Chemistry Academic Support: The Profile and Rationale of Attending Students

Vino Paideya

Abstract

This paper explores the profile of students who attend chemistry academic support in the form of Supplemental Instruction (SI). The SI programme was introduced at an institution of higher education in 2008 to improve retention and through-put rates. Data was collected from the first year students in 2013 using questionnaires (n =117) and three focus group interviews to determine the profiles of the students attending the chemistry SI sessions. The data was analysed using an interpretive methodology. Several categories emerged from the data with respect to the effects of gender, prior academic achievement, place of residence, year of study and home language on regular SI attendance. The findings may be used to identify and proactively target students at risk of poor academic performance and of dropping out of university.

Keywords: Supplemental Instruction, Retention, Through-put, First-year Chemistry, Academic Support

Introduction

According to the Council of Higher Education (CHE 2011) the higher education system has grown by more than 80% since 1994 to an enrolment number of over 900,000 students. The implementation of policies to improve access to higher education and the increase in university enrolments have resulted in changes to the student population in higher education. For example, female students now constitute around 58% of the student

population, out numbering their male counterparts in both full and part-time study (CHE 2013).

A troubling aspect of increased access and enrolment has been a concomitant increase of non-completion rates. A recent CHE study notes that 'only about one in four students in contact institutions…graduate in regulation time; only 35% of the total intake, and 48% of contact students, graduate within five years' and, 'it is estimated that some 55% of the intake will never graduate' (CHE 2013: 15). Students who drop out of the courses taken usually do so in the first year of study, which significantly contributes to the overall statistics for non-progression (Scott, Yeld & Hendry 2007). There are several reasons for students to dropout of university which have been established by Terenzini *et al*. (1996); Letseka (2007) and Scott, Yeld and Hendry (2007). Firstly, some students may leave for reasons that are beyond institutional control, such as the lack of finances, changing academic or career paths or to unrelated personal circumstances. Secondly, many more students leave because they are unable to adapt to the educational environment of the institution. Thirdly, the students' inability to manage normal course workload or to integrate within the student population could discourage some students from returning.

The supplemental instruction (SI) programme has been in existence since 1973 when it was introduced by Dr Deana Martin and set up as a centre at the University of Missouri-Kansas City. This centre continues to provide training to promote SI as an academic development initiative globally (UKMC, 2015). Within South Africa, there are numerous university faculties running SI programmes, with the Nelson Mandela Metropolitan University (NMMU) being the national office. At the study site, SI is a voluntary support programme making use of trained and mentored SI leaders to conduct the SI sessions. SI leaders are trained with respect to SI principles and facilitation techniques. The SI approach, the literature indicates, is designed to assist students to master course concepts, simultaneously increasing student competency in reading, reasoning and study skills (Blanc, De Buhr & Martin 1983).

By contrast, Tinto (2005: 3) viewed SI as 'an important condition for [students'] continuation in the university', hence as a strategy that can enhance retention. Bowles, McCoy and Bates (2008: 856) who suggested that SI can enhance the development of 'micro and macro-behaviours related to successful long-term educational outcomes', provided another layer of

support for the idea of preventing student dropout rates. The positive values imputed to SI form the point of departure for the exploration of the profiles of students who regularly attend chemistry SI sessions in an attempt to improve academic support policy and practice with a vision to address student retention and throughput. Whilst considerable attention has been directed towards researching factors associated with first year student dropout phenomenon (Letseka 2007; Scott, Yeld & Hendry 2007) less attention has been dedicated to the factors that contribute to academic failure.

At the study site, SI sessions were usually conducted by third year or post-graduate students who were referred to as SI leaders. SI leaders reportedly were recruited by the SI supervisor and academic staff based on their interpersonal skills and course competency. SI leaders were not employed as tutors; their role purportedly was not to introduce new content or to 're-teach' lecture material (Dawson; Lockyer & Ferry 2007). Instead, they were expected to facilitate the learning process with the aim of developing chemistry students' competency in reading, reasoning and study skills, that is, lecture note-taking, text book reading, memory enhancement and time management (Paideya 2011).

The SI sessions were adapted for the South African context and were usually held for 45 minutes twice a week. The SI sessions integrated facilitative measures to encourage an atmosphere of engagement that emphasised that 'no question is a dumb question' (Webster & Hooper 1998) and more importantly, to encourage the students to ask 'why' questions. The environment was designed to facilitate small group discussions, and reflection through discussion which was used to encourage collaborative learning during the SI sessions (Paideya 2011).

Furthermore, the SI leaders were required to attend course lectures to keep abreast with content covered by lecturers. The SI leader also served as a source of feedback for the course lecturer through discussion with respect to the concerns and difficulties which students may have been experiencing with the course material.

The SI learning context was deliberately designed to include a social dimension on the assumption that students do not acquire scientific concepts in isolation. In fact, students ability to grasp concepts is increased because of the SI group's assistance, and which, I argue, they could not achieve independently (Paideya 2011). Session activities varied throughout the semester, influenced by both the SI attendees and the leaders' needs.

The Effect of Academic Support Services on Student Retention and Throughput.

According to Cuseo (2010) success at university is influenced by both the individual and the individual's environment. In a comprehensive review of over 2500 research studies, the following conclusion was reached, 'The impact of college is not simply the result of what a college does for or to a student. Rather, the impact is a result of the extent to which an individual student exploits the people, programs, facilities, opportunities, and experiences that the college makes available' (Pascarella & Terenzini 2009: 610-611).

Studies showed that students who become actively involved with academic support services outside the classroom, such as a learning center or academic support center, are more likely to attain higher college grades and complete their college degree, particularly if they began their involvement with these support services during the first year of college (Tinto 1993; Cuseo, Fecas & Thompson 2007). It was also found that students who sought and received assistance from academic-support services showed significant improvement in academic self-efficacy, that is, they developed a greater sense of personal control over their academic performance and developed higher self-expectations for future academic success (Cuseo 2010).

Despite the multiple advantages of being involved with academic support services outside the classroom, these services are typically under-utilized by college students, especially by those students who could gain the most from using them (Cuseo 2010). There could be several reasons for students to under-utilize academic support programmes based on beliefs that seeking academic assistance is an admission that they are not 'smart' and that they cannot succeed on their own.

Terenzini & Reason (2005) hypothesized that students come to college with a variety of personal, academic, and social background characteristics and experiences that both prepare and predispose them to varying degrees to engage with the formal and informal learning opportunities. These precollege characteristics shape students' subsequent college experiences through their interactions with institutional and peer environments, as well as the major socialisation agents (for example, peers and faculty members).

Guided by Terenzini & Reason's (2005) conceptual framework of

student persistence and retention, this study explored the effects of attendees' gender, prior academic achievement, the place of residence, home language spoken and the year of academic study to determine the profile of regular SI attendees.

Researching the Profiles SI Attendees'

A pilot study was initially undertaken to assess the profile of the 2013 cohort of first year chemistry students. The results of the pilot study revealed that there were 744 female students and 522 male students in the first year chemistry cohort. The majority (96%) of the students were in their first year of study. The analysis of the students' residential arrangements while attending university indicated that 35 % of the first year cohort resided at a student residence while 65 % commuted to and from university on a daily basis. Further, it was found that 791 (63%) out of a cohort of 1266 students' home language was isiZulu. Students' university entry points[1] revealed that 939 (74%) of students achieved matric points that ranged between 30-39 points. This is consistent with the College of Science and Agriculture entry points of between 28-48 points. The purpose of the pilot study was to measure the validity and reliability of the results obtained from the profile of the SI academic support programme against the pilot study.

The data for this paper was derived from a case study of the 2013 cohort of first year Chemistry students who attended the SI sessions. In order to establish the profile of the participants, a survey and three focus group interviews were conducted. The purpose of the questionnaire was to gain information regarding the SI attendees' biographical data to create a generalized profile of the students who attended the SI sessions. The students participating in three or more chemistry SI sessions per semester (a period of approximately 10 to 12 weeks) were selected to complete surveys. One hundred and seventeen SI attendees responded to the questionnaire which

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[1] Academic Performance Score (APS) are obtained in the South African National Senior Certificate (NSC) examinations. University entrance requires a minimum of seven subjects with at least four subjects (passed at level 4 i.e. between 50-59%). Further each college and school has their own minimum entry points. Points are calculated according to an 8 point rating scale e.g. 60-69% = 5 points, 70-79% = 6, etc.

constituted 9.24% of the total cohort of first year chemistry students in 2013. However, it should be noted that SI is a voluntary academic support programme and not all participants in the SI programme completed a survey.

To clarify aspects of the profile of regular SI attendees gained from the questionnaires (24 students who attended more than 5 SI sessions per semester), were asked to attend focus group interviews. Further, focus group interviews sought to establish the rationale for students' regular or irregular attendance at the SI sessions.

Results

The analysis of the data from student questionnaires and focus group interviews revealed the following results with respect to profiles of the students who attend SI sessions and the student rationale for attending the sessions. The results were further thematically analysed according to emerging categories of description. Five categories of description with respect to profiling of SI attendees were analysed.

1. *Gender Profile of Students who Attend SI Sessions*

The category of gender was assessed against SI attendance to determine if the profiles were gendered with respect to academic support attendance.

Fig. 1 Gender and SI attendance
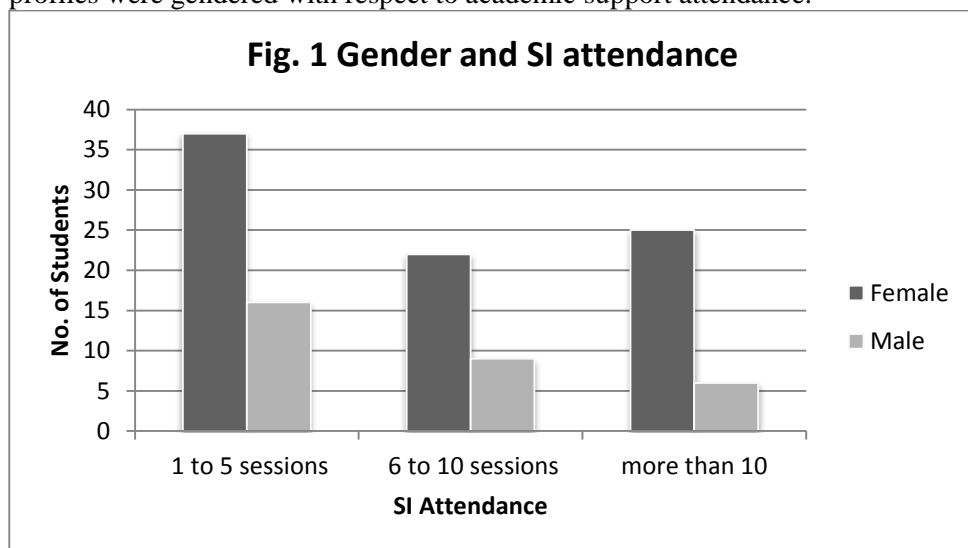
From the graph (Fig. 1) it can be interpreted that there are three different categories of SI attendees: students who have attended from 1 to 5, 6 to 10 and more than 10 SI sessions for the semester. It is evident that in all three categories the number of female students attending SI sessions is greater than the number of male students. In the overall sample analysed it was found that females represented 72% of the SI attendees whereas the male student attendance was 28%. There could be several reasons for the trend, however, the most apparent seems to be the population of female students enrolled for the first year course is larger than the male student enrolment which was evident in the pilot study.

Female students appear to be more conscientious, less likely to miss lectures or any other academic programme, and are more likely to believe that their marks reflect their ability than do their male peers (Mlambo 2011). This is evident from the following comment received from one of the regular female SI attendees:

> *I attend SI regularly because I am determined to pass chemistry with good grades*

According to Borman and Rachuba (2001) females are also more likely to seek and receive support from academic staff. By contrast, male students have a greater tendency to be absent from classes due to other commitments and a general tendency not to seek assistance (support) in any form. Some male students also believe that playing sport is an important part of university life, which is evident by the following comment:

> *I attend SI sessions when I have free time and I don't have other commitments like attending a soccer match or studying for a test.*

It can therefore be concluded that the present generation of female students are more focused on academic success and are determined to take on opportunities for success unlike their male counterparts, who instead have other competing interests that seem to distract them from attending the SI sessions. When it comes to gender, student interest appears to be the most likely explanation for the dominance of female attendees.

2. *Profiles of Students Attending SI Sessions by Year of Study*

The next category assessed was the profiles of students' by year of study, in terms of whether they were first timers or repeating the module in the subsequent years of study at university. The graph below (Fig.2) reveals SI attendance in relation to the student profile in different years of study.

Fig. 2 Profile of students by year of study and SI attendance
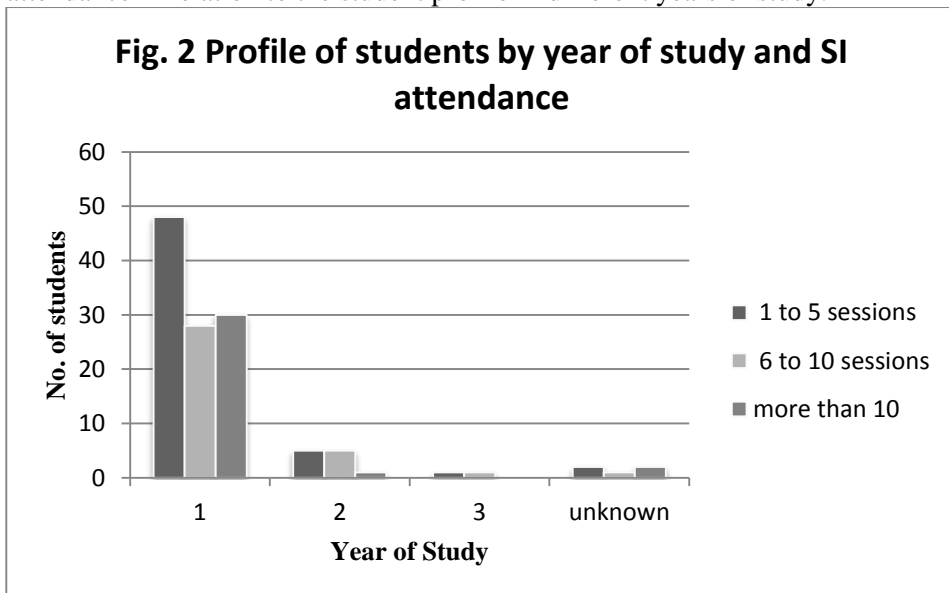
It is evident that the majority of SI attendees are from the first year of study, followed by those in the second year of study. It would seem that the longer the students take to pass the first year module the less interested they are in attending support programmes. Furthermore, those students who were in the 3rd year of study at university seem to only attend SI sessions to prepare for a test and were, therefore, not regular attendees at the SI sessions.

The focus group interviews with students revealed an over confidence of their competencies in chemistry:

> *I attempted this course last year so I don't attend SI sessions regularly. I only attend before a test because I did all of this stuff last year and I need to focus on courses that I am studying for the first time.*

Research indicated that younger students generally perform better than older students (Jansen 2004; Van den Berg and Hofman 2005). In particular, Omigbodun and Omigbodun (2003) identified a direct correlation between increasing age and decreasing performance in students taking a psychiatry examination. Nevertheless, the age-performance relationship often differs between men and women or over various disciplines (Richardson and Woodley 2003). By contrast, a study by Newman-Ford *et al* (2009) reported that on average the relationship between age and attainment was not statistically significant ($r = -0.10$, $p > 0.05$) and did not vary by gender. Despite attaining on average lower results with respect to other age categories, older students achieved a higher proportion of 'good' marks. In essence, the quality of older students' performance was better than younger age categories. This could be attributed to developing a sense of maturity with respect to academic attainment. However, the data about age and attendance suggests that the marketing of the academic support programme needs to be targeted at dynamic ways of luring the older, over confident students into the system to attend the SI programme.

3. *Profile of SI Students in Relation to Place of Rresidence*

The category place of residence was sub-categorised into two: students' who lived on campus residences and students who resided at home with respect to SI attendance.

Fig. 3 Place of Residence in relation to SI attendance

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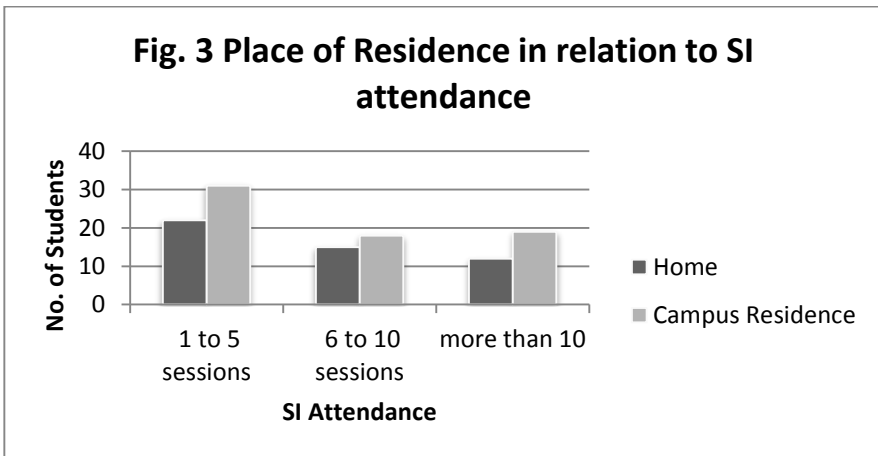
It can be interpreted from the graph (Fig. 3) above that there are two categories of students who attended SI sessions viz. those who reside at home and those who live on campus residences. It would seem that in all three SI attendance categories (attendance from 1 to 5 sessions, 6 to10 sessions and more than 10 sessions for the semester), students who lived on campus residence were more likely to attend as evidenced in the focus group interview:

> *When we live on campus residence we most often study with our friends doing the same course. So attending SI is no different except here we have someone who has already passed the course and is able to show us different learning skills to pass the course.*

Students who reside at home while attending university also find SI sessions useful, which is evident in the response that follows:

> *I find studying chemistry more effective when I attend SI sessions than me trying to figure stuff out on my own. I learn easier methods of understanding chemistry and I learn a lot more at SI than I do on my own at home.*

Blimling (1999) conducted a literature review and found little difference between the academic attainments of students living in university residences and those residing at home. However, research conducted by (Cutrona *et al.* 1994) suggests that remaining within the family home can be advantageous. Although support from friends and peers is significantly associated with achievement (Wall & MacIntyre 1999) parental support had a more positive impact on academic attainment (Cutrona *et al.* 1994) than other forms of support. By contrast, Reynolds (2012) showed that students living in university residences tended to perform better academically than those living off-campus. In the study at hand, only 35% of the first year student cohort resided at a university residence.

Arya and Smith (2005) found that students who live at home throughout their studies do not have the same relationship with, nor access to the university structures and events as those who live away from home. Holdsworth (2006) reported that students who remain in the family home have less freedom to socialise and generally are not accustomed to engage in

peer learning activities. They also experience additional problems related to travel time and fatigue which might impact negatively on academic performance.

Further, a more recent study by Newman-Ford *et al.* (2009) reported that students living in student or private houses or residence halls performed better on average than those residing in the family home. 'Home' students attained a mean of 44.3% in assessments, compared with 49.7% by the 'away' group. Differences in attainment between the groups were found to be statistically significant. It can, therefore, be concluded that students who reside in student residences away from home are more accustomed to peer learning and are more likely to attend SI sessions more frequently.

4. Profile of SI Students' with Respect to Language Spoken at Home

The category language spoken at home was analysed against two subcategories of students' viz. students whose first language was English and those who were English second language students. Fig. 4 &5 that follow represent the results obtained from profiles of SI attendees' home language.

Fig.4 Home language in relation to SI attendance

Fig. 5 SI Attendance

22%

78%

■ English 1st language
■ Other
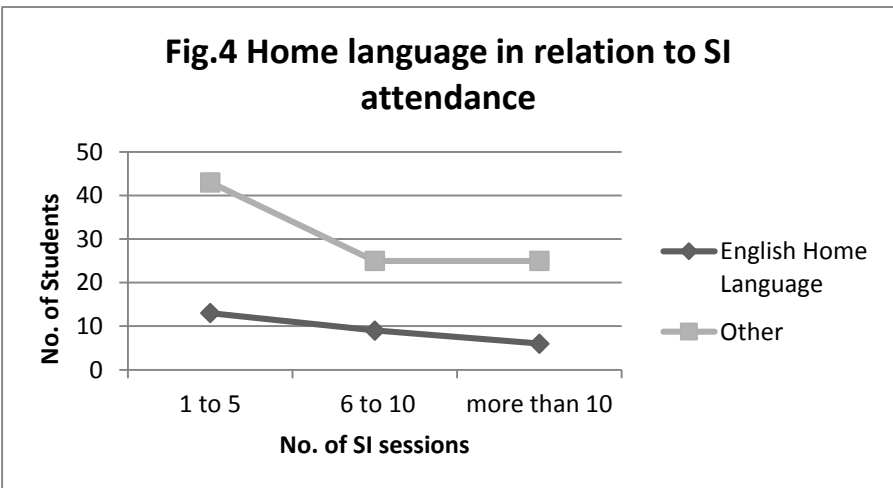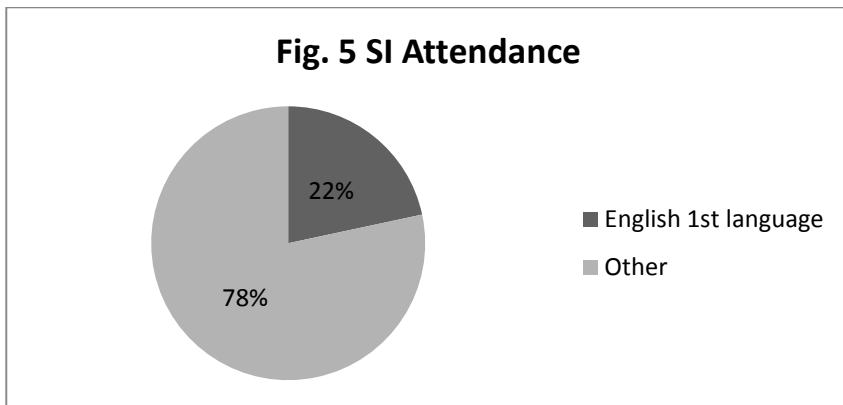
The graphs above suggest that English second language students in all three categories seem to be the majority (78%) of those attending SI sessions. Focus group interviews revealed that English second language students felt more confident about the chemistry content when collaborating with their peers in the SI sessions.

According to students responses, unlike the chemistry lectures, which limited the opportunities for engagement and discussion, SI sessions allowed students to engage with the chemistry concepts through activities such as discussion, problem solving and reflection on task:

> *I've developed the skills of working with other people in small groups which makes me understand my work much better. We get to discuss the questions together in isiZulu before we attempt them on our own.*

> *I also get to ask questions to improve my understanding of chemistry by asking my colleagues to explain to me in isiZulu.*

It was apparent from the data that English second language students valued the peer learning opportunities offered by SI sessions the most, since these sessions offered small group learning opportunities as well

as prospects for reflective learning and engagement with chemistry concepts in isiZulu.

5. *The Profile of SI Attendees with Respect to Prior Academic Achievement*

The category prior academic achievement was analysed against the matric points acquired by students in their final year at high school and SI attendance.

Fig. 6 Matric points in relation to SI attendance
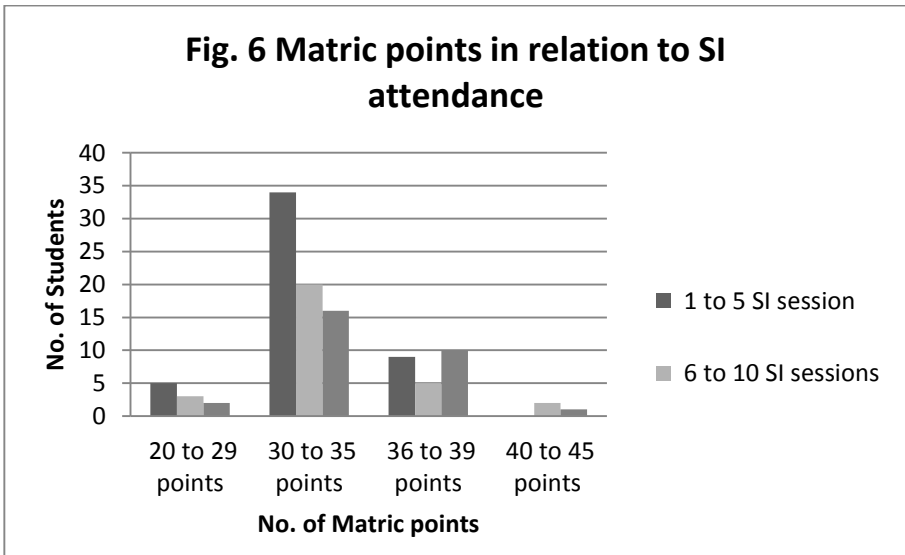
From the results in Fig. 6 it can be interpreted that students with matric points from 30 to 35 attended SI sessions more regularly followed by those with matric points from 36 to 39. It is evident that those in range of 40 to 45 either attended SI sessions to maintain their results or that the majority of students within this category felt that they did not need the support. The students with a matric point range of 20 to 29 showed below 5% attendance of SI sessions which is an interesting phenomenon for further investigation in an attempt to understand why this category of students do not make use of the academic support programme. The correlation between low matric scores and low

attendance is surprising because one would assume that students within this range would access SI sessions more frequently considering their low matric scores and the possibility of developing an 'at risk' status and of possibly failing the semester or being excluded from the academic programme.

Focus group interviews revealed the following responses:

I attend chemistry SI to ensure that I get good grades. I was an 'A' candidate in school but I did not do too well in my first test so I decided to join SI. I have done much better in Test 2 since I have been attending SI sessions.

A number of studies have examined the relationship between students' A-level points on entry and their final degree classification to determine how previous educational attainment can be used to predict undergraduate performance and progression. The results from these studies have implications not only for admissions policies, but also for the costs of widening participation in higher education.

McCarey *et al.* (2006) demonstrated that students with high entry qualifications attained consistently better grades than those with lower level entry qualifications. Indeed, evidence suggests that students who perform well in secondary education usually continue in this vein throughout their student life (McKenzie & Schweitzer 2001; Jansen 2004). Of course, on the other hand, students with strong prior attainment tend to enroll in particular sorts of universities where there may be cultural factors which impact on their performance or their behaviour. Conversely, Chapman (1996) found a significant positive correlation between entry qualifications and degree results for eight disciplines over a 21year period. However, the strength of the relationship varied, depending on whether the subjects were at an institutional or departmental level, with some displaying consistently counter-intuitive combinations of above-average entry qualifications and below-average attainment (and vice versa). A decade later, Gbore (2006) confirmed that the general background knowledge in the same subject matter area did facilitate learning of new material and in a similar academic tasks in the future, but examinations did not always consistently measure present achievement or accurately predict future performance because performance is not static but changes as interest and attitudes change over time and the emergence of new abilities.

Nevertheless, one still expects that the students with the lowest matric entry level scores would access the SI support programme the most which is certainly not the case as indicated by the data. The data about the cohort of students who access the SI support programme the least, is alarming considering that these students might be the target population for such academic support programmes. It is apparent from the data that a lack of knowledge and awareness of university support programmes by students could be one of the root causes for poor performance at university.

Conclusion

The results that have evolved from the questionnaire that were given to first year chemistry students in semester one of their studies reveals several key issues which are vital in planning, supporting and assessing the SI academic support programme. The questionnaire revealed vital information with respect to who is seeking academic support and the focus group interviews revealed why students seek this type of support. In particular, the profile of the chemistry SI attendee is most likely to be a female student in their first year of study who resides in the university campus residence, is an English 2nd language student with a National Senior Certificate matric with points ranging from 30-35. This information may be beneficial to the academic planners, teachers and administrators of chemistry SI courses in higher education, as it could be utilized to increase SI attendance of students who are most at risk of dropping out.

It is also evident that the greater the number of SI sessions and academic support programmes students attend the less likely they are to fail and the greater the chance of achieving high grades (Fraser & Killen 2003). However, correlation is not causality and attendance alone does not ensure that a student is learning. Research has shown that for a few students despite consistently attending lectures and academic support programmes, they have attained poor assessment results (Newman-Ford *et al* 2009). The focus group interviews have revealed students' feeling of belonging and a sense of confidence in their abilities after regular attendance at SI which is encouraging when considering that academic success is more likely by students with high positive motivation and persistence.

The data seems to be in the direction of a positive correlation be-

tween attendance and prior attainment with respect to points obtained in the matric examination and SI attendance, which needs to be validated by a correlation study. This would suggest that a number of undergraduates had already established good work ethics which contributed to their previous success. Therefore, one may conclude, that regular attendance at both lectures and academic support programmes should result in persistence and retention. It is alarming though that the students with the lowest matric scores access the academic support programme the least. These findings could initiate mechanisms to ensure that the academic support programme is marketed more effectively to ensure that all students benefit from the programme.

Furthermore, it has been noted that students who reside away from home while at university achieved significantly better grades than those living at home, and that they also attended significantly more SI sessions than the peers who lived at home. Poor attendance patterns of the academic support programme appears to be a particularly good indicator of educational disengagement, reinforcing the importance of reliable attendance monitoring systems for the quick identification of persistent absentees and to increase attendance. It can be concluded that students' gender and year of study appear to have little impact on educational achievement during the first year of study. In contrast, the place of residence, prior attainment, language barriers and attendance had more significant effects on academic achievement and retention.

Finally, it is important for more research to be carried to refine the profile of the students attending the Chemistry SI sessions and to fathom the reasons for attendance or non-attendance. Deepening our collective understanding about those who attend higher education support programmes means that we can design programmes that aligned to the students who are most likely to benefit from support structures, as well as to attract those who are most likely not to attend. University education is expensive and every effort to address student retention and throughput has benefits for a wider society.

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Vino Paideya

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Vinodhani Paideya
School of Chemistry & Physics
University of KwaZulu Natal
paideya@ukzn.ac.za