

Gender Disparities in Sciences: The Question of Parental Influence on Children's Self-Concept and Utility-Value

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Abstract

Self-concept and utility-values are thought to influence differences in choices, participation and performance in schools-careers between students of different genders and ages. This study was investigating existence of gender differences in such constructs regarding science. Further, the study investigated whether development of such constructs is still influenced by how children feel their parents perceive them in relation to sciences. Using a 30-item, Lickert-type questionnaire, data were collected from a random sample of 184 second and third graders. Results showed that, students' self perceptions and those of parents regarding science are positively related. Further, self-concept and utility-values were higher among boys than girls. Based on the result, it was concluded that, parents' gender-based perceptions regarding science that are still communicated at home might be the reason for the development of children's gender-based self-perceptions regarding sciences.

Keywords: Gender, parents, sciences, self-concept, utility-value, Tanzania

Introduction

Despite the importance of science in solving major human and environmental problems, the world-wide reports provided by the World Bank (2008) and OECD (2008) have shown that, the number of children who decide to choose and engage in sciences particularly girls decreases as they transit into higher grades. According to these reports, many children particularly girls, lose their enthusiasm and decide not to engage fully in sciences. It is until very recent years when some developed countries, especially in Europe, have attained equality of participation between genders and improvement of performance in sciences (Quenzel & Hurrelmann, 2012).

Variations in participation and performance of science subjects among students have attracted researchers' attention with the aim of studying the reasons behind it. According to them, one of the scholarly explanations for the differences in choice, participation and achievement in sciences are the *self-concept* and academic related *utility-value* differences among children. It is argued that such psychological constructs motivate and enhance students to cognitively judge, evaluate, and instill confidence to select strategies and resources required to do their academic tasks successfully. Studies have shown that, despite the lack of cause-effect relationships, self-concept and academic-values correlate positively, mediate or play a predictive function with subject choices, persistence and scholastic performance.

A number of studies exist to provide evidence on the influence of such constructs on choices and participation in academics among girls and boys. With the exception of few studies which reported absence of significant gender differences in such constructs (e.g., Tenenbaum & Leaper, 2003), many other researchers (e.g., Nagy, Trautwein, Baumert, Koller & Garret, 2006; Senler & Sungur, 2009; Frenzel, Goetz, Pekrun & Watt 2010) reported that, boys have higher self-concepts and utility-values regarding sciences than girls. Therefore, it has been widely argued that, it is because of such perceptions that boys have always perceived themselves confident, fit and strong in doing science and other tasks that are stereotyped to be difficult by the society. Eventually, this has motivated more boys to choose and engage into sciences-disciplines compared to girls. A point to note however is that, although various studies have shown existence of gender differences on such constructs, these differences were found not to relate to intelligence differences between them (Nagy et al., 2006).

Theoretical Background

For decades, the term *self-concept* has been used as both a *descriptive* (e.g. "I like science"), and *evaluative* (e.g. "I am good at science") to refer a totality of individuals' self-perceptions on academic task (Winne & Alexander, 2006). However, due to its long life in education field, the terminologies deployed to define it vary greatly. Some of the terminologies used over the years include: "self-efficacy" (e.g., Dintner, Dochy & Segers, 2011) and "self-esteem" (e.g., Frank, Plunkett & Otten, 2010). However, according to Winne et al. (2006), self-concept differs from such synonymous motivational-concepts in a number of ways. First, unlike them, self-concept does not

include control-beliefs (i.e. students' perception about the likelihood of accomplishing desired ends under certain conditions), which is another component of motivation. Second, self-concept focuses more on competence than on attitude. This distinction is important because perceived lack of competence should be addressed differently from lack of control. Due to the number of terminologies deployed, in the present study self-concept has been used as a competence-belief to refer to self-inferences concerning abilities the individual makes regarding sciences.

On the other hand, individuals ask themselves personally, "Why should I do or learn it"? According to Winne et al. (2006), Shechter, Durik, Miyamoto and Harackiewicz (2011), such questions address the value-component (benefits, advantages or rewards) of engaging into such activities. Basing on internal or external perceptions, individuals make decisions regarding the values expected to be accrued from such activities. One of such values-perceptions is *utility-value* which refers to present and future extrinsic benefits that might be accrued by participating in a given activity. As it is with self-concept, according to Winne et al. (2006) and Eccles (1993) utility-value is also synonymous to other types of academic-values which collectively contribute to students' desires and preferences. They include intrinsic-value (i.e. interest and enjoyment), attainment-value (i.e. importance of doing well) and cost-values (i.e. perceived negatives aspects of engaging into a task such as fear of failure). Although this study will focus on utility-value, the review will be based on all other academic value-constructs. This is because; all academic task-values can influence each other as well as interests which in turn influence students' learning behaviors (Shechter et al., 2011).

Self-concept and utility-value orientations are rooted the *social-cognitive psychology* (Bandura, Barbaranelli, Caprara & Pastorelli, 1996). According to them, children's self-concept and utility-values are neither innate nor static attributes, but develop over time through either personal success-failure experiences (e.g. 'I failed my two last science tests, I really am no good at it'), or those of models and persuasion from important close persons (e.g. "I know, science is not for persons like you" or "science will not give you the best return"). Thus, self-concept and utility-values vary and undergo certain modifications within an individual so as to enable him or her to adapt and fit in the social-environments (Eccles, 1993).

In line with social-cognitive psychology theory, many researchers (e.g., Jodl, Michael, Malanchuk, Eccles & Sameroff, 2001; Tenenbaum et al., 2003; Eccles, 1993) argued that children's self-concept and academic utility-value orientations are more likely to be shaped by the family than other social entities. According to them, parents are particularly salient at times children start to explore different conceptions of who they are and who they want to be. Being potential and immediate socializing agents, parents have always exploited that opportunity to influence children's future conceptions in multiple ways. Consequently, children have been using parents as interpreters and filters of reality and providers of learning experiences (Jodl et al., 2001 & Frenzel et al., 2010). Grounded on these beliefs, in such young-ages, children have always been at a higher risk of assimilating each of their parent's perceptions due to their psychological beliefs that parents know everything that is good for them. Empirical evidence to support these arguments are accessed from a study conducted by Tenenbaum et al. (2003), Senler et al. (2009), and Gniewosz, Eccles and Noack (2011). According to them, children and parents tend to hold similar competence-beliefs, academic utility-values and aspirations for the future. Yet, despite this observation, it is important to note that the efficacy of parents' influence is not straightforward as it might always be assumed; rather it depends on the sense children give to the messages itself.

The research problem

As it is with many other countries, Tanzania has made considerable efforts to enforce equal educational opportunity especially gender-parity in sciences. Some of such efforts include endorsement and implementation of the Millennium Development Goal III (MDG3) 2000 – 2015, as well as launching and implementation of phase-by-phase of the National Secondary Education Development Plan (SEDP) 2004-2009. Despite such efforts, similar to the world-wide reports provided by the World Bank (2008) and OECD (2006; 2008), according to the reports provided by the Tanzanian Ministry of Education and Vocational Training –MoEVT (2013), and that of the Millennium Development Goal (MDG) progress report (2010), achievement has been registered only in the areas of gender parity related to primary school enrolment. Thus, there is existence of gender imbalance particularly related to choices, participation and performance in sciences.

In relation to gender-based differences in choices and performances trends that are noted in Tanzania, the study intended to explore whether such differences are accounted by *self-concept* and *utility-values* regarding sciences between boys and girls. In order to attain this objective, the study was guided by the following questions:

- i. Are there gender differences on self-concept and utility-values regarding science among children's in Tanzania?
- ii. Do children's perception of their parents' beliefs and expectations regarding science relate to their self-concept and utility-values on science?

Rationale

One would ask himself/herself: based on social-cognitive theory, a literature has shown how others' evaluations and perceptions function as a mirror in which one sees oneself regarding sciences. Why conducting this study again? Answers to this question could be that, despite such scholarly documentation, a conduct of the present study is geared by two main reasons: First, given the fact that studies regarding parental influence on children's self-concept and utility values is well documented, it is expected that Tanzanian parents have learnt a lot about it. Grounded on this, the current study wanted to ascertain whether Tanzanian parents are still the reason or not, for the observed gender-based differences in the choices and performance in sciences among their children. Secondly, as Shafiq (2011) argued, gender-variations in self-concept and academic utility-values are further influenced by sets of other variables such as socio-cultural, education and economic conditions of the parents. The fact that such conditions in developing-countries are different compared to developed-countries, has driven conduction of this study in Tanzania.

Methodology

Sample and sampling procedure

The population for the present study was Tanzanian secondary school students. Out of all students, the study involved a total of 200 participants in 10 schools. The study planned to use students who were in grade ten and eleven, with equal gender representation. The two grades were selected because in Tanzanian education system, as a student transit from grade ten to grade eleven, he or she may decide to take either science or art stream. This offers a best opportunity to study self-concept perceptions among students which are likely to influence their future choices (for tenth grade students) or which have already influenced their previous choices (for the eleventh grade students). In order to ensure maximum representation, Cluster and Stratified random sampling were employed to get representative schools and participants respectively. In each school, each grade (i.e., grade ten and eleven) contributed 10 students.

Instrumentation

In this study, 5-point Likert-type scaled questionnaire adapted from the Modified Fennema-Sherman Mathematics Attitude Scale (MFSMAS), which was at first modified by Doepken, Lawsky and Padwa from the length of the original attitude scale of Fennema and Sherman (1976) was used. In order to fit the Tanzanian context and purpose of the present study, wording changes were made first, and then items were reduced from 47 to 30¹. Finally, the questionnaire was organized into four sub-scales each measuring one study-variable:

- i. Students' competence-beliefs, (e.g. "I am sure I have enough strength do study science").
- ii. Students' utility-values of science, (e.g. "I will use science in many ways as an adult").
- iii. Perceived parents' beliefs regarding values of science, (e.g. "my parents believe that jobs requiring science knowledge pay less in life").
- iv. Perceived parents' beliefs regarding ability of their children to study science (e.g. "my parents believe that science is hard and is not for persons like me").

Following some changes made, the content-validity of the instrument was assessed and agreed to be sufficient by authors of this study. Further, reliability testing was performed to ascertain the sub-scales' internal consistence. Except the second variable which fell just short of the satisfactory point, the remaining subscales had acceptable Alpha coefficients required for internal consistence of the items in statistical research tests (see Table 1).

Table 1: The Cronbach's Alpha reliability coefficients of the subscales

	Subscale	No. of items	Cronbach α
1	Students self competence-beliefs (SECOB)	6	.73
2	Students' perception on the values of science (SPVAS)	7	.69
3	Parents' perception of science and ability of their children to study it (PESCV A)	12	.82
4	Parents' perception of science as a male domain (PPSM)	5	.74

Design and procedure

This was a survey study which employed a cross-sectional approach. Before collecting data, a permission to meet with students was sought from the District Educational Officer and the Principal of each school. The consent was also sought from each participant before the questionnaires were distributed to them. Collection of the filled-in questionnaires was either on the spot or the next day morning.

¹ Other items of the original MFSMAS-instrument had no content-related validity appropriate for this study because they were prepared for measuring attitudes and not self-concept

Planned data analysis

With respect to the first question, a T-test was conducted to determine whether there was significant difference regarding competence-beliefs and utility-values on sciences between boys and girls. In a similar way, a T-test was conducted to ascertain whether there was gender-based difference regarding the perceived perceptions of their parents on the value of sciences and the abilities of boys and girls to study it. Next to that, correlation analysis was carried out aiming to examine the relationship between the students' self-concept and utility-values on the one hand and the perceived parents' beliefs and expectations regarding sciences on the other.

Results and discussion

Response summary

The study suffered from mortality-threat by 8%. Thus, data analysis was based on 184 respondents. Of these respondents 55% were girls while 45% boys. What was very interesting was that, of all the respondents, 87% were living with their parents. This provided confidence that the collected data would match the purpose of the study because few participants were living with other next of kin (brothers or sisters 8%; other relatives 5%).

Gender difference on their self-concept and utility-values in sciences

Regarding differences in self-concept and utility-values between boys and girls, the results showed that on average, boys have somewhat higher self-concept ($M=3.50$) and higher utility-values ($M= 3.85$) compared to girls who had ($M=3.10$) and ($M=3.43$) for self-concept and utility-values respectively. In both cases, this difference was significant (see Table 2).

Table 2: T-test result for self-concept and utility-values toward science between genders

		<i>n</i>	<i>M</i>	<i>SD</i>	<i>T-value</i>	<i>df</i>	<i>Sig. (2-tailed)</i>
Self-concept	Girls	100	3.10	.77	-3.387	182	.001
	Boys	83	3.50	.79			
Utility-value	Girls	100	3.43	.58	-4.334	182	.001
	Boys	83	3.85	.67			

Parents' perceived perceptions regarding girls' and boys' in relation to sciences

A t-test was then conducted to determine whether there is any difference regarding the parents' perceptions on the value of sciences and ability of their children to study it, that are communicated to boy and girl-children at home. Results (see table 3) showed that boys are getting a positive message regarding their abilities on sciences and its value on their future life as compared to girls. In both cases, this difference was significant.

Table 3: T-test result for the perceived parents' perceptions as reported by boy and girl-children

	<i>sex</i>	<i>n</i>	<i>M</i>	<i>SD</i>	<i>T-value</i>	<i>df</i>	<i>Sig. (2-tailed)</i>
Parent's perception regarding utility of science as reported by	Girls	100	2.87	.67	-3.01	182	.01
	Boys	83	3.89	.58			
Parents' perception of children's ability as reported by	Girls	100	3.23	.82	-2.27	182	.01
	Boys	83	3.52	.62			

Relationship between perceived parents' beliefs about science and children's self-concept and utility-values

Furthermore, a correlation analyzes were conducted aiming to study whether perceptions of the children regarding sciences are influenced by the messages they receive at homes from parents and next-of-kin. Results (see Table 4) showed that, students' self-concept correlated positively (albeit low) with perceived parents' beliefs regarding ability of their children to study it ($r = .37, p < .01$). Also, a moderately low (albeit significant) correlation was found between students' utility-values and perceived parents' perceptions of the utility of science ($r = .34, p < .01$), and of their children's abilities ($r = .30, p < .01$). Interestingly, a high relationship was found between: (i) students' self-concept and utility-value ($r=.60, p < .01$), and (ii) perceived parents' expectations of the value of science on the one hand and of their children's abilities on the other ($r = .60, p < .01$). On the one hand, this shows that, children with high competence believes in sciences develop positive perception regarding the usefulness of sciences in their lives. On the other hand, these results show that, the more parents value sciences, the more they would expect their children to be able to venture in that career.

Table 4: Relationship between students' self perceptions and perceived parents' perceptions

	<i>M(SD)</i>	1	2	3	4
1. Parents' perception of children's ability	3.26(.86)	1	.60**	.37**	.30**
2. Parent's perception regarding utility of science	3.36 (.82)		1	.35**	.34**
3. Students' self-concept	3.28 (.80)			1	.60**
4. Student's utility-values	3.62 (.66)				1

** Correlation is significant at the 0.01 level (2-tailed)

* Correlation is significant at the 0.05 level (2-tailed)

Discussion

These results are congruent to those reported in the developed countries by Hergovich et al. (2004), Nagy et al. (2006), Senler et al. (2009) and Frenzel et al. (2010) who also found that, boys have higher self-concept and utility-value compared to girls. Grounded on these findings, it infer that higher choices, participation and performance in science among boys compared to girls in Tanzanian secondary schools, could be due to their higher positive self-perceptions regarding science. Again, the present results are consistent with conclusions drawn from studies conducted in developed countries by Tenenbaum et al. (2003) in California, Hergovich et al. (2004) in Austria, Senler et al., (2009) in Turkey, Frenzel et al. (2010) in German, and Gniewosz et al. (2011) in USA. Generally, according to them, beliefs hold by both boys and girls regarding sciences were influenced by the gender-based messages communicated at their homes. This shows that, children's perceptions of their parents' judgments and expectancy accounted for their perceived competence and utility-values in sciences at homes. Thus, when the nature of parent-child communication regarding different careers is gender-based, children tend to develop such perceptions in a similar way. This is because, in such young ages, children psychologically believe that parents are the best filters of information they will have to live.

Conclusion

Despite socio-economic differences in-terms of the place where similar studies were conducted, the present study found similar results regarding gender differences in sciences and the parents influence on its development. Grounded on these results, in sum, it can be concluded that in Tanzania: (i) boys have higher self-concept and utility-values than girls regarding sciences, (ii) children's perceptions that parents' are expecting them to be competent or incompetent in sciences have a significant influence on the development of their own self-concepts and utility-values. Therefore, parents' gender-based perceptions regarding abilities in sciences that are communicated at home are likely to influence the development of students' gender-based self-perceptions regarding sciences which in-turn affects choice and participation in sciences.

Limitations and recommendations

Participants of this study were students sampled from public schools of one district only. Thus, these results might not be reliable if they are generalized beyond students enrolled in a similar school culture and context. For example, different results could be obtained when data are collected from schools in other districts or when private schools are included in the same study.

Recommendations

Results of the present study do invite policy makers' and community's attention regarding a need to strengthen efforts to close gender-gap in sciences. In a nut shell, these results suggest that if self-concept and utility-values regarding sciences are equally enhanced between boys and girls through socialization practices, girls might feel free to choose and invest their efforts with confidence against every difficulty as boys do in sciences. Therefore, psychological intervention practices should be strongly adhered to rescue girls out of the negative perceptions and expectations regarding sciences.

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