regarded as a gender neutral career.

Results and discussion

Table 2 below shows the results of the data analysis (of Part A of Section B of the questionnare) concerning gender differences in the subjects' perceptions about physics. This is with a view to resolving research question one.

Table 2

Frequency counts, mean scores, standard deviations (SD) and t-value of subjects' perceptions about physics by gender.

Gender	No. of Respondents N (%)	Mean	SD	t-value	Sig. Level (2-tailed)
Male	193 (***48***)	32.39	4.54	***4.57***	0.05
Female	209 (***52***)	30.09	5.56		

The mean scores of the boys and girls are 32.39 and 30.09 respectively, at about five standard deviation points above the mid-point of the ten-item, five-point scale. Hence, from the mean scores, it can be deduced that while the boys hold positive perceptions about physics, the girls' perceptions about physics is somewhat neutral. This is, however, not out of the ordinary as both sexes of this study are physics majors. Inferential statistical analysis by a two-tailed t-test reveals that there is indeed significant gender differences in the subjects' perceptions about physics. The computed t-value (4.57), when equal variances were not assumed, was

significant at 0.05 level (t = 1.96; df = 400; p = 0.05). This shows that there is a significant gender difference between them with the boys having a stronger positive perception about physics than the girls. In addition, the respondents' gender stereotyping of physics as a subject/discipline follows the same trend as 45% and 62% of the males and females respectively perceive physics as a masculine subject while on the other hand 65% of the boys and 73% of the girls disagree with the view that physics could be regarded as a feminine subject.

Table 3 below presents the details necessary for the resolution of research question 2. The results of the data analysis (of Part B of Section B of the questionnare) concerning the respondents' perceptions about physics-related careers underscore again their stereotyping perspectives as shown in Table 3 below.

Yes, separate t-test analyses were carried out for data derived from the two parts (a & b) of section B in order to deal with research questions one and two. Section C provided data for highlighting the stereotyping of physics-related careers (See Table 4 below).

Table 3

Frequency counts, mean scores, standard deviations (SD) and independent samples t-score of the respondents' perceptions about physics-related careers by gender.

Gender	No. of Respondents N (%)	Mean	SD	t-value	Sig. Level (2-tailed)
Male	193 (*48*)	27.31	4.14	***3.05***	0.05
Female	209 (*52*)	26.04	4.25		

From relative scores of boys and girls in the table above, the result reveals that the boys have stronger positive perceptions about physics-related careers than their female counterparts. A two-tailed t-test analysis reveals that there are indeed gender differences in the students' perceptions about physics-related careers. The calculated t-value of 3.05 is significant at 0.05 (t = 1.96; df = 400; p = 0.05). This is a clear indication that boys relate more positively to physics-related careers than their female peers and that they are thus more likely to pursue such careers in the future than their female counterparts. In this case too, the males tend to have stronger stereotypic view than their female counterparts about the subjects matter of study. They both, however, perceive physics-related careers as belonging to the 'male terrain' as evident from the contents of Table 4 below.

As the results in Table 4 above reveal, both the female and male students perceive physics-related careers as masculine. According to the frequency counts, the careers are either suitable for men only or for both men and women, but insignificantly appropriate for women only. In fact, all the careers have been labelled to belong to the male domain except for the four that were classified as gender neutral. These are i) science teaching at secondary school level, ii) information and technology engineering, iii) computer engineering and iv) civil engineering. The fields of mining engineering, mechanical engineering, electrical engineering and piloting have been strongly gender-typed as masculine.

To further examine research question two, a descriptive statistical analysis

Table 4
Frequency counts of students' sex stereotyping of physics-related careers.

Physics-related career (*Total no. of Respondents to item*)	Percentage Responses N (%) For Men	Both	For Women
1. Secondary school physics teaching (*401*)	144(*35.9*)	251(*62.6*)	6(*1.5*)
2. University level physics teaching (*398*)	212(*53.3*)	182(*45.7*)	4(*1.0*)
3. Electrical engineering (*396*)	253(*63.9*)	138(*34.8*)	5(*1.3*)
4. Mechanical engineering (*396*)	299(*75.5*)	93(*23.5*)	4(*1.0*)
5. Piloting (*399*)	241(*60.4*)	156(*39.1*)	2(*0.5*)
6. Mining engineering (*399*)	333(*83.5*)	63(*15.8*)	3(*0.7*)
7. Information. & technology. engineering (*400*)	81(*20.3*)	285(*71.8*)	34(*8.6*)
8. Structural engineering (*394*)	197(*50.0*)	178(*45.2*)	19(*4.8*)
9. Computer engineering (*399*)	84 (*21.0*)	254(*63.7*)	61(*15.3*)
10. Civil engineering (*399*)	169(*42.4*)	202(*50.6*)	28(*7.0*)

(using the Likert five-point ratings of 1 to 5 respectively for careers most suitable for women only to careers most suitable for men only) of the respondents' responses to the ten items in Section C of the instrument gives mean scores of 37.3 for the male students and 34.8 for the female students. Thus, the respondents in general have a strong perception of physics-related careers as belonging to the male field. However, the boys tend to have a stronger perception about physics-related careers as belonging to the male domain than the girls. The significance of the difference was tested by subjecting the obtained mean scores above to the test of mean difference (t-test). The calculated t-value (of 5.57) was found to be significant at 0.05 (t_c =1.96; df = 399; p = 0.05). This shows that there is a strong gender differentiation between boys and girls on the gender stereotyping of physics-related careers. Indeed, a preponderance of the girls share similar perceptions with their male counterparts about the masculinity of physics-related careers. It is worth noting that the students' gender stereotyping of the physics-related careers is consistent with the work force situation in physics-related occupations in Botswana.

To resolve research question three, the relationship between the students' perceptions about physics and physics-related careers was addressed by employing both Pearson's correlation and chi square analyses. A Pearson's correlation coefficient of 0.34 was obtained between the two variables (perceptions about physics and perceptions about physics-related careers). This shows that the two variables are somewhat directly correlated in view of the positive (irrespective of the low) value of the correlation coefficient of 0.34. A chi square analysis carried out yielded a value of 1125.31 at a significance level of 0.05 (df = 648; p = 0.05). The chi square test result indicates that there is indeed a significant relationship between the students' perceptions about physics and about physics-related careers. As the correlation coefficient value (0.34) shows that the relationship between the

two variables is positive, it can be inferred that students who perceive physics as belonging to the male domain are likely to hold the same view about physics-related careers.

The research findings above suggest that there are significant gender differences in the students' perceptions about physics and about physics-related careers. Similarly, the study shows that there is significant difference by gender in the way the respondents gender-stereotyped physics and physics-related careers. Girls, more than boys, see physics as a 'hard' subject. It is thus apparent from the available literature and the current research findings that both girls and boys stereotype physics and the physics-related careers as masculine, even though they both have a positive perception about physics. The female students' reluctance to select physical science courses at college level could partly be attributed to their perceptions about physics and physics-related careers as belonging to the male domain. Please see the modifications above.

Despite the fact that the girls perceive physics positively, the results indicate that the girls believe it to be difficult. The fact that girls think that physics is difficult and gender-stereotype physics and physics-related careers as masculine could be a reflection of an embedded perception emanating from both their social and educational background. Hence, an essential aspect of achieving equity will require addressing impinging societal and educational variables. Studies have demonstrated that experiential differences could account for the differentiated perceptions about physics and physics-related careers between boys and girls (Farenga and Joyce, 1999 & Greenfield, 1995). Hence, the difference in the perceptions of difficulty and the gender stereotyping of physics and physics-related careers of the students in the study could be explained in terms of their experiences, socialisation and the school factor.

Studies have indicated that children are embroiled in their culture and shaped by it (Kahle and Meece, 1994 & Mphele, 1995). The out-of-school experiences available to students, and chosen by them, and their gender stereotyping of the science-related careers, are expressions of the larger culture (Kahle and Meece, 1994). As long as the culture maintains the traditional view of what is appropriate for girls (nurturing and household chores), and boys (exploring) and conveys the idea that science is more appropriate for boys than for girls, so long would it be likely for young people to bring these values and attitudes to the science classroom (Jones et al, 1999). The school may be the only place in their environment where students may experience different values and attitudes about science; and yet many of the research findings reviewed earlier indicate that schools themselves are not free of gender bias (Mannathoko, 1996; Mooko, 2003 & Moji, 1997).

Conclusions

Deriving from the findings of the study, the following conclusions could be drawn.

1. That there was a significant gender difference in the subjects' perceptions about physics with the boys having stronger positive perceptions about physics than their female counterparts. In addition, the respondents on the whole stereotyped physics as a masculine subject.

2. That there was a significant gender difference in the subjects' perceptions about physics-related careers with the males holding a stronger stereotyped view of the subject matter. Overall, they both perceived physics-related careers as belonging to the 'male terrain'.
3. That there was a positive and significant relationship between the subjects' perceptions about physics and about physics-related careers. Consequently, students who perceived physics as belonging to the male domain were likely to hold the same view about physics-related careers.

Please note that this query has been addressed by the modifications above and pls note further that this section is just giving a summary of the findings of the study.

Emerging implications

Based on the above conclusions, it is the considered opinion of the researchers that the findings of this study *and the* relevant literature on the subject matter of the study have profound implications for the teaching and learning of science, particularly physics, in the developing world in general and in Botswana particular. The under-representation of females in the physical sciences does not appear to be caused by gender-based genetic differences. Nor does it appear to be the result of gender-based differences in cognitive abilities. Rather, the under-representation of females in physics and in physics-related careers appears to be a result of the gender role socialization and the creation and maintenance of hostile environments in physical science courses and departments (Baird, 1997). It is suggested that more emphasis be placed on "gender inclusive" science that is accessible to all irrespective of their gender. The catchword here should, therefore, be 'science for all'. While this will not be an easy task, a concerted effort must be made by all concerned for its achievement. This might require some kind of extensive social re-constructions. Community leaders, parents, and teachers may have to undergo some behaviour modifications. Furthermore, this requires that there be changes in the school academic structures and environment. According to Kenway and Annete (1998), there is no one absolute way of addressing the question of gender imbalance in the physical sciences. As the literature suggests, the problem is multi-causal and there is the need to address it in a holistic manner, taking into account the interests and nature of the girl student. The following is an outline of the implications of the outcome of the study that are informed by the pertinent literature on the topic and the findings of this study for the various stakeholders.

Implications for the science curriculum developers: It is strongly advised that curriculum developers develop science curricula that focus attention on addressing gender inequities in science. There is also the need for curriculum developers to identify the kinds of situations that reinforce differential experiences between boys and girls and to adequately address and alter identified inequitable situations in order to bring girls into the mainstream of science. They need to ensure that they develop science curricula that reflectively address concerns about gender equity.

Implications for educational administrators: School administrators have a professional obligation to ensure that schools provide students with adequate and

relevant education, both equally and equitably. Hence, they need to address teacher-student-related factors that will positively impact on female students' perceptions about physics and about physics-related career participation as well as influence female students' participation and performance in physics. Teachers should be encouraged to carry out action researches into the gender dynamics of their science classrooms with a view to effecting desirable changes in them.

Implications for teaching: Previous studies have shown that teachers are influential in shaping the views and attitudes of their students about science in general (Baird, 1997). Physics teachers, as the ultimate implementers of physics curricula, have both moral and professional obligations to ensure that their pedagogical approaches address the question of gender equity and adequately address the stereotypes in physics teaching.

Implications for guidance and counselling: Numerous researches point to the way pupils' career aspirations determine their subject choices such that even where girls say they like physics in school, they still do not choose it (Roger & Duffield, 2000). This is synonymous with the case of a boy who loves netball but could still not be a player in the netball team because it will be "unmanly" and "unnatural" for him to do so. All these point to the social construct of what pupils see as reality. Several suggestions regarding the roles that the guidance and counselling services can play in schools to enhance female participation in science have been made in previous studies (Baird, 1997; Kenway & Annete, 1999; Roger & Duffield, 2000). It is imperative that the guidance and counselling departments in schools raise students' awareness, particularly the female students, on a wide range of careers that a qualification in physics opens up.

Implications for parents: Parents' words are powerful and can influence perceptions about a subject and performance and participation in the subject at school as previous studies have indicated (Kahle &Meece, 1994; Kelly, 1981; Jones et al 1999; Rennie & Dunne, 1994; Roger & Duffield, 2000, Smail, 1986). Research has thus shown that parents play a significant role in shaping the way their children view the world. The problem of gender equity in physics education and the stereotypes associated with physics will not be adequately addressed without taking parents aboard in this endeavour.

Implications for future research: It is an incontrovertible fact that a lot of efforts have been devoted to this important issue of gender disparity in perceptions about and attitudes towards science (Kesamang & Taiwo, 2002). But unfortunately most of such studies have addressed the problem only at the diagnosis level. More efforts should now be directed towards empirically unearthing the actual causes of such disparities. Contribution to knowledge in this area would no doubt go a long way in informing practice in gender matters.

Girls-only science classes: Botswana senior secondary schools should be encouraged to experiment with girls-only science classes. Studies have demonstrated that physics classes are usually perceived as a hostile environment for girls (Baird, 1997; Greenfield 1998). Other studies have demonstrated that peer collaboration in science classes is exclusively same sex (Adamson et al, 1998). Thus, girls usually prefer to work with other girls and boys prefer to work with other boys. Many studies have demonstrated that girls' participation, achievement and attitudes towards science improve drastically in non-co-educational schools (Jones

et al, 1999). Girls-only science classes should, therefore, be encouraged in Botswana secondary schools.

Science museums/science centres: Government should work with non-governmental organizations (NGOs) to look at the possibility of establishing science museums or science centres along the same line as the ones in many parts of the United States of America or in Cape Town, South Africa. These should be structured around hands-on exploratory activities that are readily available to both boys and girls. Such exhibits must also focus on local and traditional products and processes along side modern science.

Science teacher education: There must be reform in science teacher education programme especially at the primary education level. Primary school teachers are crucial 'change agents' who must be trained adequately in subject matter, especially in the physical sciences. Studies (Roger and Duffield, 2000 & Roychoudhury et al, 1995) have indicated that most females' interests in science drop drastically after elementary school, and that primary school teachers themselves who happen to be mostly females are not enthusiastic about physical sciences. It is thus important that the reform should be aimed at helping primary school teachers in understanding science, cultivating a rich appreciation of the diversity of students and mastering of pedagogical content knowledge that will enable them to translate their understanding of science into good teaching that will connect with diverse students, especially those who have been alienated from science.

Women's groups: Women pressure groups, (e.g, Emang Basadi, Metlhaitsile etc) must be at the forefront of mobilising other females in the non-traditional fields. This would require such bodies going into schools and raising awareness about the gender disparities in science and in science-related fields, and encouraging more girls to venture into science.

Professional associations: Local professional bodies (like the engineers' associations) are aware of the gender disparity in the field and are, therefore, better placed to articulate the problem. However, these are usually unknown entities within the student community. It will be worthwhile if such bodies could visit schools in an endeavour to "sell" themselves and to encourage more students to go into physical sciences-related careers.

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Appendix I

Students' perceptions about physics and physics-related careers: A questionnaire

This is a questionnaire designed to have your views about physics and physics-related careers. It is NOT a test and therefore there are no right or wrong answers. But you are kindly requested to respond to the items in the questionnaire as honestly as possible.

NB: Your responses will be treated confidentially, so DO NOT write your name on the questionnaire. Thank you.

SECTION A: Personal details

Please provide information on your personal details below as appropriate.

1. Gender 2. Age:_____

3.Name of School:_____

SECTION B: Opinions about physics and physics-related careers

a) Opinions about physics as a subject.

This section comprises statements about physics. You are required to indicate your opinion about each statement by placing a tick (÷) inside the box that best reflects your true opinion of the statement on the five-point scale of **Strongly Agree (SA), Agree (A), Neutral (N), Disagree (D), to Strongly Disagree (SD).**

Statement	SA	A	N	D	SD
1. Physics should not be taught at school					
2. Physics is boring.					
3. Studying physics is a waste of time.					
4. Physics an abstract subject.					
5. Physics is an interesting subject.					
6. Physics provides important practical life skill					
7. Physics is an easy subject.					
8. More physics content must be taught at school.					
9. Physics is a feminine subject.					
10. Physics is a masculine subject					

b) Opinions about Physics-related Careers.

This part of the questionnaire seeks to find out your opinion about physics-related careers (e.g. mechanical engineering, electrical engineering etc). You are required to indicate your response by placing a tick (÷) in the box with the letter(s) that best represents your opinion.

Statement	SA	A	N	D	SD
1. Most physics-related jobs are highly paying.					
2. Physics-related careers are too physically demanding.					
3. Physics-related careers are scarce.					
4. Physics-related occupations are mostly suitable for men.					
5. Physics-related occupations are mostly suitable for women.					
6. The chances of progression in the physics-related occupations are limited.					
7. It is easy to progress in physics-related careers.					
8. Physics-related occupations involve a lot of health risks.					
9. Physics-related careers are not paying well.					
10. Physics-related careers are for the highly intelligent.					

SECTION C: Opinions about physics-related careers and gender

Below is a list of some physics-related careers. You are required to rate each career on a five-point scale, either as ***suitable*** for:

a men only
b mostly men
c both men and women
d mostly women
e women only

Indicate your opinion by placing a tick (÷) in the box below as appropriate.

Career	a	b	c	d	e
• Physics Teaching at Secondary School Level.					
• Physics Teaching at University Level.					
• Electrical Engineering					
• Mechanical Engineering					
• Piloting					
• Mining Engineering					
• Information and Technology Engineering.					
• Structural Engineering					
• Computer Engineering					
• Civil Engineering					