Analysis of Some Factors that Influence Causal Attribution of Mathematics Performance among Secondary School Students in Lesotho

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ABSTRACT Student learning is influenced by many factors which educational research is tasked to determine and feed into the teaching-learning process to enhance its effectiveness. Several studies with different populations have determined that that to which a learner attributes his or her performance significantly influences such performance. To determine some of the factors that significantly impact upon students' causal attribution of their performance on mathematics, this study analysed, using chi-square (c^2) statistics, survey research data from 717 Form D (Form 4) students. from 30 randomly selected secondary schools in the Kingdom of Lesotho. The results showed that while gender of students had no significant influence on students attribution of their performance in mathematics, the person with whom the students were living, students' preferred occupation after school, type of proprietor of schools, and preferred classroom seating zone during mathematics lesson, each had significant influence on this variable. Based on these results, appropriate discussions and recommendations were made.

BACKGROUND OF THE STUDY

Introduction

Causal attribution has to do with causes people attribute to observations and events in their lives. Attribution theory (Heider 1944) is concerned not only with causal attribution, but also with factors that influence such attribution, as well as how this causal beliefs influence related behaviour (Nenty 1998; Bar-Tal 2000; Kallenbach and Zaft 2004; Weiner 2004; Nenty and Polaki 2005; Attribution Theory 2009; The Executive Fast Track 2009). In the academic arena, the most important event is the success or failure of the learner to learn. Experience of failure in a task designed to test the level of learning is often followed by a 'naive' reaction of blaming either lack of ability, lack of effort, difficulty of the task, or lack of luck. Success, on the other hand, is often followed by an attribution to possession of ability, exertion of effort, easiness of task, or possession of luck. While ability and effort are seen as personal factors internal to the learner, task difficulty and luck are seen as environmental factors external to the learner. On the other hand, ability and task difficulty are considered stable, while effort and luck are considered as unstable factors (Heider 1958). Associated with attribution to internal factors are positive or desirable achievement-related behaviour and superior performance, while with attribution to external factors are associated negative or undesirable achievement-related behaviour, as well as inferior performance in mathematics.

Following from this analysis, personal factors such as sex, parental background, and environmental factors such as sex-type, location, and management of school can influence the type of causal attribution a learner makes when he or she is faced with success or failure in an academic task. Since such influence ultimately impacts on learning, causal patterns, and hence performance could be enhanced through identifying and manipulating the extent to which these variables influence such pattern.

The Problem and Purpose of the Study

The Education Sector Survey of 1982 indicated a continuing decline in the quality of education at all levels, especially at the secondary level where the rate of pass in Cambridge Overseas School Certificate (COSC) examination declined from 61% in 1970 to 21% in 1981. Up to 1997, this percentage, on the average, hovered around 30, while only an average of about 10% who pass in divisions 1 and 2 are likely to meet the require-

ments for admission into tertiary institutions. "This has resulted in a critical shortage of post-secondary students for scientific and technical training" (p. 8).This problem is a lot more serious when it comes to performance in mathematics, which is a required core subject for such training.

Education lacks valid and utilizable or functional knowledge of some of the factors that significantly influence learning directly or indirectly. Performance attribution is one of such factors as it has been shown by the results of several studies across different populations (Eccles et al. 1986; Nenty 1998; Bar-Tal 2000; Weiner 2004; Nenty and Polaki 2005) to have significant influence on learners' performance. The results of a study on causal attribution of performance by students in Lesotho have shown that generally a majority of them have undesirable attribution pattern in mathematics performance and this has contributed to a poor and deteriorating perfor-mance in the subject (Nenty 1998). Since education is concerned with ensuring desirable changes in learners' behaviour, that is learning, the natural assignment of educational research is to find out factors that impact on learning.

Belief patterns are known to differ from person to person as a result in differences in personal and environmental factors. As much as it is important in education to look at the behaviour that are influenced by such beliefs, it is also important to look at factors that influence such beliefs. In other words, some personal and environmental factors influence causal beliefs which in turn influence related behaviour. Educators would like to know not only the causal attribution of the learner, but also what underlie or influence such causal beliefs. Because in order to mould desirable causal beliefs among learners, factors that influence such beliefs must be known. Therefore the question with which this study is concerned is: what are those factors which underlie learners' causal attributions which could be considered in any attempt to develop a more desirable attribution pattern among learners? Identification of such factors could also inform and empower teachers to ensure the development of desirable attribution patterns among learners.

Hypotheses

The study attempted to contribute a solution to this problem by testing the following research hypotheses:

(i) Causal attribution of performance in mathematics among Lesotho secondary school students depends significantly on: (a) their sex; (b) the person with whom they are living; (c) the occupation they prefer to enter after schooling; (d) the proprietor of their school; (e) the rural/urban location of the school they are attending; and (f) the high/lowland location of the school they are attending.

(ii) Among Lesotho secondary school students, there is a significant relationship bet-ween their causal attribution of mathematics performance, and the seating zone they would prefer to sit during mathematics class.

Review of Literature

While literature is lacking in studies on other factors considered in this study, many studies have found small but consistent gender differences in the attributional patterns of learners for their performance in mathematics. Boys attribute their successes in mathematics more to stable factors, for example task difficulty or ability, in contrast to girls who attributed more to unstable factors like effort, luck, and good teacher (Gregory 1978; Eccles et al. 1986; Nenty 1998; Bar-Tal 2000).

Assouline et al. (2005) explored the differences in top attributional choice between gifted boys and girls for success and failure in general academics, language arts, science, and mathematics. Gifted children were found to attribute failure to effort rather than ability. Significant gender differences were found in boys and girls performance attributional pattern. For 62 fourth-grade and 99 fifth grade pupils, finding by a study by Lloyd et al. (2005) indicated that girls' achievement in mathematics met or exceeded that of boys and girls' attributional patterns were more self-enhancing than those of other studies reviewed for the study. Girls however were found to display under-confidence relative to their actual mathematics achievement and compared to boys were more likely to attribute failure in mathematics to lack of teachers' help.

RESEARCH DESIGN AND METHODOLOGY

A survey inferential design was used in this study. Representative data gathered from a wide population of people were analysed, using appropriate statistical techniques and based on the results of such analyses the sample was

described and the findings were inferred back to the population (Nenty 1998). Three secondary schools were randomly selected from each of the ten districts of the Kingdom of Lesotho. This gave a total of 30 secondary schools from each of which 30 students were also selected through the simple random process. This gave an expected sample size of 900 subjects for the study. In five of these schools, where the number of Form D students was 30 or less, all the students in this Form were involved in the study (Nenty 1998).

Out of these 900 expected subjects, complete information on most of the variables under consideration was only available for 717 students. The sample for the study was therefore made up of 717 Form D 1997 students in 30 secondary schools in Lesotho. This number was made up of 443 females and 274 males students; 455 students from rural and 262 from urban schools; 259 students from highland and 458 students from lowland schools. Of this number, 139, 348, 159, 37, and 34 students attended schools managed by Lesotho Evangelical Church (LEC), Roman Catholic Church (RCC), and Anglican Church of Lesotho (ACL), Government/ Community, and other missions respectively.

The study involved eight categorical independent variables which were mainly demographic, and one categorical dependent variable. A questionnaire was developed through which data on the demographic variables were collected. The dependent variable, causal attribution of performance in mathematics, was measured through four Likert-type items. Each of them required each student to rate his or her level of agreement or disagreement to a statement that reflects the level to which ability, effort, task difficulty, or luck is that which mostly underlie his or her performance in mathematics. The factor to which the student gave the highest mean rating was the causal attribution factor to which he or she was assigned.

All the variables used in this study were categorical in nature. To determine the classroom seating zone which a student would prefer to sit if he or she was free to choose his or her seat during mathematics class, a diagram of a typical classroom seating arrangement with six columns and six rows of seats was presented to each student. He or she was asked to mark the seat he or she would prefer to sit during a mathematics lesson. The questionnaires, with specific directives on how to administer them, were mailed to the principal of each selected school. The principals administered these questionnaires with the help of the mathematics teacher (Nenty 1998). These were returned to the researcher by mail.

To test the two hypotheses, given the categorical nature of the variables, a total of seven chi-square analyses were done (see Table 1). Based on the chi-square results for Hypothesis II, a correlational analysis was done using Pearson's contingency coefficient (see Agresti 1990, pp. 27, 75) to approximate the underlying relationship between causal attribution and seating preference in a mathematics classroom.

DATAANALYSIS RESULTS AND THEIR INTERPRETATIONS

Results of Data Analysis

By sorting the reactions of the students as regards the factor to which they attribute their performance in mathematics, it was found that 151 or 21% , 178 or 25% , 208 or 29% , and 180 or 25% , attributed their performance to ability, effort, task difficulty, and luck respectively. A significant difference ($\chi^2 = 9.07$, df = 3, $p<.05$) in the number of students who attributed their performance to each of the four factors was observed. Significantly less students than expected tended to attributed their performance to ability, while more of them than expected attributed theirs' to task difficulty (Nenty 1998).

The results of chi-square analysis (see Table 1) to test Hypotheses I showed that generally student's causal attribution of their performance in mathematics is significantly dependent on the person with whom the students were living ($\chi^2 = 21.36$, df = 9, $p<.018$); the occupation preferred by the student ($\chi^2 = 30.48$; df = 18, $p<.039$); the proprietor of the school the student attended ($\chi^2 = 35.79$, df = 12, $p<.000$); and on urban/rural location of the school ($\chi^2 = 9.80$, df= 3, $p<.020$). Such significant dependence was not observed for gender of students ($\chi^2 = 5.19$, df = 3, $p<.115$), and for high/lowland location of the school ($\chi^2 = 5.02$, df= 3, $p<.170$). A further analysis of the data on gender revealed an insignificant ($\chi^2 = 3.42$, df = 1, $p < .068$) trend in the relationship between gender and causal attribution. While males generally tended to attribute their performance in mathematics to internal factors, females tended to attribute theirs to external factors.

The result of a similar analysis done to test Hypothesis II found that causal attribution of

Table 1: Chi-Square (c^2) analysis of the dependence of causal attribution on some mathematics-related factors

Factor	*Levels*	*Frequency*				*df*	χ^2	*p<*
		Ability	*Effort*	*T/Diff.*	*Luck*			
Sex	Male	65	72	79	57			
	Female	85	105	129	122	3	5.19	.115
With Whom Student Resides	Both Parents	81	100	128	100			
	Father alone	7	6	5	4			
	Mother Alone	36	33	30	51			
	Relation	24	30	27	12	9	21.36*	.018
Preferred Occupation by the Student	Banking-related	14	14	19	10			
	Engineering-related	15	18	16	9			
	Law	3	1	10	4			
	Medicine	26	32	28	17			
	Nursing	34	38	38	45			
	Teaching	13	22	24	26			
	Soldier/Police	17	13	22	34	18	30.48*	.039
School Proprietor	LEC	27	48	44	20			
	RCC	74	76	98	100			
	ACL	28	30	49	52			
	Govt./Comm.	12	11	11	3			
	Other Missions	10	13	6	5	12	35.79**	.000
Location I of School	Urban	64	67	82	49			
	Rural	87	111	126	131	3	9.80*	.020
Location II of School	Highland	48	62	72	77			
	Lowland	101	116	136	103	3	5.02	.170
Preferred Seating Zone	Front	96	119	137	86			
	Middle	22	21	28	33			
	Sides	14	14	26	22			
	Back	14	19	17	37	9	26.96**	.001

*p < .05 ; **p< .01

mathematics performance had significant (χ^2 =26.96, df=9, p<.001) influence on which classroom seating zone the student prefers to sit during mathematics lesson. A Pearson contingent coefficient analysis between the two categorical variables gave a correlation value of .19 which, with 703 degrees of freedom (df), was found to be significant at beyond .005 alpha level.

Interpretation of the Results

A detailed consideration of the results of the chi-square analysis showed that in the case of the person with whom the student was living while attending school, significantly more students than expected who lived with their mothers alone attributed their performance in mathematics to luck, whereas fewer of them than expected attributed it to task difficulty. Similarly, significantly less number of students than expected who lived with their relatives attributed their performance to luck.

In the case of preferred occupation, among students who preferred engineering-related occupations, significantly less number of students than expected attributed their performance to luck. Also, among those who preferred law, significantly more students than expected attributed their performance to task difficulty. For those who preferred medicine, significantly less number of students than expected attributed their performance to luck, whereas for those who preferred force-related occupation, significantly more students than expected attributed their performance to this factor.

In the case of proprietorship of schools, significantly more students than expected in LEC schools attributed their performance to effort, and significantly less than expected to luck. On the other hand, among students in ACL schools, significantly more students than expected attributed their performance in this subject to luck, unlike students in government community schools where significantly less number of students than expected attributed their performance to this factor. For seating preference, a further consideration of the chi-square results showed that significantly less number of students who attributed their performance in mathematics to luck preferred to sit at the front rows, while a signi-

ficantly more of them than expected preferred to sit at the back rows.

DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS

Studies on gender as a factor in attributional pattern of learners tends to yield inconclusive results. Given the findings in all the studies reviewed, the trend shows a general tendency for males more than females to attribute their performance to internal factors, while females more than males tend to attribute their performance to external factors. In the present study, this tendency has been found to exist in an insignificant level when dealing with performance in mathematics (Gregory 1978; Nenty 1998; Polaki and Nenty 2001); but to a significant level when general performance or performance in English language is considered (Bar-Tal and Frieze 1977; Nenty 1998; Bar-Tal 2000). In other words, type of task tends to constitute a significant covariate in the relationship between gender and attribution pattern of learners.

The relationship between gender and attributional pattern, especially in mathematics performance, is of special importance in education. Beside the significant differential influence it has been shown to have on male and female performance in mathematics and other subjects, it has also been found to have similar influence on academic decision making between these two groups. For example, according to Eccles (1986), these patterns suggest that males and females of approximately equivalent mathematics ability have different perception of the causes of success and failure in mathematics that may lead them to different decisions regarding future prospect for success in mathematics courses (p. 16) and consequently to their choice of mathematics-related careers. In other words, "males and females have different attributional patterns that may influence their academic decisions" (Eccles 1986, p. 16).

Except for environmental, for example cultural influences, there is nothing strongly inherent in being a male or a female that should make a difference in learners' attributional pattern. Culture has a powerful influence on the way people behave, but if such influence encourages discri-minatory undesirable academic-related behaviour among different groups of learners then some-thing purposeful must be done to counter such undesirable influence (Polaki and Nenty 2001). This observation strongly suggests an informed parental involvement in their children education. Through upbringing and specially designed training, females, as well as males, should be taught to make internal rather than external attribution in mathematics performance.

Equity in educational opportunity will continue to elude us if we continue to allow for extraneous cultural influences that lead to undesirable differential academic-related behaviour and decisions among different groups of learners. The person with whom the learner was living while attending school was also found to constitute a significant factor that influence learners' attributional pattern. Students who lived with their mothers alone in a single-parent family setting were found to show a significant tendency to attribute their performance to luck, an external and an unstable factor often associated with failing performance in mathematics. No other parenting arrangements, no matter how 'convenient' it seems to be to us, is superior in ensuring desirable and positive influence on the growing child than the two-parent family. Both father and mother complement each other in creating a relatively more complete and naturally conducive environment for a balanced and maximum growth and development of the child. Any other parenting arrangement, while it might be selfishly convenient to us parents in the short run, is in many imperceptible ways detrimental to the child's psychological, social, and educational growth and development.

Another factor on which students' attribution pattern in mathematics performance was found to depend significantly was the occupation that they preferred to enter after leaving school. While students who preferred engineering and medicine tended to avoid attributing their performance to luck, those who preferred law tended to attribute their performance to task difficulty. But those who preferred force-related occupations tended to attribute their performance in mathematics to luck. Mathematics is not a required subject for law and force-related primary occupations. While this may likely explain the observed attributional trend, it is interesting to note that in a subject that is not required, those who preferred law tended to attribute their performance to an external but stable factor, while those who preferred force-related occupations tended to attribute theirs to an external and an unstable factor. Those for

whom a subject deemed difficult is compulsory tend to avoid attributing their performance on it to an external and an unstable factor which has been found to be associated with poor performance.

The proprietorship of the school students attended was also found to have a significant influence on their attributional pattern. Different religious bodies and organizations knowingly or unknowingly foster certain and different philosophies that underlie the operation of the schools they administer. These tend to contribute to shaping or determining the academic climate of the school. For example, the Puritan philosophy that underlied early American education insisted on persistence and hard work, and this laid the foundation for tremendous achievement by that system of education. A school philosophy obviously goes a long way to influence the type of attribution students make. A school where the principal and staff are sincere in words and actions in portraying hard work and persistence, and de-emphasizing luck and cheating, as being necessary for success, has a high probability of developing and nurturing desirable attributional pattern among students. A dynamic academic atmosphere within which determination and adequate time-on-task are seen as the only way to success is bound to influence desirable attributional pattern among students. To the extent that the several religious bodies and organizations running schools in Lesotho differ in these behaviour, to that extent are students attributional pattern across these schools likely to be different.

Finally, it was found that attributional pattern in mathematics performance significantly relates to the classroom seating zone a student prefers during mathematics lesson. In other words, that to which students attribute their performance in mathematics has a significant influence on where they most likely prefer to sit in class during mathematics lesson. The highly significant relationship found between these two variables supports the general trend that the more undesirable attribution pattern a student exhibits the more likely is he or she to prefer a seat further away from the teacher during mathematics lesson. Students who attribute their performance to luck were found to avoid the front seats, but to prefer the back seats. Attribution to luck is known to be characterized by poor attitude to study, low motivation, and low need-to-achieve (Forsyth and McMillan 1981; Nenty 1998; Bar-Tal 2000; Nenty and Polaki 2005). Following from this result, it is the students with these characteristics that prefer the back row seats as far away from the teacher as possible. To a conscientious mathematics teacher, this is a utilizable knowledge that empowers him or her to enhance the learning of mathematics through the manipulation of the spatial arrangement in the classroom.

Based on these findings, one important recommendation strongly suggests itself. That is the need to develop and maintain a good guidance and counselling programme for all secondary school students in Lesotho. Views about oneself are not immutable and thus can be changed through purposefully designed environmental intervention strategy, for example, a well designed guidance and counselling strategy. The intention of such strategy would be to maximize performance by providing learners with instructions and feedback that would encourage them to make internal or positive attributions (Dweck 1999). For example, according to Steve's Primer of Practical Persuasion and Influence [SPPI] (2004);

"Consider this chain of events.

1. The word asks me, 'Why?'
2. I provide attribution.
3. My future behavior depends on the type of attribution.

Now, if we can control the attributions people make, then we can influence their future behavior, right?" (p.1). According to Bar-tal (2000), tendencies to form causal attribution are learned and depend on situational factors. In practice, attribution can be taught through discussion, role playing, teacher modeling, students modeling, analyses of success, teaching strategy that enhances students control, caveat (see Kallenbach and Zaft 2004) and drama. This study has identified some of such factors in the case of secondary school students in Lesotho. Based on these and other factors that may be identified through similar studies and experiences, the Lesotho Ministry of Education should formulate and implement a related policy on a programme of guidance and counselling in Lesotho secondary schools.

Given the deteriorating performance of Lesotho secondary school students in mathematics, teachers in this subject should, especially for the girls, "focus heavily on effort as the factor critical to success," and if students tend to reject the value of effort it is important to change such perception by "clarifying the meaning of effort and

by seeing to it that effort does actually pay off." (Rao 2007, p. 3). To Rao (2007), effort is most effective only if defined as the persisting devotion of effective academic time to the task. The belief in competence or ability, given a task, may lead to lack of insufficient effort and a wrong feeling that "additional effort is superfluous . . . the ideal attribution for success is. 'I succeeded because I am a competent person to make the required effort and I did put the effort.'" (p. 2). With attribution to effort, failing experience prompts a feeling of persistence until success, so teachers should help students "develop the conviction that they have the ability to succeed and they will succeed if they give it their best shot" (p. 2).

According to Rao (2007) When students fail, they are most likely to persist and eventually succeed if they attribute their failure to a lack of appropriate effort. Therefore, it is extremely important that when students perceive themselves as unsuccessful teachers help them develop the conviction that they have the ability to succeed and they will succeed if they give it their best shot.

It is extremely hazardous to motivational health for students to fail repeatedly after making a serious effort at academic tasks. When this happens, they will either (a) stop believing they are competent, or (b) stop attributing their failure to lack of effort. Both of these outcomes are likely to reduce persistence at the academic tasks. It is important, therefore, to arrange tests and tasks so that students who work hard are able to perceive themselves as successful (p. 2).

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