Students' perceptions towards technology (PATT): A professional development tool for technology teachers.

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Abstract

In the context of the design and implementation of professional development for technology teachers, a PATT instrument was administered to students in an attempt to develop an understanding of their dispositions toward technology, and so inform, through professional development, technology teachers' implementation of technology in Malawi.

The PATT questionnaire was completed by 358 form 3 (year 11) students (191 males and 167 females) from three secondary schools who gave informed consent. The questionnaire was categorised into three parts: the attributes of the students, an attitudinal scale and a concept scale. All data were analysed using SPSS and only descriptive statistics were used during discussions with teachers in each of the schools.

Using the PATT survey results during the professional development program helped the teachers to recognise technology as a very broad learning area as shown by a cross range of concepts covered in the PATT instrument. It also helped the teachers to understand students' views about technology and the need to develop appropriate technology programmes and pedagogy for both boys and girls to reinforce their confidence. The teachers all considered discussing PATT results as insightful since the students' views highlighted the need for developing learning materials, tools and pedagogical approaches that take into consideration the students' own world and knowledge of technology.

Introduction

Over the past two decades, many countries have reformed their school curriculum to establish technology as a recognised learning area with a focus on students developing technological literacy (Jones, 2009). Besides the economic and political influences, such reforms were epitomised by the need to educate citizens to be able to live in an increasingly technological society (de Vries, 2009). Many countries, particularly those categorised as least developed, often maintained their imperial curriculum as a consequence of political, economic and educational pressures in the belief that such a curriculum would help to reduce poverty and youth unemployment (Lauglo & Maclean, 2005). This belief may stem from the times of independence movements when third world countries were consequently influenced by colonial powers and donor agencies not to 'reinvent the wheel' (Williams, 2009: p. 238).

The curriculum in Malawi is no exception to this and largely remained the same after independence. Education policies over the years have supported vocationalisation of the school curriculum but, suffice to say, poverty and youth unemployment continued to escalate - despite

the promises and expectations of such a curriculum. A number of national policy and curriculum reforms were undertaken to advance technological literacy (National Research Council of Malawi, 2002; Nyirenda, 2005) but the reforms largely failed because teachers were not supported. The curriculum has maintained its industrial arts UK origins for five decades and remains colonial and restricted to skills training with little consideration of the Malawian context and prevailing social and economic conditions. The existing curriculum also has little scope for developing student technological knowledge and capabilities so they could understand, create, control and manipulate technology as called for in Malawi's Vision 2020, the Science and Technology policy and the Malawi Growth and Development Programme (Ministry of Economic Planning and Development, 1998; Ministry of Finance, 2006; National Research Council of Malawi, 2002).

To shift from a colonial based technical curriculum to a broad-based technology education incorporating local context requires a concerted effort drawn from across the social divide and teachers are central to such a process. Thus far teaching and learning only concentrated on the development of motor skills, intellectual skills and conceptual understanding but the wider dimensions of what technology encompasses have been neglected. Such experiences and beliefs have shaped the practices of technology teachers in Malawi.

This study engaged with six technology teachers to understand their implicit beliefs and theories surrounding their teaching practices and how these impact on curriculum reforms. As the teachers held limited views about technology and technology education, a professional development program was organised to enhance the teachers' knowledge about the nature of technology and technological pedagogical knowledge and practices. This paper presents findings from a part of the study that used the Pupils Attitude towards Technology (PATT) data, modelled in Malawi, as a professional development tool.

A PATT questionnaire (Bame, Dugger, de Vries, & McBee, 1993; Burns, 1992; Raat, de Klerk Wolters, & de Vries, 1987) was administered to 358 Form Three (Year 11) students from three selected secondary schools: Shire, Kabula and Mudi secondary schools in Malawi. Besides generating Malawi's PATT model for understanding students' dispositions towards technology, the data was also used in discussions during teacher professional development meetings. The purpose of the discussion over the PATT results was to help inform teachers about their students' perceptions towards technology to review how this affects classroom practices and learning in technology. PATT research (Raat et al., 1987; van Rensburg, Ankiewicz, & Myburgh, 1999) had influenced curriculum developments and added to educators' understanding about students' dispositions and how to shape them. Discussion of the PATT results helped the teachers to think about more appropriate programmes that consider students' perceptions towards technology. The PATT data were therefore used as a tool for enhancing technological classroom practices, unlike other research studies where it mostly informed technology education curriculum development and its implications (Raat, de Vries, & Alting, 1985; Volk, Yip, & Lo, 2003).

Literature related to students' perceptions towards technology

Studies on students' perceptions towards technology have been conducted in many countries (e.g. Becker & Maunsaiyat, 2002; Raat et al., 1985). Most studies found that students' interests have a bearing on their learning and their perceptions need to be accounted for when teaching technology. Boser et al. (1998: 6) observed that "…students who have a positive experience in a technology education program will develop a positive attitude toward technology and the pursuit of technological careers, and would therefore be more interested in studying about technology". Lewis (1999) also pointed out that understanding the conceptions that students have about aspects of the subject matter of technology is an important prerequisite for better teaching, and improved learning.

The first PATT studies were conducted under the Physics and Technology Project at the Eindhoven University of Technology in the Netherlands (Raat et al., 1985). Follow-up PATT studies were done in over 20 other countries including Nigeria, Kenya and New Zealand, Hong

Kong and South Africa. Synthesis of findings of the PATT studies conducted across the globe show that students have positive attitudes towards technology and technology education but narrow or limited conceptions of the nature of technology (Bame et al., 1993; Mather, 1995; Raat et al., 1987; Solomonidou & Tassios, 2007). Jones (1997) argued that dispositions and perceptions of technological phenomena and problems are significantly affected by students' conceptual knowledge of technology. However, students' perceptions and dispositions regarding the concepts and nature of technology may not be sustained unless the students become independent thinkers and lifelong learners.

Research design

All form 3 (year 11) students from Kabula, Mudi and Shire secondary schools in Malawi were invited to complete the PATT questionnaire and only those that gave informed consent participated. The questionnaire was completed by 358 (191 males and 167 females) students from the three schools. The questionnaire was categorised into three parts. Part A was about the attributes of the students, Part B was an attitude scale and Part C was a concept scale. All the data were analysed using SPSS and only descriptive statistics were used during discussions with teachers in each of the schools.

Several data analysis techniques have been used with previous PATT studies. In the studies conducted in New Zealand, USA, RSA and Hong Kong, the analyses included principal component and factor analyses, reliability tests (Guttmann and Cronbach alpha tests), and inferential and descriptive statistics (Boser et al., 1998; Burns, 1992; van Rensburg et al., 1999; Volk et al., 2003). A factor analysis was used for both categorisation of the items into subscales and also as a way of confirming applicability of the categories generated in previous PATT studies. Both inferential and descriptive statistics were also used to analyse data generated from the PATT questionnaire.

Table 1 shows students' subject choices and only 9% (30 boys and one girl) were taking technical subjects (technical drawing, metalwork and woodwork) while 21% (74) were doing home economics which was more subscribed by girls than boys.

Subject	Sex		
	Male (n=196)	Female (n=162)	Total (n=358)
Technical Drawing	30	1	31
Metalwork	6	0	6
Woodwork	9	1	10
Home Economics	21	53	74
Science and Technology	18	8	26
Computer Studies	21	7	28
Science	193	159	352
Social Studies	140	74	214
Agriculture	163	121	284
Biology	194	161	355

Table1: Students' subject choices

The data also showed that only 20% have computers at home, 14% want to become engineers and 29% aspire to become medical doctors. Gender seemed to have played a greater influence in the students' subject choices and career aspirations which also skewed their attitudes and conceptualisation of technology.

PATT Modelling for Malawi

Modelling of the PATT instrument to suit Malawi's context involved the computation of reliability indices and factorability of the data that was administered in the sampled schools. After adjusting the items and ascertaining the factorability of the model, a factor analysis was hence attempted on both the attitude and concept scales of the PATT data which produced results comparable to other PATT studies conducted across the globe. The Malawi PATT model generated 55 items on the attitude scale and 28 items on the concept scale which can be applied with confidence to a cross country study in future. Modelling of the PATT questionnaire helped to provide a reliable and valid tool for discussion during the school-based professional development programmes. The modelling of the attitude and concepts scales will be discussed below.

Attitude Scale

The students' attitudes towards technology were measured using a five point Likert scale. Participants were required to circle strongly agree, agree, disagree or strongly disagree with the statement that best expressed their feelings. U was for 'undecided' if they did not fully agree nor disagree. The responses were scored 1 for strongly disagree to 5 for strongly agree and scores for the negative items were reversed.The attitude scale comprised 60 questions but after a reliability analysis was conducted on the data, five items that had the lowest item-total correlation were deleted, to reduce their effect during further analysis of the data. A Cronbach's alpha reliability coefficient was computed (0.859) which was comparable to the internal consistency reliability measures from other countries such as New Zealand (0.84), the Netherlands (0.84), Kenya (0.58) and South Africa (0.66) (Burns, 1992; van Rensburg et al., 1999).

Factor Analysis of attitude scale

A factor analysis is a data management technique for reducing variables to a size that best summarises information and whether the variables tap into the same construct (Coakes, Steed, & Ong, 2009). As too many components were extracted initially, a scree plot was used to extract the six components that explained most of the variance, and a rotation showed that the six components attributed 35.35% of the variance. The attitude components are shown in Table 2.

Factor	Component	Mean		
		Total (n=358)	Female (n=167)	Male (n=191)
1	Career	4.17	4.08	4.25
2	Interest	3.94	3.89	3.98
3	society	4.31	4.23	4.38
4	Gender	3.55	3.66	3.43
5	Science	3.46	3.50	3.41

| 6 | Curriculum | 3.93 | 3.90 | 3.95 |
| | Overall mean | 3.89 | 3.88 | 3.90 |

Table 2: Attitude components.

The student's views towards technology appeared to be moderately positive as shown by a mean of 3.89 (see Table 2) but they had shown an understanding of the relationship between technology and society (mean 4.31). Many also viewed technology as a future career (mean 4.17). A further analysis of variance (ANOVA) showed that gender had no significant influence ($p > 0.05$) on their attitudes towards technology in over 60% of the items.

Concept scale

The last part of the questionnaire was a concept scale comprising 31 questions with the options: agree, don't know and disagree. Cronbach's alpha reliability coefficients for PATT studies conducted in New Zealand, the Netherlands, Poland and Kenya, among other countries, were 0.89, 0.74, 0.71 and 0.61 respectively. This study reported a Cronbach's alpha coefficient of 0.636 which is below that recommended (de Vaus, 1999; Lewis-Beck, Bryman, & Liao, 2004). Only three items had low corrected item-total correlation and these were deleted leaving the model with 28 items for further analysis.

Factor analysis of the concept scale

After a Principal Components Analysis, 11 components with eigenvalues greater than 1 were extracted and these explained 57.36% of the variance. Four components were selected for an orthogonal rotation and these explained 28.11% of the total variance. The components of concept scale are shown in the Table 3 below:

Factor	Description	Mean			
		Total (n=358)	Female (n=167)	Male (n=191)	Mean variation
1	Science and technology	0.81	0.78	0.83	0.05
2	Social effects of technology	0.60	0.58	0.63	0.05
3	Techniques and skills	0.46	0.45	0.47	0.02
4	Hardware	0.31	0.30	0.31	0.01
	Overall mean	0.54	0.53	0.56	0.033

Table 3: Components of concept scale

The students' views as depicted in Table 3 show that they have some understanding of the concepts of technology as they were able to indicate an accurate concept in 54% of the questions. However the students appeared to have a much better understanding of the relationship between science and technology (81%) while they maintained their stance where technology was associated with hardware, computers and machines (31%). A further analysis to determine any influences of the students' views showed no significant differences by gender ($p > 0.05$) as also shown by the negligible mean variations in Table 3.

Overall, the students' attitudes towards technology were moderately positive but their conceptualisation of technology was restricted to viewing it as things and hardware. Although Malawi lags behind technologically and the curriculum emphasises crafts skills, the results are

not different from outcomes of similar studies conducted elsewhere (for example, Burns, 1992; Solomonidou & Tassios, 2007). Following PATT studies and other influences and motives, many countries established technology as a learning area to broaden students' conceptualisation of technology and enhance their creativity and innovative capacities (de Vries, 2009; Parkinson & Hope, 2009). Taking advantage of students' interest for a curriculum that incorporates technology, students would therefore benefit from programmes that enhance their attitudes and also broaden their understanding of technology through teaching and learning that emphasises technological literacy. Malawi should therefore shift from the colonial, prescriptive craft based curriculum to a broad based technology education in order to enhance student technological literacy. With these findings in mind, the teachers' reflections of the PATT results focussed on remedies to develop pedagogies that would help enhance students' attitudes and conceptualisation of technology.

Teachers' reflections of the PATT results

Reflections of the PATT results involved thematic understanding of the questionnaire items and considering the implications of the students' responses on teaching and learning. This was achieved by going through all the questionnaire items against the frequencies of the students' responses. The results of the discussions revealed the teachers' understanding of the breadth of technology; students' limited knowledge about the nature of technology and the need for appropriate pedagogy and actions for learning technology and deconstructing stereotypes among teachers, students and the society in general. The discussions are described below.

The teachers said that the discussion helped them recognise technology as a very broad learning area as shown by the range of concepts covered in the PATT instrument. Discussing the results therefore helped them to further develop their own understanding of technological concepts, processes and learning approaches beyond what they learnt during the professional development workshops. It was suggested that technology should be a focus of the curriculum.

> *Technology is a broad subject... It encompasses many things and in fact I feel technology should be a core subject, from which other subjects can be derived now. So technology should be the centre or focus of learning in schools in Malawi (Didi).*

The discussion also helped the teachers to understand students' views about technology and the need to develop appropriate technology programmes and pedagogy for both boys and girls to reinforce their confidence. This was in light of the disparities in subject choices between boys and girls shown in Table 1 which, besides other influences, were attributed to students' lack of confidence in their own capabilities.

> *…I think we should encourage them by starting with little things, technological little things; that everybody should be able to do regardless of gender or ability… (Didi).*

> *Some students find it difficult to use machines leading to their negative attitude and therefore they need thorough motivation to develop their interest in machine work (Zagwa).*

The teachers suggested that teaching should emphasize coaching and sensitizing the students to the practical relevance of the subject. The teachers' also considered cognitive apprenticeship as an appropriate theoretical base for student learning in technology, and also gain confidence in doing technological activities. Teachers felt that social beliefs and stereotypes affect girls' participation in technical subjects as most of them opted for home economics. PATT data showed that only 74 out of 358 students (21%) were taking home economics while only 31 students (9%) were taking technical subjects. School policy related to student placement in streams was seen as a root cause of the imbalance.

The teachers recognised while there will be need to review policy, that the establishment of technology clubs could help to support students' interests in technology programmes and careers. Technology clubs were seen to help develop messages and programmes to potentially deconstruct beliefs that associate gender with skills, knowledge or careers and help society to

appreciate that both boys and girls can become car mechanics or operate a computer or undertake any technological job.

The teachers said that the PATT results provided insights into their students' interests in technology that they could nurture and broaden.

> … the students are really interested in technology. They feel that it's part of them and that they cannot do without it (Buli).

> I also think that the students appreciate the importance of technology. They know the need for technology but it looks they just don't understand clearly what technology is all about as they only associate it with computers and machines and that's what causes some negativity (Chiipira).

Teacher discussions using PATT data were helpful to better understand students' views and to consider the development of learning materials, tools and pedagogical approaches that take into consideration the students' own world and knowledge of technology.

> … it will help us to approach the subject at a different angle. We have learnt how the students feel about our subjects. Some actually feel that we give them an impossible, boring subject which they thought it was just supposed to be done as a club but we force them to do it as an examinable subject. Yea, it's food for thought, as we have seen how to approach technology to enable change in students' perceptions and practices (Zagwa).

> … the discussion has been fruitful in that students are interested in technology and when we see them running away from technical subjects, perhaps we should check our approaches towards teaching the subject. Probably we are the ones scaring them. But otherwise, the students are interested to study technology (Buli).

The teachers also suggested the need for an integrated and flexible approach to the teaching of technology beyond the current curriculum restrictions. The teachers recognised that change in technology education classrooms in Malawi will require a broader approach to technology that could be effected by teachers working together with education policy makers, other technology professionals and other subject teachers.

Conclusions

The PATT data provided teachers with an opportunity to reflect on their own knowledge of the nature of technology and technology education by finding out about their students' beliefs and understandings. The teachers recognised that the PATT instrument content presents rich aspects of technology helpful for understanding and developing appropriate teaching and learning activities. The discussion of the PATT data helped teachers share ideas about how to motivate students' towards learning technology, addressing the gender divide, and designing activities that help to develop the concepts of technology by drawing on the students' own world views and experiences. It may therefore be concluded that the PATT instrument was an effective tool in the professional development as it helped teachers expand their knowledge of technology and technology education and develop an understanding of students' existing concepts of technology.

The findings suggest that the PATT data not only has implications for teachers' own learning but also provides them with a better understanding about their learners. Incorporating it in both in-service and pre-service teacher training programmes could promote teachers' development of technological knowledge, students' conceptions about technology and how to support students learning in technology. Preparing teachers to be able to design and analyse school level PATT studies would help provide basic data for teachers developing a deeper insight for teaching and learning that addresses students' needs and expectations. Therefore, innovations for scaling up the PATT model including establishing a PATT data bank covering a number of learner cohorts would help inform teaching and learning and teacher professional development.

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