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Meeting the social and emotional needs of first-year mathematics students through peer-tutoring

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Academic under-performance among first-year university students calls for effective support systems. In this regard, a peer tutor-mentor programme was introduced at a private university in South Africa to improve the academic outcomes of vulnerable first-year mathematics students enrolled in an academic development programme. This article examines the influence of peer tutor-mentoring through a qualitative inquiry framed by a bricolage of learning theories. Data gathered from a comprehensive sample of students, tutor-mentors and lecturers indicate that the programme assists students' social adjustment in a multicultural setting; that cultural diversity among tutor-mentors is both a barrier and a resource, and that positive campus perceptions of the programme are essential to its continuation, thus forging a new community of mathematics practitioners.

Ontmoet die sosiale en emosionele behoeftes van eerstejaar wiskundestudente deur middel van portuur-tutor programme

Akademiese onderprestasie van eerstejaar-universiteitstudente vra vir doeltreffende ondersteuningstelsels. In hierdie opsig is 'n portuur-tutor-mentorprogram by 'n privaat universiteit in Suid-Afrika bekendgestel om die akademiese uitkomste van kwesbare eerstejaarstudente in wiskunde wat vir 'n akademiese ontwikkelingsprogram ingeskryf is, te verbeter. Hierdie artikel bestudeer die invloed van tutors se leiding deur 'n kwalitatiewe navraag wat deur 'n *bricolage* van leerteorieë omring is. Data uit 'n omvattende steekproef van studente, tutor-mentors en dosente versamel dui daarop dat die programme studente help met hul sosiale aanpassing in 'n multikulturele omgewing; dat kulturele diversiteit tussen tutormentors beide 'n hindernis en 'n hulpbron is; en dat positiewe kampuspersepsies van die program noodsaaklik is vir die volhouding daarvan. Dit vorm dus 'n nuwe gemeenskap van wiskundepraktisyns.

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Many first-year university students worldwide are inadequately prepared for the academic and social demands of higher education.[1] The situation is exacerbated in the case of students from a low socio-economic background, who have had poor quality schooling, have not acquired the requisite social and academic skills for coping with higher education (Jones *et al* 2008), and study in a medium of instruction other than their home language (Ovando & McClaren 2000). A particularly vulnerable group of students are those enrolled for programmes requiring mathematics. Poor mathematical knowledge and skills are a major cause of attrition and failure among first-year students, thus preventing access to certain professions, such as engineering. Higher education institutions which report success with vulnerable students, in particular in high-risk subjects such as science and mathematics, advocate support programmes that promote a holistic adjustment to the academic environment by providing social, psycho-emotional and academic help (Alred *et al* 2003, Austin *et al* 2003, Chang 1999). In this regard, tutoring and mentoring interventions that offer support in all areas of university life are desirable (Lucas *et al* 2006). Several studies attest to the efficacy of tutoring and/or mentoring programmes but tend to keep the practices of tutoring and mentoring separate.[2] Tutoring emphasises the academic aspect whereas mentoring stresses the psychosocial aspect of support. Additional benefits emerge when the two functions are combined. Tutor-mentors can provide academic assistance in a particular discipline as well as social, emotional and cultural support, guidance, counsel and advice to students. Thus, the tutor-mentor acts as a teaching assistant while providing sociocultural and emotional support to individual students or to small groups to facilitate student achievement. In addition, a tutor-mentor programme that uses peers as tutor-mentors has additional benefits as students are often reluctant to make use of strictly academic support strategies, and prefer seeking help from peers (Goodlad 1998). A number of South African institutions

1 *Cf* Crosling & Webb 2002, Lucas *et al* 2006, McMillan 2005, Pokorny & Pokorny 2005, Scott *et al* 2007.

2 *Cf* Goodlad 1998, Loots 2009, Page *et al* 2005, Fagenson 2006.

such as Stellenbosch University (Page *et al* 2005), the University of the Western Cape (*s a*), and the University of the Witwatersrand (*s a*) have introduced tutoring and/or mentoring programmes with a measure of success.

This article aims to extend the literature by reporting on the findings of a qualitative inquiry into a peer tutor-mentoring programme at a private university in South Africa which formed part of a doctoral study (Maitland 2009). The purpose of the programme is to improve mathematics outcomes among students enrolled in an academic development programme, the Foundation Programme (FP), with a view to meeting admission requirements for a degree in Information Technology. The tutor-mentor programme offers support for FP mathematics students without charge, and participation is voluntary. Peer tutor-mentors are drawn from former FP students who have successfully enrolled for the Information Technology degree; all undergo specialised training and are paid for their services. Their obligations entail assistance in small groups to FP students for one hour twice a week during mathematics tutorial classes presented by a lecturer who also acts as coach and advisor to tutor-mentors. Tutor-mentors are free to provide additional assistance, one on one or in groups, to mentees at their own discretion and convenience (Monash South Africa 2008).

1. Theoretical framework

A multi-theoretical approach was considered appropriate to provide theoretical justification for the design of the FP tutor-mentor mathematics programme (Maitland 2008), and as the conceptual framework for this qualitative inquiry. Hence aspects relevant to education and to mathematics education, in particular, from a multiplicity of theoretical perspectives were incorporated. Gravemeijer (Cobb 2007: 29) calls this a *bricolage* of theories. The article emphasises theories that recognise the holistic nature of cognitive, social and emotional development in relation to developing a personal and group identity within a sociocultural milieu. The discussion follows Moll's (2002) argument that constructivism is a broad term that covers both cognitive and social

learning theories. Teaching and learning is a social phenomenon situated in a social milieu (Cole & Wertsch 1996, Vygotsky 1978, Wenger 1998), and it is both an individual and a social event that occurs naturally within a community.[3] In the light of this, the FP tutor-mentoring programme was considered a particular teaching and learning practice with both cognitive and sociocultural perspectives that provides different theoretical settings. Each perspective allowed for a different approach to the practice of tutor-mentoring within a teaching and learning paradigm (Greeno 1997, Greeno *et al* 1996). This resulted in a more robust theoretical framework than if only one approach was used (Adler 1998, Cobb 2007, Schoenveld 1999). In addition, a multitheoretical approach allowed focus "on the manner in which different theoretical perspectives [...] contribute[d] to the collective enterprise of developing, testing and revising the design for supporting learning" (Cobb 2007: 9). This was important for the development of a dynamic tutor-mentoring programme.

The inclusion of *Gestalt* theory was relevant since it describes the way in which human beings perceive the world as a meaningful whole rather than as isolated stimuli (Passer & Smith 2008). It also recognises that whatever occurs to an individual shapes and influences all aspects of that person's life (Cohen *et al* 2000). In addition, holism – a philosophy rather than a theory – ties in with the *Gestalt* idea in that it emphasises the person as a whole or complete being "acting in the world" and "the world acting on (influencing) the person" (Lave & Wenger 1991: 49). From a holistic point of view, Hacking (Moll 2002: 23) adds that an understanding of how things are socially constructed should incorporate the "non-social domain of forces". This links to Paivo's (1986: 53) dual coding theory which posits that human cognition has become specialised for dealing simultaneously with language and non-verbal objects and events, showing the holism of the human mind as it processes verbal and non-verbal functions simultaneously in a teaching and learning situation. Recent groundbreaking research in neuroscience endorses Paivo's

3 *Cf* Goodlad 1998, Lave 1988 & 1996, Lave & Wenger 1991, Wenger 1998.

view as it illustrates that mathematics comprehension is partly independent of language in the cognitive system (Brannon 2005, Varley *et al* 2005). Thus, the concept of holistic learning and the interconnectedness of the individual's mind, body, emotions and spirit support the perception of human beings learning in a social setting (Leonard 2002). Further to Lave's (1996: 149) argument that "[l]earning is a highly social, interactive activity that involves a great deal of collaboration and mentoring", Wenger (1998: 3) proposes that learning, as an essentially social phenomenon, should be viewed as situated "in the context of [a person's] lived experience of participation in the world" and that people become what they are because they are actively involved as a community of individuals in specific social practices.

Integrating constructivist and sociocultural learning theories, as referred to by Moll (2001) earlier in this discussion, combines two main metaphors applied to learning, namely acquisition and participation (Sfard 1998). By integrating the participation perspective into constructivism, learning is firmly fixed as "a dimension of social practice" (Lave & Wenger 1991: 47) and as phenomena, situations and events, including classroom instruction, are interpreted through the perspective of the individual's existing knowledge (Smith *et al* 1993), and cognitive self-reliance is developed in the individual learner. It stands to reason that, since learning is viewed as "an integral part of generative social practice in the lived-in world" (Lave & Wenger 1991: 33), it must be placed "in the context of our lived experience of participation in the world" (Wenger 1998: 3). This concept of "legitimate peripheral participation" (LPP) (Lave & Wenger 1991: 29) describes how by engaging (participating) in the social practices of the community – whatever that community may be at any particular time – individuals are able to contribute to the practices of that community (Wenger 1998) which simultaneously benefits through the refining of its practices and the addition of members. In relation to the FP mathematics tutor-mentor programme discussed in this article, an underlying assumption is that not only individual participants but also the

university's mathematics community could benefit through active participation in the programme.

The above theories are to a large extent based on Vygotsky's (1978: 90) supposition that cognitive skills and learning activities are practised in social institutions embedded in a certain culture. Accordingly, patterns of thinking are not primarily determined by natural instinct but are influenced by social interaction and the example of community members (Bandura 1989). It is important, therefore, to employ teaching and learning strategies in a mathematics tutor-mentor programme that acknowledge sociocultural factors (Falchikov 2001: 85-9). Principles of Vygotsky's theory recognise that full cognitive development requires social interaction (Falchikov 2001: 88) and in order to do this, students need to be able to adapt to a learning situation within a cultural milieu without losing their own cultural identity in the process. Bruner's (1990: 105) assertion that human actions need to be situated within a cultural domain supports Bordieu's philosophy of *habitus* (Kozulin 2003) as a social space within which people construct realities as social realities as they negotiate and share ideas with others in a "shared problem space" (Kozulin 2003: 246). Bruner (1990: 106) claims that learning takes place in "communities of learning and thinking", and that learners participate in a kind of cultural geography that sustains and shapes what they do "and without which there would [...] be no learning" (Bruner 1990: 106). His idea is based on principles that advocate learning through vigorous involvement in activities and problem-solving, either singularly or as part of a group, and agrees with Bordieu's principle of *habitus* and Wertheimer's (Leonard 2002: 79) concept of the *gestalt*. This discussion highlights the role of language. While taking cognisance of recent research on language and mathematics reasoning mentioned earlier, language remains the primary tool whereby human beings construct their reality in a social environment.[4] This is considered most pertinent to mathematics learning in a multicultural situation; support given by tutor-mentors who can communicate with tutor-mentees

4 *Cf* Cole & Wertsch 1996, Falchikov 2001, Leonard 2002, Vygotsky 1978.

in the vernacular of the latter would enable them to make sense of information and so construct meaning.

It is important to note the caution expressed by Anderson *et al* (1997: 5) regarding Lave's (1996), Lave & Wenger's (1991) and Greeno *et al*'s (1997: 10) claims concerning situated learning. Anderson *et al* (1997) argue that much of what has been empirically demonstrated by the cognitive science community has been ignored by situated learning researchers. Notwithstanding this critique, learning cannot and does not take place in isolation but is a socially constituted (situated) phenomenon that incorporates all aspects of a person's being. Since learning is a complex phenomenon, one theory cannot cover every argument and the use of a *bricolage* of theories (Cobb 2007: 29) is justifiable. Therefore, developing both the situated and cognitive perspectives in a tutor-mentor programme is a reasonable and logical strategy. In this way, the unique qualities and life experiences of individuals in the university's mathematics community can be drawn upon in the FP tutor-mentor mathematics programme. As a result, the process of tutor-mentoring is enriched; learning is made meaningful for the individual (students and tutor-mentors), and the community (the university community and the FP community) benefit (King 2008, Leonard 2002, Wenger 1998).

The tutor-mentor programme was designed against this eclectic theoretical framework that allowed theoretical bridges to be forged and a 'whole' developed from the parts. The practice of tutor-mentoring (teaching and learning) in the FP mathematics community was intended to be an active and interactive complex process involving members of the mathematics community. This article emphasises tutor-mentoring offered as a support service situated within a specific university mathematics community on a multicultural urban campus. The programme was offered to less experienced and less knowledgeable individuals (FP students) by more experienced and knowledgeable peers (suitably equipped undergraduates), with all participants working for the same purpose and desiring the same outcomes, namely improvement of mathematics performance.

2. Research design

The empirical inquiry formulated and addressed the following research question: What is the influence of a peer tutor-mentor programme designed to improve the mathematics performance and meet the psychosocial needs of FP Information Technology students at a private university in South Africa? The inquiry was undertaken as part of a doctoral study, using a mixed method research design. This article reports on only the qualitative component thereof.

The research site at which the principal researcher was located is an international private university situated in Johannesburg with an enrolment of approximately 3 000 students (Monash South Africa 2009). The majority (approximately five to one) of the students are mainly but not exclusively from African countries. Data was gathered from a comprehensive sample (McMillan & Schumacher 2006: 319), which included all the participants in the FP mathematics tutor-mentoring programme (McMillan & Schumacher 2006: 319). This sample comprised the following groups. First, all FP students who had enrolled for mathematics with a view to entering the Information Technology degree programme (N = 142), of whom 79 had opted to participate as tutee-mentees in the tutor-mentoring programme. However, those who had refrained from participation in the programme were included in data-gathering. In this way their opinions about the programme and their reasons for non-participation were heard. Secondly, all mathematics tutor-mentors (N=10) were selected. These were undergraduates in the Information Technology degree programme, had completed tutor-mentor training, and had already been employed as paid tutor-mentors for at least two years. Finally, all lecturers teaching mathematics in the FP mathematics programme (N=5) were included.

Data was gathered by means of written comments, individual and focus group interviews using an interview schedule, observation, and spontaneous conversations enriched by photographs and documented by field notes. Due to the large number of FP

student participants, written opinions of the tutor-mentoring programme were elicited using a broad open-ended question. Focus group interviews were held with tutor-mentors, and individual interviews were held with lecturers. Interviews were audio-recorded; field notes were made of spontaneous conversations with FP students and tutor-mentors on campus during an extended period of fieldwork by the principal researcher, and field notes and photographs were taken during observation sessions. The latter comprised observation of tutor-mentors as part of the formal tutor-mentor training evaluation, and observation of student, lecturer and tutor-mentor interaction during mathematics tutorial classes. All data captured and storage was conducted according to the requirements of the institution's Ethics Committee. Participation by all participants was voluntary, confidential and anonymous. Pseudonyms are used in quotations in the presentation of the findings.

The audio-recordings of the interviews were transcribed; all transcriptions were supplemented by field notes taken during interviews and observation sessions and by the photographic material. As suggested by Boyatzis (1998), thematic analysis was used to develop the categories, or themes, during the process of data analysis. The inductive process focused on the data, examined it for overlaps and redundancy, and collapsed it into codes. Similar codes were then combined to form a single idea or theme (Delamont 2002: 171). The coding was used to define units of meaningful information, and grouped according to the commonality of the information. Where necessary, findings were cross-checked with participants for clarification and accuracy. Finally, the second researcher carried out peer checking.

3. Results and discussion

The findings are discussed according to four themes, namely social adjustment of tutee-mentees in a multicultural setting; cultural diversity as both barrier and resource; the role of on-campus perceptions in sustaining the tutor-mentor programme, and forging a community of mathematics practitioners.

3.1 Social adjustment of tutee-mentees in a multicultural setting

As young adults first-year university students are coping with many complex changes typical of this phase of life. New students experience psychosocial problems caused by stressful situations (Theron & Dalzell 2006: 397). This theme explores obstacles to students' social adjustment which can become barriers to learning. Due to its international, multicultural mandate, foreign (in other words, non-South African) FP students far outnumber local FP students (Monash South Africa 2009). Although all new students must adjust to campus life on arrival at university, foreign students experience an additional culture shock, including coping with off-campus practicalities, such as shopping for supplies, opening a bank account, using public transport, and coping with life in a metropolis as opposed to a small town or village (Megalis 2003, Zubin 2007). In this regard, a knowledgeable tutor-mentor, often a foreign student, who can guide new students in adjusting, is important for their psychosocial welfare. Pindile explained how unreliable transport affected her social adjustment, her health and her studies:

> The bus is always late and I was always late. I started getting bad headaches and I couldn't sleep and I couldn't concentrate in class. I didn't know what to do, so I asked Portia [a tutor-mentor] and she told me who to go see about transport. It was nice having someone my own age to ask about things.

Her experience was echoed by several other tutee-mentees who identified additional stressors, such as loneliness, unaccustomed gender-role expectations, religious differences, xenophobic attitudes, and even dietary changes, which caused emotional distress and affected their academic performance. Having a peer tutor-mentor at hand helped social integration during the initial settling-in period. Vivian commented:

> The tutor-mentor programme does give support. Tutor-mentors are there when we need help and guidance. Support from another student who has experienced the same kinds of things, problems as us, they managed to be okay with them We look at them and

> see, yeah, they're successful, they dealt with problems like this, so I can too.

Tutor-mentors give advice on practical issues, such as how to cope with social life on campus, including the pitfalls of excessive student "partying" both on and off campus and the accompanying hazards of sleep deprivation, substance abuse and risky sexual behaviour. Finally, the value of tutor-mentors was noted, not only during the initial period of social adjustment, but when social and emotional issues arose throughout the year. Fiona explained:

> Sometimes problems only come later [...] some of the stuff I needed to know was much later in the year and I could go to the tutor and ask her.

Thus, FP students need to construct a new personal social space as part of their 'new' university environment in order to succeed academically. In this endeavour the tutor-mentor role filled by an acceptable and accepted peer rather than a university functionary is invaluable.

As mentioned earlier, the FP tutor-mentoring programme was designed to be a holistic endeavour, incorporating both cognitive and affective aspects (Lave & Wenger 1991). Addressing problems of social adjustment is primarily linked with the mentorship aspect (Hayes 2001: 5). Tutor-mentors have a clear conceptual understanding of the dual nature of their task as a result of their training, during which they are introduced to the theoretical framework that underpins the programme, and are encouraged to reflect critically on their own experience and needs as former FP mathematics students. Victor described the link between social adjustment and academic performance:

> Sometimes problems with work come because there is another problem, like problems at home, or a problem with a roommate or fees, or something.

Robert noted the value of trust and empathy with a tutee-mentee:

> Without developing a good relationship with the student, I can't tutor; not properly anyway. Something will be missing and I know

> I won't be able to get through to the student as well as if we had a good relationship.

This comment brought nods of agreement in the focus group and elicited further comments such as the following from Kabo:

> How can you tutor someone if you don't know them as a person; if you don't know who they are or something about their background?

However, although the tutor-mentors are trained to deal with general difficulties experienced by first-year students, they are not expected to take on the role of a professional counsellor but rather to recognise when a tutee-mentee may need professional help from university counselling services and to recommend this.

3.2 Cultural diversity as both barrier and resource

A formidable hurdle faced by FP mathematics students, who are nearly without exception English Second Language (ESL) speakers, relates to language diversity encountered on campus and in the city, and the use of English as medium of instruction in the mathematics classroom. Foreign FP students found that their inability to speak local South African languages exacerbated off-campus adjustment. One student explained:

> It affects everything; like getting around Jo'burg. Yes, and using taxis, and explaining to some shop assistants. They pretend that they don't understand us. Or, yeah, because we're black, they start talking a local language and when we say 'We don't understand', they even get abusive.

In addition, the foreign student found it difficult to follow English spoken with local accents by lecturers and fellow students in the classroom. For the majority of ESL students, South African and foreign, the greatest risk to academic achievement was having to use English as medium of instruction (Ovando & McClaren 2000) without adequate cognitive academic language proficiency necessary for academic achievement (Cummins 2000). Tutor-mentors, Marco and Itai, recalled how they struggled with English as academic language in their first year as FP mathematics students. Marco, a Mozambican,

> spoke Portuguese in school and at home [...] but not English. I'm okay now, but not at the beginning. When I first came, I really struggled and went to the Centre for Learning and Teaching but actually I got the most help from the tutors.

According to Itai,

> English was a big problem for us. It caused a lot of stress because we wanted to do well but the English pulled us down; even our maths, because sometimes we couldn't understand the question.

Teaching mathematicss to ESL students is equally challenging for the lecturers who cannot code-switch to a student's home language:

> You don't really know if students are following you. They say, 'Yes, we understand' but then you don't know if they're just being polite [...] until they've written a test and you see the marks.

However, the rich linguistic diversity among tutor-mentors is also a useful classroom resource. A Portuguese-speaking tutor-mentor came to the rescue of Angolan students whose competence in mathematics was masked by their limited English proficiency. Similarly, a French-speaking tutor-mentor could assist students from francophile Africa. The communication dilemmas described by all the student participants were confirmed during the principal researcher's observations of mathematics tutorial classes in which lecturers spoke English rapidly, expected a quick response from students, and used subject-specific vocabulary typical of mathematics discourse. Student access to tutor-mentors outside class hours alleviated this problem, as Mandla explained:

> Sometimes I don't understand the lecturer; she talks fast and she's usually in a hurry so [...] we just copy what she does from the board. Then we have to do homework in our own time [...] the tutors help a lot when the lecturer's not around. Yeah, and it's easier to find a tutor who's good at maths to explain and they also talk so we understand you know, like, make sure I know what he's saying.

Students also had to adjust to other culturally different aspects of the mathematics classroom. Lecturer expectations and pedagogy often differed. A lively, participatory classroom created new freedoms of expression while arousing additional stresses (Lucas

et al 2006). Students from African countries and, in particular, those from Islamic societies were accustomed to an authoritarian teacher-student relationship and rote-teaching methods (Swartz *et al* 2004). Classroom observation showed that students are often reluctant to question, interrupt and differ with lecturers. Young female students, in particular, lack self-confidence to participate in mixed gender discussions. Students tend to speak softly and lecturers often become impatient with what appears to be a waste of teaching time as they struggle to understand students. During one observation session, a lecturer noticed that students were struggling to understand a particular concept. After several unsuccessful explanations, she exasperatedly asked a tutor-mentor to take over. An audible sigh of relief from the class aroused laughter from all, including the lecturer, and the tutor-mentor elaborated slowly, using simple language, and punctuated the discourse by allowing opportunity for tutee-mentees to ask questions. In this case, the latter did not hesitate to ask for additional explanation. Tshepo, a tutee-mentee, summed up the tutor-mentor role in the culturally diverse classroom:

> [Tutors] can explain in words we understand and sometimes even use my own language. They're near our age; we can relate, even when we are speaking English.

3.3 The role of on-campus perceptions in sustaining the tutor-mentor programme

As participation in the tutor-mentor programme is voluntary, its promotion and sustainability depend on the positive perceptions of the various role players. Satisfaction among programme participants (students, tutor-mentors and mathematics lecturers) creates 'goodwill ambassadors' on campus for future implementation of the programme.

Lecturer participation and involvement is positively linked to programme success: lecturers are responsible for training and advising tutor-mentors and for allowing them entry into their professional space. Lecturers were persuaded most powerfully of the value of the programme when they observed evidence of

improved attitudes to mathematics and improved mathematics test scores among FP mathematics students (Maitland 2009). However, lecturers did not fail to notice the contribution of tutor-mentors to enhancing students' social adjustment and emotional well-being and its salutary effect on learning mathematics. One lecturer noted:

> I could see that Sophie was miserable. I asked Thoko to see if she could help her. It seems to work because she's coping fine now with the maths and is quite willing to participate in class discussions and contribute to the group.

The majority of the lecturers diligently took to their task as advisors to the tutor-mentors. Another important aspect of lecturer cooperation is to afford "space" to tutor-mentors within their professional domain, the mathematics classroom. Although tutor-mentors are given a general job description based on the requirements of the FP and the rules of the university (Maitland 2008), the way they function is left to a large extent to the lecturer and the needs of the specific class. Ditso remarked:

> Mr. J trusts us [...] he's always there but he lets us get on with it. If we're not sure about something we refer to him but he never interferes. We feel that the students know he trusts us and so they trust us too.

However, one lecturer felt less comfortable with the presence of tutor-mentors in the classroom, fearing a "loss of control". Such fears cannot be dismissed summarily in a successful programme; a tutor-mentor programme requires lecturers to relinquish some classroom control and to assume the role of coaches and managers, rather than dispensers of knowledge. Finally, lecturer attitudes to tutor-mentors gave FP mathematics students a behavioural cue; if the association between lecturer and tutor-mentor was observed to be positive, respectful and appreciative, students picked up on this and responded similarly. The role of the lecturer in the tutor-mentor programme is thus crucial to its success.

In general, FP mathematics students responded positively to the tutor-mentor programme. In terms of academic improvement, a number of mathematically strong students benefited from their

participation in the intervention with improved performance and distinctions in the final examinations. Weak students improved their mathematics performance from a fail to a pass in the final examinations (*cf* Maitland 2009). Students recognised the significance of tutor-mentoring in sharpening conceptual understanding and developing mathematical skills, as is evident from the following comments: "I understood better", and "My marks improved because every time I approached the questions I knew what steps to take". In addition, a recurring strand in students' comments, such as "[Tutor-mentors] give personal help"; "She's patient"; "She gives comfort"; "He made me feel better about myself', and "I started to believe in myself', demonstrates that students understood that tutor-mentoring was not limited to academic assistance; emotional support, quintessential to mentoring, was also distinguished. This kind of encouragement altered the low mathematics achiever's perception of him-/herself as an incompetent learner. In addition, written comments gathered from FP mathematics students who had, for various reasons, chosen not to participate in the programme, were also positive:

> I think it's a good idea to have [tutors] because some people don't always understand easily and tutors can help these students. I don't need a tutor 'cause my maths is good but some students do.

This appraisal of the programme's benefits contributed to the general opinion on campus that the tutor-mentor programme was worthwhile. This perception is crucial if academically vulnerable FP students are to be persuaded to participate voluntarily in future.

Positive perceptions are necessary for the recruitment of new tutor-mentors and the retention of the present corps. Current tutor-mentors have been mainly motivated to join the programme because of the benefits they enjoyed as FP mathematics students. Maambo related:

> I used tutors a lot in the FP. They extend your school hours. My marks improved and my understanding. Yeah, having a tutor made the work easier.

Tutor-mentors reflected enthusiastically on their role in facilitating mathematics learning and repeatedly mentioned two indispensable aspects of their task, namely availability to students and effective communication. One tutor-mentor highlighted this:

> We are always more available than the lecturers and even the language we use is understandable and student-friendly.

They grasped the value of a non-threatening peer relationship:

> We saw a need for there to be student-tutors who are basically the same age, almost the same age as the students so as to develop a peer to peer relationship with them and because us tutors, we were FP students before so we know exactly what goes into the programme and the output expected from the students.

They also acknowledged the personal qualities necessary for mentorship, namely tolerance and empathy. Finally, the small remuneration paid to tutor-mentors enhanced their perception that tutor-mentoring was important and productive work.

3.4 Forging a community of mathematics practitioners

A unity of purpose evolves through academic and social participation and, in the process of working together in a common enterprise, a group identity develops and a community of practice is formed (Lave & Wenger 2005: 149). The findings suggest that the programme formed a community of practitioners – FP students, mathematics lecturers and tutor-mentors – participating in a common enterprise for a mutual purpose on campus. Of these three groups, lecturers and tutor-mentors had the clearest insight into the concept of community of practitioners as this theoretical perspective had been discussed at some length during tutor-mentor training. Tatenda explained:

> I understand a community idea [...] if students want to get the best out of the programme; they need to understand that they must

> work with us and with the lecturers because we all want the same thing in the end.

As tutor-mentors were chosen on the basis of a passion for and achievement in mathematics and a keenness to impart their knowledge to others, they shared a strong sense of purpose: "[A] group, all doing the same thing for the same purpose". In addition, tutor-mentors had already formed close bonds with their lecturers during their own FP mathematics year. The latter had identified them as potential tutor-mentors and had engaged in their training. Newly trained tutor-mentors were quickly drawn in from the periphery to become part of the 'master' class of tutor-mentors. Personal and professional relationships with each other and with the lecturers based on mutual interest contributed to group identification. Kabo and Kedi remarked that acting as tutor-mentors made them feel "special" and "unique", respectively, within a community in which they were recognised as knowledgeable and trusted to assume a responsible position.

The FP tutee-mentees were aware that they formed a special group. While they often did not yet experience membership in the wider university community, they comprised a unit and tended to socialise together beyond the classroom. Belonging to the tutor-mentoring programme made them a cohesive body aimed at achieving at least the minimum mathematics score required for admission to the IT degree the following year. The idea of community of practitioners increased in strength throughout the year. Constance echoed the sentiment:

> I was the only one from Romania. I think I still am. There was no one to talk to. I tried but no, I don't feel I belong to the university. But I really know my class and the students [...] I like the tutor and my lecturer, so, yes, I feel like I belong to a maths community.

Learning mathematics in a small group with a tutor-mentor was a social activity, and relationships were not limited to the tutor-mentors but included fellow mathematics students. Alex commented:

> Me and Brian, we work together all the time. I reckon that's a partnership, Ma'am? I mean we argue with each other about how

> to solve something. We go on arguing until we find the right solution.

Brian agreed:

> Yeah, we work well together. We don't actually need anyone else, you know, like a tutor or even the lecturer, although sometimes we ask him a hard question, but most times we can do it ourselves. I guess that's a partnership.

Alex and Brian's experiences are suggestive of Vygotsky (1978) zone of proximal development and Bruner's (1990: 105) notion of a "shared problem space". Collaborative mathematics learning with peers, albeit at times only marginally more knowledgeable and experienced than oneself, enhances individual learning, makes it meaningful and helps to build cognitive self-reliance (Wenger 1998).

Finally, within this community of practice, notions of equality and authority or power had to be negotiated. Observation of the mathematics tutorial classes suggested that mathematics occupied the commanding space. If all classroom participants – lecturer, tutor-mentor or tutee-mentee – are considered equal in the sense of a community of practitioners, the mathematics problem is open to exploration by all, and all are able to speculate and offer conjectures without fear of embarrassment or showing disrespect. Observation over the period of fieldwork indicated that both tutee-mentees and tutor-mentors increasingly appeared to enjoy freedom to join problem-solving, to argue, to take risks and to acknowledge better options offered by fellow mathematics students. Tatenda elaborated:

> By doing this work with the lecturer and the students you get to learn more about maths and ways of expressing maths. I had to sometimes think very hard when a student came up with another way of solving a calculation, but that was good and I learned to listen and not be so sure that I was always right.

Thus, a common problem space was shared within which students and tutor-mentors and even lecturers could participate in finding solutions to problems by means of "a process of negotiation and co-construction of knowledge" (Kozulin 2003: 246). In this regard, one lecturer conceded:

> I actually learned a lot from my two guys [tutor-mentors]. Some of the ways they tutored were quite innovative and the students really seemed to enjoy it when they took the class. They're coming back to work with me again next year and I'm looking forward to getting to know them better and developing our relationship.

Thus, FP mathematics students have the opportunity to act as, what Ball (2000:5) terms, "beginning practitioners"; tutor-mentors shift further along the continuum from novice to becoming expert practitioners within the community of mathematics practice.

4. Conclusion

Based on the findings of the empirical inquiry, this article argued that well-designed support programmes that combine the functions of tutoring and mentoring as a holistic enterprise within a community of practice can offer academic and psychosocial support to at-risk first-year students and enhance academic performance. It is obvious that tutor-mentoring cannot replace professional counselling or high-quality instruction; neither can the university load tutor-mentors with work and responsibilities that morally and contractually belong to its professional corps. However, the use of peer tutor-mentors can be of great benefit, in particular to mathematics lecturers in South African institutions, who often struggle with large classes where English is the medium of instruction within a linguistically diverse context. To be effective, tutor-mentor programmes should be based on a sound theoretical basis, organised and managed with initial and ongoing training of tutor-mentors and participating lecturers. Trained, enthusiastic and committed tutor-mentors can add value to mathematics education and reduce the demands on lecturers by giving them time to focus on what is most needed. For optimum learning, at-risk mathematics students need to find meaning in what they are taught by actively participating in their learning. Opportunities to engage with and learn from others are created by incorporating well-trained, experienced and knowledgeable

tutor-mentors in the mathematics classroom in an emerging com-munity of practice.

Bibliography

ADLER J
1998. Lights and limits: recontextualising Lave and Wenger to theorise knowledge of teaching and learning of maths. Watson (ed) 1998: 161-77.

ALRED G M, M BYRAM & M FLEMING (eds)
2003. *Intercultural experience and education*. Clevedon: Multilingual Matters.

ANDERSON J R, L M REDER & H A SIMON
1997. Situative versus cognitive perspectives: form versus substance. *Educational Researcher* 26: 18-21.

AUSTIN J, L COVALEA & S WEAL
2003. Going the extra mile: Lilydale's international mentor program. Unpubl presentation at the 16th Annual IDP Australian International Conference, Hobart, Tasmania, 30 September, 2003.

BALL D L
2000. Bridging practices: intertwining content and pedagogy in teaching and learning to teach. *Journal of Teacher Education* 51: 241-7.

BANDURA A
1989. Human agency in social cognitive theory. *American Psychologist* 44(9): 1175-84.

BERLINER D C & R C CALFEE (eds)
1996. *Handbook of education psychology*. New York: Macmillan.

BOYATZIS R
1998. *Transforming qualitative information: thematic analysis and code development.* Thousand Oaks, CA: Sage.

BRANNON E M
2005. The independence of language and mathematical reasoning. *Proceedings of the National Academy of Sciences of the United States of America* 102(9): 3177-8.

BRUNER J S
1990. *Acts of meaning*. Cambridge, MA: Harvard University Press.

CENOZ J & U JESSNER (eds)
2000. *English in Europe: the acquisition of a third language.* Clevedon: Multilingual Matters.

CHANG M J
1999. Does racial diversity matter? The educational impact of a racially diverse undergraduate population. *Journal of College Student Development* 40(4): 377-95.

COBB P
2007. Putting philosophy to work. Coping with multiple theoretical perspectives. Lester & Charlotte (eds) 2007: 3-38.

COHEN L, L MANION & K MORRISON
2000. *Research methods in education.* 5th ed. London: Routledge Falmer.

COLE M & J V WERTSCH
1996. Beyond the individual-social antimony in discussions of Piaget and Vygotsky. *Human Development* 39(5): 250-6.

CROSLING G & G WEBB
2002. *Supporting student learning: case studies, experience & practice from higher education.* London: Kogan Page.

CUMMINS J
2000. Putting language proficiency in its place. Responding to critiques of the conversational/academic language distinction. Cenoz & Jessner (eds) 2000: 54-83.

DANIELS H (ed)
2005. *An introduction to Vygotsky*. 2nd ed. London: Routledge.

DELAMONT S
2002. *Fieldwork in educational settings*. London: Falmer.

DETTERMAN D K & R J STERNBERG (eds)
1997. *Transfer on trial: intelligence, cognition, and instruction.* Norwood, NJ: Ablex Publishing Corporation.

FAGENSON E A
2006. The mentor advantage: perceived career/job experiences of protégés versus non-protégés. *Journal of Organizational Behavior* 10(4): 309-20.

FALCHIKOV N
2001. *Learning together*. London: Routledge Falmer.

GINDIS B, V S AGEYEV & S M MILLER (eds)
2003. *Vygotsky's educational theory in cultural contex*t. Cambridge: Cambridge University Press.

GOODLAD S
1998. *Mentoring and tutoring by students*. London: Kogan Page.

GREENO J G
1997. Response: on claims that answer the wrong questions. *Educational Researcher* 26(1): 5-17.

GREENO J G, A M COLLINS & L B RESNICK
1996. Cognition and learning. Berliner & Calfee (eds) 1996: 15-46.

GREENO J G, J L MOORE & D R SMITH
1997. Transfer of situated learning. Detterman & Sternberg (eds) 1997: 99-167.

HAYES D
2001. The impact of tutor-mentoring on student primary teachers' achievements: a case study. *Mentoring and Tutoring* (1): 5-21.

JONES B, G COETZEE, T BAILEY & S WICKHAM
2008. *Factors that facilitate success for disadvantaged higher education students.* Athlone: Rural Education Access Programme.

KING L A
2008. *The science of psychology.* New York: McGraw-Hill Higher Education.

KOZULIN A
2003. Introduction. Gindis *et al* (eds) 2003: 1-15.

LAVE J
1988. *Cognition in practice: mind, maths and culture in everyday life*. Cambridge: Cambridge University Press.

1996. Teaching, as learning, in practice. *Mind, Culture and Activity* 3(3): 149-64.

LAVE J & E WENGER
1991. *Situated learning: legitimate peripheral participation*. Cambridge: Cambridge University Press.

2005. Practice, person, social world. Daniels (ed) 2005: 149-56.

LEONARD D C
2002. *Learning theories A to Z*. Westport, CT: Greenwood Press.

LESTER F K & N C CHARLOTTE (eds)
2007. *Second handbook of research on maths teaching and learning: a project of the National Council of Teachers of Mathematics*, 1: 3-38. Greenwich, CT: Information Page Publishing.

LOOTS A G J
2009. Student involvement and retention in higher education: the case for academic peer mentoring programmes for first-years. *Education as Change* 13(1): 211-35.

LUCAS M, M DAMIANOVA, S BURNEY & M PONTO
2006. *Globalization and cultural specificity in stress and coping among female and male students studying in South Africa and Australia.* Conference proceedings of International Education: A matter of heart, Sunway Lagoon Resort Hotel, Selangor Darul Ehsan, Kuala Lumpur, Malaysia, 13-16 February 2006. Convened by Monash University, Melbourne, Australia.

MAITLAND I D M
2008. *MSAFP tutor-mentor policy*. Johannesburg: Monash South Africa.

2009. Tutor-mentoring of foundation maths students at Monash South Africa. Unpubl DEd thesis in Comparative Education, University of South Africa.

MCMILLAN J
2005. *Course change and attrition from higher education*. Victoria: Australian Council for Educational Research.

McMillan J H & S Schumacher
2006. *Research in education: evidence-based enquiry*. 6th ed. Boston: Pearson.

Megalis C N
2003. Does acculturation, social support, and being in an international baccalaureate honours program affect high school students' academic stress and burnout levels? *Dissertation Abstracts International* 64(1-A): 68.

Moll I
2002. Clarifying constructivism in a context of curriculum change. *Journal of Education* 27: 1-32.

Monash South Africa
2008. *Undergraduate guide 2008*. <http://www.monash.ac.za/prospective/courses/msafp/regulations/>

2009. Statistics. Department of Advancement. Unpubl document. Johannesburg: Monash South Africa.

Ovando C J & P McClaren
2000. Editor's preface. Ovando & McClaren (eds) 2000: 1.

Ovando C J & P McClaren (eds)
2000. *The politics of multiculturalism and bilingual education*. Boston: McGraw-Hill.

Page B, A Loots & P du Toit
2005. *Perspectives on a South African tutor/mentor program: the Stellenbosch University experience.* <www.informaworld.com>

Paivo A
1986. *Mental representations*. New York: Prentice Hall.

Passer M W & R E Smith
2008. *Psychology: the science of mind and behavior.* 4th ed. New York: McGraw-Hill Higher Education.

Pokorny M & H Pokorny
2005. Widening participation in higher education: student quantitative skills and independent learning as impediments to progression. *International Journal of*