Diversity and first-year student integration in an engineering faculty

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Abstract

Within the backdrop of widening access to higher education in South Africa, shortage of skilled engineers, and a lack of ethnic representation in engineering professions, South Africa's universities are increasingly having a more diverse student profiles. However, government funded subsidies directed at reducing student attrition and poor throughput rates do not often yield the desired results. Most of the students who struggle to cope with first-year university studies come from a poor background with inadequate schooling and poor preparation for tertiary studies. These students are often perceived in the same frame as their counterparts who come from more resourced backgrounds.

This paper employs Bourdieu's concepts of habitus and capital in order to explore the influence of socio-economic factors in the retention of first-year university students in an engineering discipline. Using a case study approach whereby data was collected through surveys and focus group discussions, rich data from first-year engineering students at a university of technology in South Africa was extracted. The findings highlight some of the often ignored factors that account for poor retention and throughputs in engineering education within the context of unequal access to resources. The paper argues that these universities need to shift their gaze to the structural conditions such as poverty, poor schooling, first generation students, and lack of world view dispositions, as factors that constrain the integration and persistence of diverse students into the engineering profession.

Introduction

South Africa is a country known for its rich natural, ethnic, religious, and cultural diversity (Seekings, 2008). It is also a country with a turbulent historical past that has contributed enormously to current economic and social inequalities that the country faces (Badat, 2010). Such inequalities ultimately affect access and success of schooling at different levels (Donohue & Bornman, 2014). Many South African students enter the university from positions of extreme disparity, most noticeably is schooling, but also in terms of financial and social resources (Scott, Yeld & Hendry, 2007). Furthermore, there is huge under-representation and poor graduate numbers for students from previously disadvantaged backgrounds especially in disciplines like engineering, mathematics, and sciences (Akoojee & Nkomo, 2007). This is an indication that students entering university have diverse learning support needs which are related to their social, cultural and schooling transitions (Dumais & Ward, 2010). Consequently, universities in South Africa are expected to transform their curriculum and pedagogic practices to reflect the diverse nature of the country and to meet the economic and

social aspirations of the country (Banks, 2015). This paper explores how first-year students' socio-economic conditions affect retention and throughputs in an engineering faculty. Using Bourdieu's framework of habitus and capital, the paper argues that in a context of massive inequalities and difference, a university's disregard of first-year students' historical, social and economic backgrounds result in inefficient utilization of learning support being provided on campus. We suggest the use of theory to frame a more nuanced understanding of first-year learning in engineering.

Capital and habitus: Bourdieu's perspective of learning and society

Pierre Bourdieu is a French sociologist, anthropologist, and philosopher who spent some time as a French military conscript and also as a lecturer in Algeria. His research is dominated by issues of power and how it is perceived in the society (2002). Using innovative investigative frameworks, Bourdieu introduced influential concepts in sociology such as cultural, social and symbolic forms of capital, cultural reproduction, habitus, field and location (Fowler, 1997).

Habitus, for Bourdieu, is a system of dispositions (Grenfell, 2012). It expresses the clash between objectivism and subjectivism (Navarro, 2006). Through habitus, Bourdieu articulates how agents' dispositions is an inculcation of objective social structures into subjective mental experiences (Shusterman, 1999). This is a key outcome of Bourdieu's field theory, and its unique contribution is his extrapolation of habitus and doxa. An agent (any individual) has deeply ingrained beliefs and values seating in the unconscious which they take as self-evident universals (dispositions) and which influences the agents' actions and thoughts within a particular field (Grenfell, 2012). He states that we experience doxa when we become blind to the limits that propel inequality in the society; 'an adherence to relations of order which, because they structure inseparably both the real world and the thought world, are accepted as self-evident' (Bourdieu, 1984, p. 471). For Bourdieu therefore, habitus is crucial towards social reproduction because it enables the generation and reproduction of practices that constitute social life (Bourdieu, 1990). This conceptualization of habitus and field offers methodological and theoretical tools to understand the objective-subjective antinomy in the social sciences (Jenkins, 2002). Any given community has rules (structure/social laws) which are explicitly and tacitly demonstrated by how the people (agents) in that community think, perceive, and do things (agency). This relationship between structure and agency can be significant in how we understand first-year students' challenges in an engineering faculty within the backdrop of inequality and difference. In this regard, Bourdieu offers the term 'reflective sociology' (Navarro, 2006) to enable us to identify our own biases, beliefs, and assumptions as we attempt to rationalize the dismal first-year engineering students' retention statistics.

Capital and symbolic violence

The conventional Economics definition of capital, as the use of sums of money or assets to produce new wealth, is extended in Bourdieu's theory (Grenfell, 2012). Bourdieu suggests that there are several forms of capital, such as economic, symbolic, cultural and social (Shusterman, 1999). Cultural capital refers to qualities and competencies, qualifications that are seen as cultural assets in a society. Linked to cultural capital is economic capital, which is the ability to purchase a good or service (Fowler, 1997). Economic capital looks at the opportunity cost of purchasing a good or service (De Graaf, De Graaf & Kraaykamp, 2000). When social networks are created, and trust, reciprocity, transactions, and cooperation are established based on such networks, Bourdieu sees social capital (Bourdieu, 1986). Symbolic capital refers to the ability to garner prestige, honor, and attention as a source of power (Grenfell, 2012). These forms of capital give the holders authority over those that do not have them. When symbolic

capital is used against members of a society who lack such capital, it is referred to as symbolic violence (Jenkins, 2002). The concept of symbolic violence is crucial in challenging the practice (of universities in South Africa) of negating the historical, social, economic, political and cultural attributes that constrain first-year students' access to the engineering discipline in a context of inequality.

Context

This paper is set within the backdrop of the recently introduced First-Year Experience project in some universities across South Africa. The authors of this paper are academics involved at different levels in the conceptualization, planning, and delivering of the First-Year Experience program in one of such university in the Western Cape Province. As a consequence of post-apartheid liberalization of South Africa's higher education landscape, the majority of our students are profiled as coming from previously disadvantaged backgrounds and most of them are not sufficiently prepared to study the disciplines for which they enroll in. Such profiling often fails to appreciate the kinds of capital that these students tap into in order to make it to the university. Therefore, we as practitioners of academic development programs that seeks to improve student learning in challenging disciplines such as engineering are interested in theories and frameworks that enhance our understanding of the role of power dynamics and uneven access to economic resources as constraining first-year student learning. All the students reported in this paper were enrolled in the Faculty of Engineering at a university in the Western Cape in the 2016 academic year.

Methodology

This paper employs a case study approach in order to understand a phenomenon within clearly define conditions and in a real-life context (Yin, 2003). The methodology used in this study is a concurrent mixed data collection, relying largely on a quantitative questionnaire that probed students' perceptions of their readiness to engage in engineering studies at a university. The data reported in this paper is part of an institution-wide study that seeks to explore first-year learning at a university of technology in South Africa. The questions in the questionnaire were framed to extract information that responds to themes such as family background, economic and social conditions of students, and perceptions of readiness to study. This was necessary to enable a theory-based analysis of the findings. The survey was administered prior to the commencement of lectures for first-year students in 2016. Students from all the departments in the faculty participated in the surveys and discussions.

The data from the questionnaire was supported by concurrent focus group interviews with students, as well as informal discussions to further understand the responses that the students provided in the questionnaire. The focus group interviews and informal discussions provided subtle details that we could not have easily found if we had used only surveys. The focus group interviews and informal discussions also provided qualitative data that complemented the quantitative statistics obtained from the surveys (Denzin, 2012). While the quantitative data was captured in appropriate graphs and tables, we employed the thematic approach (Braune & Clarke, 2006) to classify and code the qualitative data. This helped us in finding correlations and specific details for analysis.

742 students out of an estimated 1800 first-year students from 6 departments (out of 8 departments that make up the faculty) participated in the surveys. This was a controlled sample of students based on the planning of the subject-specific lecturers. Because lecturers from the departments were involved as co-facilitators of the first-year experience program, they were able to make referrals of students who participated in the focus group discussions. Such

workshops and discussions happened as per department schedule, with an average of 18 students per department attending. In order not to put extra strain on the students, the subject-specific lecturers ensured that focus group discussions were planned and time allocated in the timetable. The students were not compelled to participate in the surveys, and they all signed consent forms that were read to them. Ethics Clearance for this project was obtained from the institutional ethics office.

Findings and discussions

This paper argues that first-year students' socio-economic backgrounds are not adequately foregrounded by university authorities when planning first-year student support. We use Bourdieu's concepts of habitus and capital to argue that a history of discrimination, repression, uneven access to economic resources, and unequal provision of pre-university schooling are significant attributes that constrain most first-year students who enroll for engineering qualifications in our context. We demonstrate this by presenting statistics extracted from 742 students in 6 departments in the Faculty of Engineering at a university in South Africa (see Table 1).

Table 1. Extract from Student Survey.

	Dept 1		Dept 2		Dept 3		Dept 4		Dept 5		Dept 6		Faculty	
Question/Statement	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
	%	%	%	%	%	%	%	%	%	%	%	%	%	%
Qualification was first choice	72	28	53	47	75	24	78	22	25	75	80	19	73	26
Qualification is aligned to career path	91	7	86	14	93	7	96	3	83	13	95	5	93	6
I knew about qualification before admission	86	14	65	33	80	19	91	9	58	42	86	13	83	16
School prepared me for CPUT demands	84	16	89	10	77	22	85	15	88	13	88	11	85	14
I have confidence in my capabilities to succeed	99	1	96	4	91	9	96	4	92	8	97	3	96	4
I have specific goals to motivate me	95	5	93	7	94	6	97	3	96	4	96	4	95	4
I know how to study	88	12	82	18	87	13	78	22	75	25	88	11	84	16
I know how to prepare for tests	84	16	75	25	80	19	75	25	63	38	82	16	79	21
I know how to do assignments	72	28	57	43	71	28	61	38	46	54	62	38	63	36
I manage time well	77	23	76	24	65	33	82	18	67	33	88	12	80	20
I feel stressed and cannot focus	17	83	26	74	32	68	20	81	46	54	18	81	22	77
I have self-discipline to pull me through my studies	94	6	92	8	89	11	94	6	83	17	93	5	93	7
I can control anxiety and stress before and after tests	80	20	71	29	77	20	74	26	63	38	81	18	77	23
I tend to give in to negative pressure	14	86	4	96	7	90	7	94	4	96	8	91	8	92
I experience relationship problems	8	92	22	76	23	77	21	80	29	71	17	82	19	81
I have sufficient funds to complete my studies	51	49	36	64	49	50	58	42	17	83	40	59	47	53
Poverty will affect my ability to study	19	80	39	61	24	74	21	78	58	42	36	63	29	70
I have conducive living conditions that support my studies	87	13	67	33	67	32	74	26	50	46	70	29	72	28
Transport is a challenge that can affect my studies	37	63	57	43	41	57	42	58	46	50	53	47	46	53
My parents support with my studies	85	15	79	21	68	30	78	22	58	33	74	26	75	24
I exercise regularly	55	44	28	72	39	60	53	47	38	58	47	52	46	53
I am aware of campus resources that support my studies	70	30	82	18	75	23	95	5	92	4	79	20	83	17

Socio-economic capital: financial readiness for higher education

A major indicator of a student's readiness to embark on higher education in South Africa is the student's (or parents') ability to fund the study. Owing to the debilitating economic conditions of many South African families, most of the learners who qualify for tertiary education cannot afford to pay for such studies. In Chart 1 below we find that 52.8% of first-year engineering students do not have sufficient funds for their studies. Furthermore, 23.9% of the students in the faculty also indicate that their parents cannot support them. Surprisingly, only 16.6% of these students indicate that they are aware of resources on campus to support them.

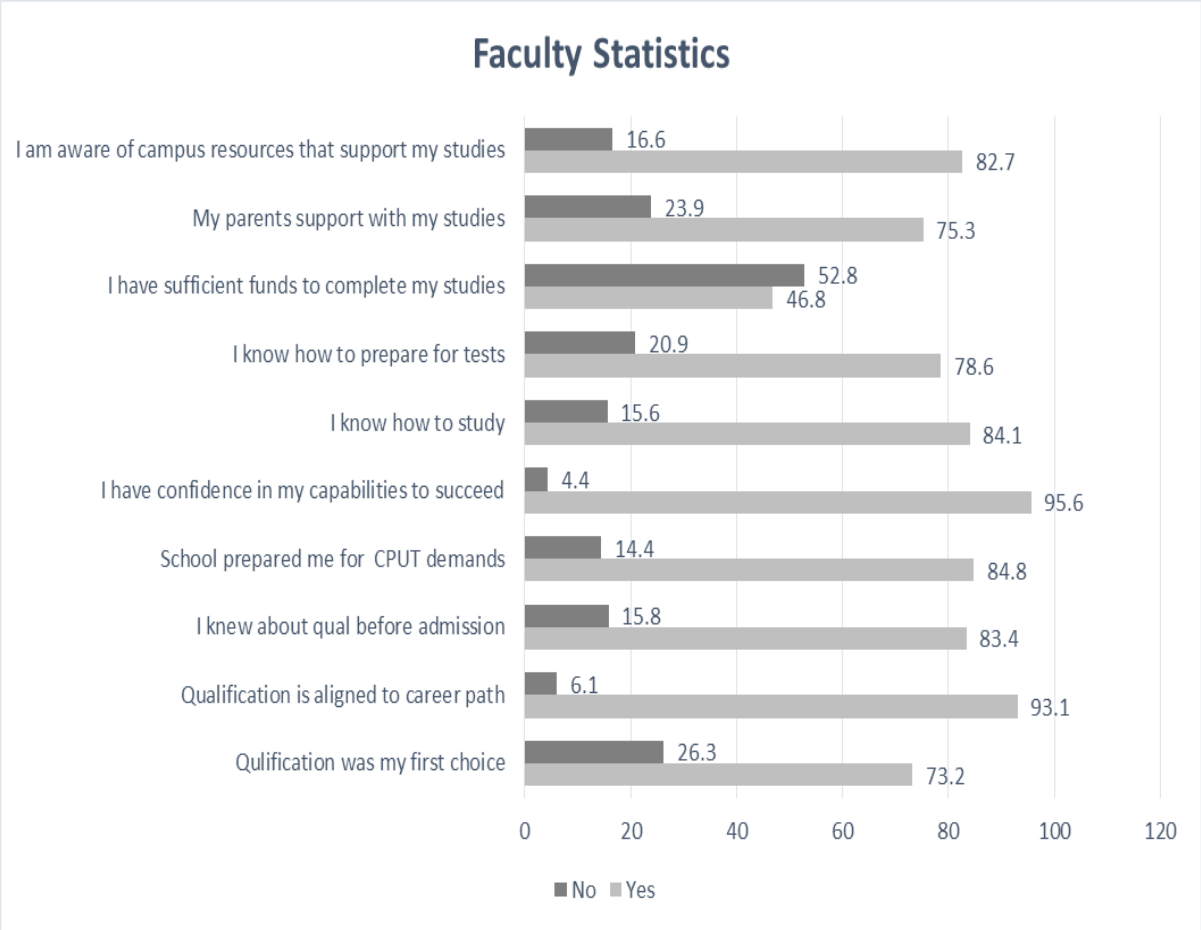

Chart 1. Faculty Statistics.

It is possible to consider that these first-year students in the engineering faculty consider the lack of resources as normal. In one of the focus group interviews, Tombela explained as follows:

> Because my matric grades were ok, I got my NSFAS (National Student Financial Aid Scheme). So I think I am sorted. But now, you ask whether we have laptops and stuff. The NSFAS is not enough, so maybe next year, I will buy it. I didn't budget for it in the NSFAS and I don't think it is right to go back to them now and ask. For now, I will just manage and use my classmates' laptop whenever I can [Tombela[1], 19yrs old, Civil Engineering student].

[1] All names of participants used have been changed for purposes of confidentiality

Tombela's account above supports the statistics provided in Chart 1 above. From focus group discussion, some students confirm that while they are under-resourced at home, there seems to be clear inertia in making use of support that is available to the University. This is not just a case of ignorance of such support. It is more related to a predisposition to not enquire; to not be assertive enough to request for such support from staff in the university. De Graaf et al. (2000, p. 93) explain that 'cultural resources include familiarity with conceptual codes that underlie a specific culture with major artistic and normative manifestations. These can include high-status cultural signals such as behaviors, tastes, and attitudes (Lareau & Horvat, 1999; Farkas, 1996). Therefore, a student coming from a poor and impoverished background, who cannot articulate their needs clearly will not be able to get the help that is available within the university. This can be considered as an example of symbolic violence. It suggests that beyond a mastery of mathematics and physical sciences, a typical previously disadvantaged student from an impoverished background lacks the dispositions to engage with campus life proactively. This is captured vividly when Tombela says '… I don't think it is right to go back to them now and ask'.

Cultural capital: prior schooling and world view

In his book *Distinction: A social critique of judgment and taste*, Bourdieu (1984) asserts that judgments of taste are related to social position, or more precisely, are themselves acts of social positioning. The relationship between market forces and university education is what currently defines contemporary higher education systems globally (Coward, 2013). Thus, disciplines like engineering and medicine to name a few are now seen as high-status vocations whose training is more expensive compared to other disciplines such as Chemistry or History. De Graaf et al (2000, p. 94) explain that 'cultural capital theory usually refers to the importance of socialization into highbrow activities, like interest in art and classical music, theater, and museum attendance'. This view purports that learners who do not participate in such activities would find it difficult to 'fit in' the schooling environment. While this is a debatable view, our experience in supporting first-year students with academic writing activities indicate that students who master particular study skills such as the SQ3R method of reading (for example) cope with university reading tasks better than those who do not. These are skills that these students are expected to bring their pre-university education experience.

From Chart 1 above, we find that 26.3% of the students did not select as 'First choice' the discipline that they are currently studying for. Also, 15.8% of the students did not know anything about the qualifications before they enrolled. While only 4.4% of the students do not have confidence in their own capabilities, it is worrying that a further 15.6% of the students confessed that they do not know how to study; and 20.9% of them do not know how to prepare for exams. This is clear indication that almost 25% of the students do not have life skills that can enable them to negotiate University with a degree of independence. Vuyo puts this vividly when he says

> I was just very happy that I finally got here. I think all my friends here will tell you the same thing. Once we passed matric, we just wanted to come to the university. Me and Nic and Temba applied to the other universities but were not taken. Then we came here and we were accepted; even though it was not in our first choice. I wanted to do Mechanical Engineering, but they put me in Clothing and Textile Technology. But it's cool [Vuyo, 20yrs old, Clothing and Textile Technology student].

From Vuyo's narration above, it is evident that his decision to study at a university was not well planned. Once confronted with the fact that he has passed the Senior Certificate examinations, he then realized that the next logical step is to embark on university studies. Without proper planning and career guidance, he is gambling with the choice of discipline to

study and the choice of institution to study at. This is a common trait in first generation students as explained by another student below:

> Sir, I am the first to come to the university in our house. I asked my friend who had a sister in the university, then she said Civil Engineering is ok and that you can get good jobs when you graduate. So I applied to study Civil, but now I am worried. I want to study by Chemistry because it is my best subject and I understand it better. So maybe next year I will apply to switch to Chemical Engineering [Nelly, 21yrs old, Civil Engineering student]

DiMaggio (1982) in a pioneer research on the influence of cultural capital on educational attainment announced that cultural resources enable educational outcomes (school grades) even when factors such as parental influence are considered. This, therefore, means that poverty alone is not enough to account for Nelly's and Vuyo's predicaments in the university. Their situation is also influenced by the fact that they live in environments where people just do not talk about children's career trajectories.

Symbolic violence: habitus and (lack of) skills and abilities

As previously intimated in this paper, Bourdieu strongly affirms that symbolic violence is a key concept that enables us to deconstruct the reproduction of inequalities in societies (Bourdieu & Passeron, 1977; Bourdieu, 1990). Symbolic violence exposes the way people contribute towards 'reproducing their own subordination' through the cumulative and 'gradual internalization and acceptance of those ideas and structures that tend to subordinate them (Connolly & Healy, 2004). The skill sets that first-year students possess to determine how they perform. When looking at the basic skill sets that students should have at the university, such as academic literacy, there is a concern that shows a great need for support. To illustrate this, the graph below shows the percentage of students who feel they know how to study independently, gradually increasing for students who do not know how to prepare for tests and for students who do not know how to do assignments.

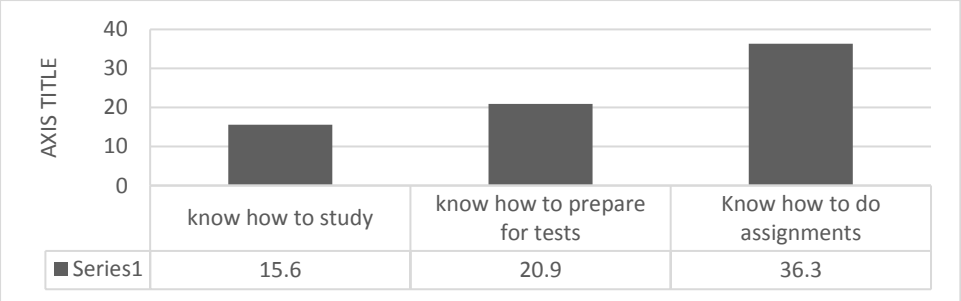

Chart 2: Academic readiness.

When studying the above graph alone, the average weighting of assignments marks at the faculty of engineering is on average around 20% and tests being around 60% (including final summative assessment). It means that about 20% of the marks is reserved for practical assessments. From the focus group discussions, we see more clearly elements of symbolic violence at play here:

> You know, in high school you just relax and do your thing. When exams are approaching, then you start studying and revising hard so that you can remember the stuff on exam day. So, if exams are not around the corner, I don't study after school. Now I am struggling to adapt here in the university because there are just too many assignments and group projects. It is difficult to find time to chill [Nic, 20yrs old, Mechanical Engineering student]

Student: I am behind schedule with 2 of my individual assignments and 1 group project. I am worried that I might lose marks as a penalty for late submission.

Interviewer: What is the cause of you being so late with your assignments?

Student: Sir, the assignments were too many and the time was too short. Just the other day we were planning to do it with my mates before you know it, the due date is here.

Interview: How did you plan? Did you write down your plan somewhere like in a diary or personal planner?

Student: No Sir. We just discussed it and agreed that we will find time on the weekend and discuss the assignments and projects. We missed the weekend meeting and … [dialogue between Dora, 21yrs old Chemical engineering student and First Year Experience workshop facilitator]

What stands out in the two extracts above is that there is some evidence that some first-year engineering students are reproducing their high school ways of learning and knowing in the university. Even though these students have been provided with tools such as time management and goal setting, they seem to struggle to use these tools to achieve their goals. The poor utilization of institutional resources such as the Writing Centre and First Year Experience Unit is an example of symbolic violence. This ends up creating frustration for both the students and their lecturers, especially when the students fail in their assessments. One of the participating lecturer captures such a frustration vividly below:

> What our students, or at least my students to be specific, are suffering from is a strong sense of inertia or misdirection. I know that many of these students come from very difficult backgrounds; but surely if you have the drive to succeed and graduate on time, then you must be actively looking for all the help you can get in order to achieve your goals. Many of these students are not doing that; they are nothing asking for help, they are not using the learning support services, they are not engaging in positive extramural activities such as sports and competitions. Go to our gyms and sporting fields, you don't find them there. Those things are there to keep the students mentally alert. Instead, they just wait until they fail, then they panic. Is that not inertia? To be an engineer is beyond just taking up a profession; it is a way of life. We need to find ways to get these students to see this [Dr. Robertson, lecturer, Civil Engineering]

Dr. Robertson's narration above can be better understood by reading symbolic violence carefully. He identifies the lack of use of student learning support structures such as Writing Centre as symbolic of student's passive attitude towards their studies. He further explains this by adding that the students are not using social support services such as gyms and sports centers. Bourdieu argues that symbolic violence:

> presupposes on the part of those who are subjected to it a form of complicity which is neither a passive submission to an external constraint nor a free adherence to values … The specificity of symbolic violence resides precisely in the fact that it requires of the person who undergoes it an attitude which defies the ordinary alternative between freedom and constraint (Bourdieu & Wacquant, 1992, p. 168)

In essence, the concept of symbolic violence helps us to see why some students are not utilizing learning and social support structures in the university. It provides a more nuanced interpretation of the social conditions (habitus) and experiences of the social world ('institutions and structures') that cumulatively accounts for 'taken for granted ways of thinking and behaving' (Connolly & Healy, 2004, p. 16). There is a correlation between physical exercise/activity and academic performance (Khan, Jamil, Khan & Kareem, 2012). 53% of the students indicated that they do not engage in any sporting activities, despite many of them acknowledging that participation in sports improves student's grades, academic

achievement, raises their educational aspirations and keeps them in schools and colleges (Khan et al., 2012). Reading such trends using the lens of Bourdieu's concepts of capital and habitus, we can be able to challenge the hegemonic narrative of first-year student support especially in disciplines such as engineering; and to suggest that academic development practitioners need to go beyond such convenient student support models in order to adequately support students from difficult backgrounds (Tierney, 1999).

Conclusion

A university qualification means different things to different people. As indicated already, South Africa is a country recovering from the effects of a history of discrimination and inequalities. This means that while the widening of access to higher education is seen as a welcome panacea to the thousands of previously disadvantaged students, it is also important to begin the difficult conversation of questioning the quality of teaching and learning that these students will confront. Considering that the government, through the Department of Higher Education and Training, is disbursing huge sums of monies to subsidize undergraduate student learning support initiatives, it is paradoxical that retention and throughput rates continue to decrease.

In this paper, we borrow from Bourdieu's concepts of habitus and capital in order to explore the influence of socio-economic factors on first-year engineering students' retention. By doing so, we problematize the attitudes of universities to ignore students' habitus and capital in their planning. We propose that in the context of strong economic, social, political, and historical inequalities, universities in South Africa should not see first-year students as a homogenous entity. In a discipline such as engineering, many of the students who come from previously disadvantaged homes see the Engineering qualification as the only route out of poverty. The opportunity cost of studying for such student is so high that it will be very unfair to not acknowledge these students 'out-of-school' conditions when designing their learning support.

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