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COGNITIVE STYLE AS A FACTOR IN THE DESIGN OF TEACHERS' PROFESSIONAL TRAINING

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Abstract: This paper charts the learning styles and hemispheric modes of teacher trainees enrolled in the National Institute of Education's pre-service courses for the training of primary schools mathematics teachers. The instruments used were the Learning Style Inventory and the Hemispheric Mode Indicator. The types of adults attracted to the teaching profession may have distinctive learning styles. The study shows that trainees from the mathematics pedagogy courses are distinguished by very strong abstract conceptualisation skills and weak concrete experience skills. In spite of the short duration of the training programme and the need to equip trainees with basic skills and knowledge, the training provided must also respond to pragmatic demands for relevance and the application of knowledge while encouraging the reflective examination of experience necessary to create the reflective teacher. The understanding of trainees' learning styles helps in the design of course activities to facilitate learning and effective transfer of training. It can provide a framework for learning during on-the-job training. The use of the teaching practicum becomes a focus for trainees to test and explore new ideas. Learning goes beyond the tutorial room to become an integral and explicit part of work itself when the trainees graduate into full fledged teachers.

Introduction

In the Third International Mathematics and Science Study (TIMSS), involving 45 countries, Singapore shared the top spot with Korea in mathematics and was seventh in science for nine-year-old students (MOE, 1997). The Singapore education's strength lies in its broad-based content emphasis.

Education in a Global Information Age

The world sits on the brink of a new millennium. Information, technology and creativity power the twenty-first century. Technological advances and rapid changes in the environment have made the world borderless. This scenario will impact how the Ministry of Education (MOE) moulds 'future of our nation'. In response to and in anticipation of global trends and developments, proactive means and education improvements were spelt out in, Thinking Schools and Learning Nation (TSLN), a vision painted by the Prime Minister, Mr. Goh Chok Tong at the 1997 Thinking Conference (Goh, 1997). If Singapore hopes to globalize her young people to possess the zeal for risk taking and be endowed with an entrepreneurial spirit, the education system must move beyond equipping students in school with knowledge and skills to instilling a sense of inquisitiveness and creativity, the confidence to solve unseen problems and to be global in outlook (Tan, 1995).

The three R's of yesteryear of Reading, wRiting and aRithmetic cannot continue to have central place in the classroom. It will evolve to a more Information Technology (IT)-based learning and teaching environment. Computer literacy will be a compulsory component of the new school syllabus, taking up 30% of curriculum time. The future worker is one with the necessary skills and knowledge to acquire and manage information in a knowledge-based economy. Skills in co-operation, empathy, tolerance and social sensitivity are critical life skills for a culturally-diverse environment (Lee, 2000). The knowledge worker strives on the synergy generated through working with other experts to stay in the forefront of new knowledge and innovations.

Traditional teaching and learning methods will be replaced by instructional strategies that are more process- and learner-oriented. Students are viewed not as consumers but as producers of knowledge. Teacher-centred delivery will diminish as students take centre-stage in the learning process. Open-ended tasks, group project work and the use of computer as an information and communication tool will become more common place. Innovative ideas of teaching and virtual classrooms, partnerships between the business communities and schools are on the rise. Children are taught to pose questions instead of just supplying answers to teacher-made questions. The world is their learning hub. Real problems will increasingly replace textbook exercises.

Education Reforms & Change

Education Minister, Rear-Admiral (NS) Teo Chee Hean outlined three areas for future direction in schools. They include efforts to enhance quality and creative thinking, the teaching of information technology skills (Straits Times, 27 Feb 1997) and imbuing the young with a sense for the country's history and natural constraints (Straits Times, 20 Jan 1997). Three education initiatives were rolled out - National Education, Information Technology and Critical and Creative Thinking (Han, 1999). These directives impacted the schools directly through curriculum reviews, school performance ranking and massive teacher training programmes.

Education is only as good as its teachers. The mindset of its 24 000 teachers and school leaders will require a shift towards a new paradigm to value critical and creative thinking and learning-to-learn skills. Schools will have to be restructured to encourage fast response to the changes and needs of the society. School reforms can only be sustained when the teachers have the capacity and the conviction to carry them through into their classrooms.

Pre-Service Teacher Training

The National Institute of Education (NIE), the only teacher training agency in Singapore has its humble beginning as the Teachers' Training College (TTC) in the 1950's (Yip & Sim, 1990) became part of the newly established Nanyang Technological University in July 1991. It offers pre-and, in service courses in addition to undergraduate and postgraduate programmes.

A number of foundation courses are offered as pre-service training for teacher certification, namely the Diploma-in-Education (Dip-Ed), Postgraduate Diploma-in-Education (PGDE) and bachelor degree (BSc/BA) programmes. These are to equip

participants with an understanding of key concepts and principles of teaching and learning, equipping them with skills and competencies to teach in a variety of classroom situations in a professional and committed manner. The training curriculum contains an interplay of theory and practice to prepare well-informed, competent and reflective teachers. The Dip-Ed programme has the largest student intake. This course is offered to both 'A' level holders and polytechnic graduates wishing to teach in a primary school. The programme extends over a period of two academic years.

A constant concern in teacher education has been in training effectiveness. However, teacher educators have fallen into a vicious cycle of seeking the ideal best instructional materials, strategies, and curriculum and classroom management. In selection and recruitment exercises, concerns are over seeking the best candidate. In teacher assessment, competencies are the focus. Research has been inconclusive because whatever methods that are used to train teachers, there will be some who turn out to be very effective while others could not even master elementary survival skills for the classroom. The usual diagnosis is that some people are not cut to be teachers or that they have not got the motivation and drive to apply themselves seriously.

Researchers may need to relook trainees as learners themselves. Most of the research efforts in education have been directed onto the young learners in the schools. Much emphasis has given to how children learn. Little has been given to the fact that adults learn differently too and need to be catered to as well when planning training and development programmes. The underlying principles behind androgogy as opposed to pedagogy are that adults learn best in a non-authoritarian environment where they have opportunities to bring their own experiences to the learning experience, exchange among participants meaningful linkages to real problems (Broad & Newstorm, 1992).

In order that teachers can manage an environment that is plagued by constant change, the teachers must take on a lifelong learning attitude. Pre-service training can be deemed effective when there is a change in the behaviours and attitudes of trainees (Blanchard & Thacker, 1999) after training.

Management of the Unlearning Process

The profile of the trainees is diverse. Some are fresh 'A' level holders from schools. Others are polytechnic graduates who have been working for some years in the private sector. Still there are some who are mid career movers. The trainees have to be convinced of the benefits and relevance of the course content for effective learning to take place. These trainee are a product of years of experiences and habits. Such acquired practices may interfere with the new learning and its application to the teaching job. Before NIE can even hope to start the training process, there is a lot of unlearning to do. Activities and other assignments have to be provided to help trainees unlearn old behaviour in order to develop new ones.

Provision of realistic work related tasks

Theoretical framework and principles learning are useful in giving trainees broad guidelines in how they can apply their knowledge and skills in non-routine situations. However, more often than not, trainees have difficulties identifying the relevant

principles to apply when analyzing work problems. Transfer will be more effective if trainees can practice on identical elements that can be found in the workplace (Blanchard & Thacker, 1999).

Practice pieces and assessment work given in the form of work related tasks would help trainees learn the necessary skills and knowledge. The higher degree of reality built into the training would help the trainees see similarities between what is learned in NIE and applying their training in their classroom teaching. Micro-teaching provides a simulated setting to allow trainees participate in a scaled down teaching which is recorded and played back to them. Trainees are given direct feedback on their individualized performance. The visual impact of the feedback will help them to learn, adapt and response to a more vivid set of expectations as classroom teachers.

Trainees' Active participation

Trainees should involve themselves actively during training by raising questions and contributing towards discussion. The many group activities would give valuable opportunities to learn from fellow trainees. They should also be quick to volunteer to do demonstration. Any mistakes or slip-ups during training will help them to prevent similar mistakes taking place at the workplace which is a less tolerable partner. Training is also a time for trainees to explore their weaknesses and learn about their strengths.

Active classroom participation and team learning are part of continuous assessment during training. In addition to pencil-and paper examinations, course assessment are also based on the level of tutorial contributions, group project work and oral presentation.

Learning Styles

People see and make sense of the world in different ways. Psychologists have conceptualised individual differences into various models to explain the different approaches people take to gather and process information for problem solving and decision making. Cognitive styles have a strong influence on an individual's personality, behaviour, perception and mental processes.

David Kolb (1981) further built upon a classical learning style framework based on the experiential learning cycle first put forth by Kurt Lewin. He proposed that learning takes place through a cyclical process, beginning with concrete experience and moving in steps through reflective observation, abstract conceptualisation and culminating in active experimentation by the learners. Kolb maintained that learning occurs when the learner is in a dialectical tension between the two sets of extremities in the two dimensions: concrete to abstract and active to reflective. As learners attempt to resolve these conflicting tensions, they lean towards certain learning styles: divergers, assimilators, convergers and accomodators.

Bernice McCarthy (Guild & Garger, 1985) integrated Kolb's work with other learning style researchers to classify four types of learners, namely, the Type One, Two, Three and Four Learners respectively. Type One learners seek personal meaning in their learning while Type Two learners are more concern with the facts and knowledge. Type Three learners ask the question "How does it work?" and the Type Four learners seek possibilities in their learning. However, she believes that all learners go through

a natural learning process that should start from personal meaning followed by the acquisition of knowledge and skills. After which the learner must apply the new concepts and finally using it in new situations. The 4-MAT system developed by McCarthy ensures that each learning style has opportunity to its strength and experience success and at the same becoming better learners by learning in the other styles. The 4-MAT system honours diversities and moves away from the traditional schools of teacher-centred instructional environment.

Another area that Bernice considered as an important component in learning and teaching is hemisphericity. Left brain processes favoured logic and rational sequence while right brain processes give room for wholistic understanding and intuition. Within each learning quadrant she superimposes both right and left brain processes activities. The 4-MAT system is a pragmatic framework for the designing and developing of lesson plans which cater to all learning types. Creating learning experiences using the 4-MAT system brings more depth and conviction to the training arena, hence effecting positive transfer of training. The use of the 4-MAT cycle provides a systemic approach in managing the unlearning and learning processes of trainee teachers.

Purpose

The purpose of this paper is to chart the learning styles and hemispheric modes of trainee teachers in the mathematics pedagogy courses at the National Institute of Education, in particular, students from the Diploma-in-Education (General) and the Postgraduate Diploma-in-Education (Primary) programmes. The study also examines the level of training effectiveness in influencing trainees' decisions to plan lessons using a more learner-oriented approach. It has implications on how the course programmes should be packaged in the use of lectures, seminars, small group discussions, role-play, case studies and student seminars when preparing trainees to become full-fledged teachers.

Methodology

Subjects

The subjects were teacher trainees from the National Institute of Education. A total of 182 trainees took part in the study. They are participants in the module entitled Teaching Primary Mathematics, a methodology and pedagogy course. Of the entire sample, 166 students came from the Diploma-in-Education (General) programme. Their highest academic qualifications are either a polytechnic diploma or a certificate at GCE 'A' level. The remaining 16 subjects were taken from the Postgraduate Diploma-in-Education programme. They form part of a supplementary intake admitted in January 2000. They represent a group of less traditional applicants attracted to the teaching professional. They come from a range of academic disciplines ranging from nursing to management. Some are even mid-career movers, who have worked in various professions such as in law, engineering, insurance and even dentistry.

Instruments

The instruments used were David Kolb's Learning Style Inventory (1976) and the Hemispheric Mode Indicator. A questionnaire was used to gather trainees' feedback on their perceived effectiveness of the training. A second questionnaire collects data

on the decisions of the trainees to adopt a more learner-oriented approach in lesson planning.

Procedure

The course programme began with trainees reflecting on their own experiences as learners. The Learning Style Inventory and the Hemispheric Mode Indicator were administered to determine their learning styles and preferred hemispheric brain processes. The 4-MAT cycle developed by Bernie McCarthy was used as a framework to design and develop tutorial lessons for the training of these teachers.

Case studies, projects, small group discussion, student discourse and feedback, take-home assignment, oral presentations and direct teaching are structured into the tutorial programme based on the learning cycle of the 4-MAT system. In teaching trainees how to write lesson plans for the topic Fractions, they were taken through the four different learning experiences of knowing why Fractions are taught, the concept of Fractions Addition and Subtraction, the working out of Fraction sums in traditional worksheet and through a bingo game and finally to culminate in a project whereby students were required to write their own games involving the use of fractions. Groups exchange their products among one another. Feedback on the usefulness in helping to increase learning motivation and mastery learning were given to the writers of the respective games. The games were then submitted as part of a project assignment. The trainees went through various cycles of learning how to teach other topics in mathematics.

Results

Table 1 shows the learning styles distribution of the trainees from the two pre-service programmes. 35% trainees were type 2 learners. 18% of trainees were Type 1 and 4 learners, respectively. Only 29% of the trainees were Type 3 learners. A high proportion of 56% PGDE trainees were Type 2 learners compared to the Diploma-in-Education's of 31%.

Table 2 displays the hemispheric modes among the trainees from the two programme. More trainees (40%) favoured left-brained processes compared to 26% favouring right-brained processes. 34% are whole-brained when processing information.

Table 1
Learning Styles

Learning Style	PGDE		Diploma-in-Education		Total	
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
Type 1	2	12.5	19	19	21	18.1
Type 2	9	56.3	31	31	40	34.5
Type 3	4	25.0	30	30	34	29.3
Type 4	1	6.3	20	20	21	18.1
Total	16	100	100	100	116	100

Table 2
Hemispheric Processes

Brain Processing	PGDE	Diploma-in-Education	Total
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	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
Left Brain	6	37.5	44	40.0	50	39.7
Right Brain	4	25.0	29	26.4	33	26.2
Whole Brain	6	37.5	37	33.6	43	34.1
Total	16	100	110	100	126	100

93% of the trainees had learned mathematics as a student under a teacher-directed environment. At the beginning of the course, 81% of the PGDE (see Table 3) said that they would use a teacher-directed style when teaching mathematics. At the end of the course, only 6% still maintained that they would use a teacher-oriented approach in teaching mathematics.

Table 3
Teacher- vs Learner-centred Teaching and Learning

<i>Focus</i>	Learnt Maths as a Student		Plan to Teach Maths (Before course)		Plan to Teach Maths (After course)		
	<i>Teacher-directed</i>	<i>Learner-oriented</i>	<i>Teacher-directed</i>	<i>Learner-oriented</i>	<i>Teacher-directed</i>	<i>Learner-oriented</i>	<i>Both</i>
PGDE	16 (100%)	0 (0%)	13 (81.3%)	3 (18.7%)	1 (6.3%)	13 (81.3%)	2 (12.%)
Diploma -in-Ed	69 (87.3%)	7 (8.9%)	57 (72.2%)	21 (26.6%)	3 (3.8%)	73 (92.4%)	1 (1.3%)
Total	85 (92.4%)	7 (7.6%)	70 (74.5%)	24 (25.5)	4 (4.3%)	86 (92.5%)	3 (3.2%)

Among the Dip-Ed trainees, 72.2% indicated that they would use a teacher-directed approach in teaching mathematics in school. At the end of the course, only 3.8% maintained to use a teacher-centred approach in their lesson planning. 92.4% indicated they will be more learner-oriented in their teaching methods. There is a mild correlation of 0.35 between how a trainee had learnt mathematics as a child and his tendency to plan his instructional strategy and lessons in a similar way.

Post-training

Using a post-training questionnaire modified from the Pacific Gas and Electric Company report (MHR5003, 2000), a preliminary survey was conducted on the 166 students. Some summary statistics from the data can be found in Table 4. Based on their school practise experience, trainees reported that 41% of the total work time at school was spent performing tasks requiring skills and knowledge taught in the mentioned courses. The trainees noted that before the start of the course they rate their performance at these tasks at 44% competency level. On completing the course, the students were confident that their competency level at these tasks increased to 75%.

Table 4
Training Effectiveness & Transfer of Training

	Mean	SD
What % of your total work time at school would you spend performing tasks requiring the skills and knowledge taught in this course?	41.3%	11.9

Rate your performance during school practice/experience before completing this course on tasks requiring the skills and knowledge taught in this course.	44.5%	18.2
How well would you be able to perform in future at school the tasks that require the skills and knowledge that were taught in this course?	75.4%	66.0

Discussion

The trainees in the study being taken from the mathematics pedagogy courses may have produced the distinctive learning styles. The study shows that trainees are distinguished by very strong abstract conceptualisation skills and weak concrete experience skills. The way trainees learn have a bearing on the teaching style they may favour using in their lesson planning. The high proportion of Type 2 learners found among the PGDE trainees indicates that they generally enjoy lectures and may respond less to learning through role play, group work and discussion.

With the recent ability driven education policy which emphasises the teaching of critical and creative thinking skills and independent learning, teachers must change their focus as knowledge dispensers to facilitators of knowledge and learning. Trainees must acquire skills to monitor and guide independent learning in project work and other open-ended tasks. The training at NIE must respond to pragmatic demands for relevance and the application of knowledge while encouraging the reflective examination of experience that is necessary to create the reflective teacher.

An increased awareness of their own learning styles and hemispheric processes facilitates understanding and acceptance among the trainees of the importance of using a variety of instructional strategies, both teacher-directed and learner-centred when planning and conducting of classroom lessons.. The trainees went through various cycles of learning how to teach the various topics in mathematics. Trainees who originated thought they would tend to plan lessons that are more teacher-directed changed their minds. At the end of the 14-week programme, most of them decided they would use learner-oriented teaching in their mathematics classroom. The trainees found the experiential learning provided by the tutorial activities designed based on the 4-MAT system was useful in helping them understand and accept the relevance of the use of a variety of instructional methods in the classroom.

Limitations

This study is limited in its generalisability in that no control group was used to compare the effectiveness of using the 4-MAT cycle in the designing, planning and implementation of tutorials. An experimental design would be a more rigorous method to tracking trainee teachers' change in attitude towards teacher-directed and learner-oriented teaching methods as a result of the use of the 4-MAT cycle in programme development. However, the study shows that there are 34% of the trainees who are Type 2 learners, suggesting that the use of lectures and seminars should be complemented by other instructional strategies so as to meet the learning needs of other learning types. There are more PGDE than Diploma students who are Type 2 learners. There is a need to persuade trainee teachers of the importance of

varying teaching strategies rather than having the tendency to teach in the style they are most comfortable.

In addition, the participants in the study is not representative of the student population at the NIE. A comparison of learning styles of trainees from other programmes would be more encompassing in charting the learning styles of the trainees and the possible influence of their academic background on their preferred way of learning and teaching.

This study hopes to serve as a pilot investigation to explore the feasibility and viability of using the 4-MAT cycle to learn more about teacher education development. The levels of transfer of training were used as a proxy to measure effectiveness of the use of the 4-MAT cycle in designing and planning of learning experiences. The study hopes to follow-up by forming control groups to test the effectiveness of using the 4-MAT cycle in training teachers about the importance of teaching in a variety of methods by using mainly lectures methods on a selected sample of trainee teachers. Having a control group will provide the needed data to surface possible aspects of the training programme for more in-depth study and comparative evaluation of training. Such information will provide the needed scope for review and modification to the existing programme.

Summary

The understanding of trainees' learning styles is a consideration in the design of course activities to facilitate learning and to ensure an effective transfer of training. It can provide a framework for learning during on-the-job training. Day-to-day experience during the students' teaching practicum becomes a focus for testing and exploring new ideas. Learning is no longer a special activity reserved for the tutorial room. It becomes an integral and explicit part of work itself when the trainees graduate into full fledge teachers.

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