Original Paper

Student Profiling as a Tool for Inclusive Instructional Design: A Case of a 3rd Year Biotechnology Class, University of Namibia

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Abstract

Massification of Higher Education (HE) has made it difficult for teachers to design instructional strategies that are responsive to the diverse student needs. We here argue that student profiling is a handy tool that the HE teacher can use for inclusive instructional design by thoughtfully selecting learning and teaching strategies, and materials and supports that will maximise student achievement. We designed a student-profiling instrument focusing on capturing students' biographical information, learning preferences, anticipated learning outcomes, personality traits, and learning related skills-set and administered to students in a 3rd Year Biotechnology class at the University of Namibia. The data on learning style preferences was analysed using the VARK Questionnaire (version 8.01) while a Chi-square (χ^2) test of association (SPSS software version 24) was used to determine whether there was a relationship between students' preferred learning styles and the other variables. Seventy-five percent (75%) of the students had multimodal learning preferences while 25% were unimodal for kinesthetic learning style. No students preferred visual or auditory learning alone. The χ^2 test revealed no significant relationship between students' preferred learning styles and any of the other variables including age, place of origin, home language, home setting, residence during school semester, pre-course anticipation, skills set, and personality traits (P > 0.05). We conclude that profiling students' learning preferences prior to teaching and learning helps HE teachers to tailor their instructional strategies to students' learning style preferences, maximises epistemological access, as well as enhance inclusivity, equality and equity.

Keywords

student-profiling, higher education, inclusive instructional design, learning preferences, VARK

1. Introduction

Student profiles are mostly shaped by their respective backgrounds (familial, cultural, economic, and academic), personalities (Dart, 1994; Duffin & Gray 2010; Hamdani, 2015; Bhagat et al., 2019), as well as their learning style preferences (Cekiso, 2011; Khurshid, 2014; Kwembeya & Mbukusa, 2019). Massification and internationalisation of Higher Education (HE) have brought about a radical diversification of students who "vary enormously in what they bring to *any* course and what they need from it" (Northedge, 2003). For far too long, teachers in HE institutions have opted to use a "wide variety of teaching activities, hoping that they will cover most student learning preferences along the way" (Diaz & Cartnal 1999), which has not necessarily been the case. There still exists a need, therefore, for teachers to consider "student diversity in their mainstream teaching and learning approaches *so as* to enable students to realise their potential" (Nyamupangedengu, 2017).

In order to teach in a manner that is responsive to students learning styles, the first part is to know one's students. Nyamupangedengu (2017) argues that "knowledge of one's students is a pre-requisite if lecturers are to choose teaching strategies that would enable epistemological access." Such knowledge can be obtained when, at the very beginning of a semester/school term, and before teaching and learning commences, teachers profile their students. This way, a teacher will know beforehand which teaching strategies are likely to respond to students learning styles (Nyamupangedengu, 2017). Not that every learning style suggested by students should be adhered to. But, as Biggs and Tang (2011, p. 16) point out, "students may use learning activities that are of lower cognitive level than are needed to achieve the outcomes, resulting in a surface approach to learning; or they can use high level activities appropriate for achieving the intended outcomes, resulting in a deep approach to learning. Good teaching is that which supports the appropriate learning activities and discourages inappropriate ones."

1.1 Defining Learning Styles

Different nuances exist as to what exactly the phrase learning styles entails, especially when applied to students in a Higher Education (HE) context. In this context, we adopted the definition of Marcy (2001) who defined learning styles as "methods of gathering, processing, interpreting, organizing and thinking about information." Various models have been used to explain the concept of learning styles. An example is the Grasha-Reichmann Student Learning Style Scales (GRSLSS) which categorises student learning into six styles including independent, dependent, competitive, collaborative, avoidant, and participant leaners (Diaz & Cartnal, 1999; İlçin *et al*., 2018). Fry, Ketteridge, and Marshall (2003, p. 16) and Milanese, Gordon, and Pellatt (2013) also describe how students' learning styles vary from Convergent, Divergent, Assimilative and Accommodative styles (CDAA), based on the work of Wolf and Kolb. Then there is also debate about the deep versus surface learning *approaches* (Baeten *et al.*, 2013). We drew a line between learning approaches and learning styles on the basis that learning approaches apply to all learning styles that students may identify with, and that it is usually the teachers' role to use teaching strategies that help learners to adopt deep learning approaches, regardless of their learning styles. Without disputing the validity and applicability of the GRSLSS learning styles,

or of Wolf and Kolb's CDAA learning styles, we used the phrases learning styles and/or learning preferences in the context of Felder and Silverman's VARK model which considers how students assimilate information for cognitive processing (Murphy et al., 2004; Deale, 2019). Li, Han, and Fu (2019) argue that conscious awareness of students' learning styles can assist teachers to adjust their teaching strategies to enhance students' learning and performance. Additionally, evaluating student-learning styles provides a means to shifting away from teacher-centered to student-centered learning as teaching is likely to be done in a manner that empowers students to take ownership of their own learning, with the teacher increasingly playing a facilitative role. Table 1 summarises the main student learning preferences under the VARK model, as extracted from Murphy et al. (2004).

Table 1. Student Learning Preferences under the VARK Model

Learning preference	Characteristics
Visual or graphic	Prefer use of diagrams, graphs, flow charts, hierarchies, models, and arrows that represent printed information. They may also explain a concept to others by drawing a diagram or picture.
Auditory	Prefer to listen (to what the teacher says) rather than take notes, discuss presented topics with classmates after class as a means to clarify their understanding. To aid their studying, aural learners may talk out their answers or listen to taped discussions about exam topics.
Read or write	Prefer printed words and text, lists, glossaries, textbooks, lecture notes, or handouts as a means of information intake. These learners prefer to arrange lecture notes into outlines, paraphrase classroom notes, and study old multiple-choice exams.
Kinesthetic	Kinesthetic preference refers to learning achieved with experience and practice. In other words, the kinesthetic learner has to feel or live the experience in order to learn it.

A student may prefer one learning style or be multimodal, in which case multimodal learners prefer learning in more than one style. Importantly, we also argue that differences in students' learning styles are partly attributed to individual students' background environments as well as their personalities. Cheaib (2018) states that "personality influences the behavior of the students in different fields, such as *in* their interactions with colleagues, interactions with teachers, as well as their motivation, academic achievement, and learning." The big five personality traits of neuroticism (N), extraversion (E), openness to experience (O), agreeableness (A) and conscientiousness (C) have been comprehensively described in relation to their effect on student learning (Monteiro et al., 2015; Cheaib, 2018; Khan, *et al*., 2018; Bhagat, *et al*., 2019). As such, it is essential that student personality be also considered

alongside their learning styles to get a holistic understanding of potential barriers to learning in our classes.

1.2 In Defense of Student Profiling

In a bid to improve the quality of teaching in HE, much emphasis has been placed on student evaluations of teaching. For instance, Cho and Baek (2019) report that teaching evaluations allow for the identification of the "various factors operating in the classroom that affect the overall learning process, from those that rest with individual students, to those having to do with classroom teaching, individual instructors, to overall satisfaction..." Our view is that while this approach is noble, it covers only half the aspect towards the attainment of its set objective, the missing link being profiling of students by lecturers. In profiling students, we acknowledge the fact that "education deals with students as people who are diverse in all respects, and ever changing, and that not everyone learns in the same way, or equally readily about all types of material", and that, "students bring different backgrounds and expectations to learning" (Fry, *et al*., 2003, p. 9). We argue that a student-profiling instrument helps in planning instructional strategies that acknowledge and honour these differences by providing each student with opportunities to learn in different ways so that each can reach his or her maximum potential. It is a means for thoughtfully selecting learning and teaching strategies, materials and supports that will maximize student achievement. Further, we argue that, unlike student evaluations of learning which are usually done retrospectively at the end of a semester (and therefore can only make a posthumous contribution to teaching and learning with respect to the class in question), student profiling proactively contributes to student-tailored learning and teaching in real time since it is done before teaching commences.

While a literature search using 'student profiling' or 'student profiles' as key phrases does produce numerous articles (Chansarkar & Michaeloudis, 2001; Darcan & Badur, 2012; Stes & Van Petegem, 2014; Tempelaar *et al*., 2018), few such studies are concerned about pre-module/course profiling of students' preferred learning styles (Cekiso, 2011; Kwembeya & Mbukusa, 2019). It is against this background that we profiled students in a 3rd Year Biotechnology course at the University of Namibia prior to the commencement of teaching and learning with the aim to understand the students' preferred learning styles. In addition, we sought to determine if there were correlations between the students' learning styles and their backgrounds and personalities. By carrying out this study, we sought to address the following questions:

    a) Which learning styles were most preferred by this 3rd Year Biotechnology Class at the University of Namibia?

    b) Was there a relationship between students preferred learning styles and either age, place of origin, home language, home setting (living with parents or not), place of residence during school semester, pre-course anticipation, skills set, or personality traits?

2. Methods

2.1 Student Profiling Instrument

Typically, a profiling instrument seeks to, among other things, capture information about student learning preferences and styles, student interests, differences related to gender, culture and personality, information on student learning strengths, needs and types of supports that have been successful in the past. We designed a student-profiling instrument focusing on the following three parts: Part A: biographical information; Part B: learning styles and anticipated learning outcomes; and, Part C: personality traits and student learning related skills-set. To strike a balance between minimising time demands for the respondents and the need for detail on our part, we designed the instrument in such a way that it consisted of approximately 50% each of closed- and open-ended questions. Closed-ended questions are less time consuming for the respondents, while open-ended questions encourage spontaneity (Desai & Reimers, 2019). And, while closed-questions are good to meet the information needs of discontinuous scenarios, open-ended questions result in detailed responses that are unbiased by experimenter expectations, as well as permit respondents to provide 'socially undesirable' feelings (Singer & Couper, 2017). The instrument was administered to 23 students in the 2020 3rd Year Biotechnology class at the University of Namibia using Google forms. Students were informed of the aim of the survey, including the fact that participation in the survey was voluntary.

2.1.1 Data Analysis

The data on learning style preferences were analysed by the VARK Questionnaire (VARK Questionnaire version 8.01) software on the computer at the following site http://vark-learn.com/the-vark-questionnaire/ to determine the preferred learning styles of the 3rd Year Biotechnology Class at the University of Namibia. To determine whether there was a relationship between students' preferred learning styles and any of the other variables including age, place of origin, home language, home setting, residence during school semester, pre-course anticipation, skills set, and personality traits; a chi-square of association was employed using the Statistical Package for the Social Sciences (SPSS software VERSION 24). Additionally, a thematic content analysis was used to extract relevant information from the questionnaire responses. Consequently, responses with a common theme were assigned a similar code while responses of a discrete nature like place of origin, home language and residence during semester were retained as they were.

3. Results

3.1 Demographic Profile

Fifty-two percent (52%) of the class responded to the survey, and their biographical information is shown in Figure 1.
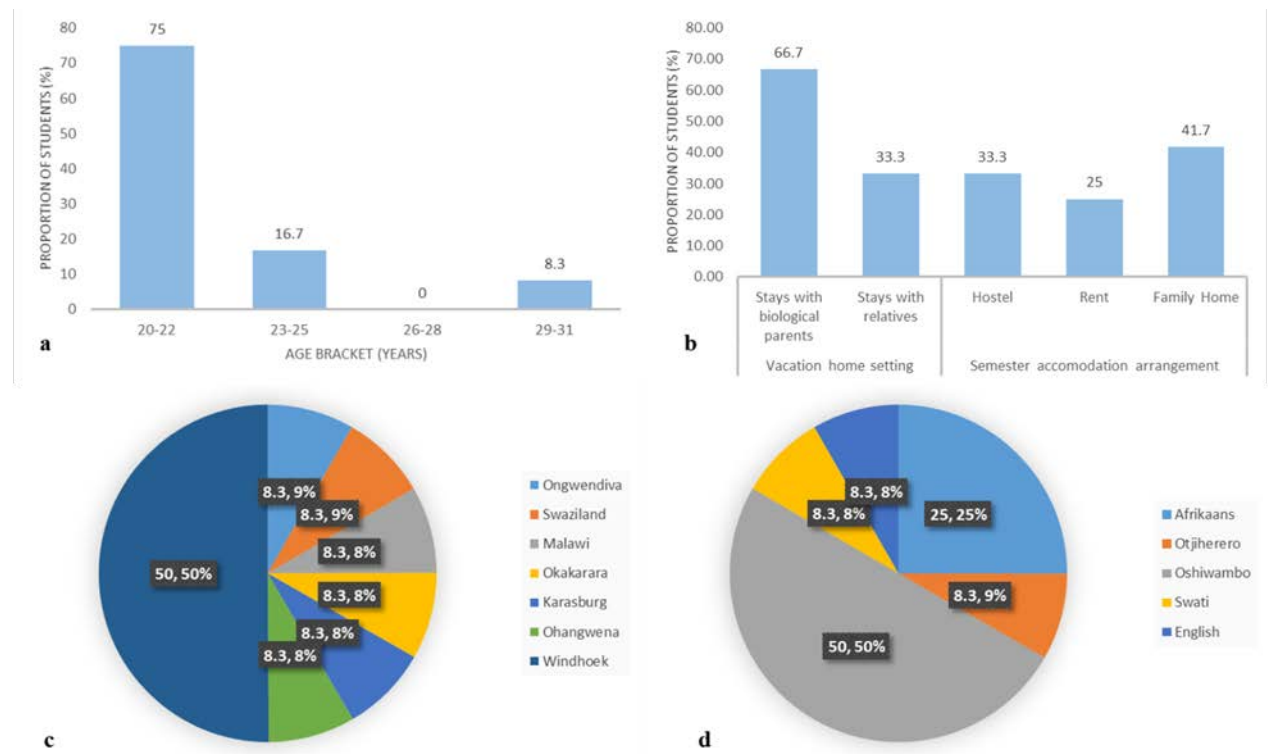
Figure 1. Biographical Information of the Participants Showing (a) Age Profiles, (b) Student Accommodation Settings during Vacation and School Semester, (c) Places of Origin, and (d) Home Language

The students' ages ranged from 20 to 31 years with a mean of 22.6 years and a standard deviation of 2.1 years. The modal age group was 20-22 years. In terms of living arrangements, the majority of the students lived with their biological parents (66.7%). During school term, 41.7% lived in their family homes, 33.3% lived in hostels and 25% lived in rented accommodation. Most of the students came from Windhoek (50.5%). In terms of mother tongue, the Oshiwambo speaking students were the majority (50.5%), followed by the Afrikaans speaking (25.25%), with English, Swati and Otjiherero speaking students constituting 8.3% each.
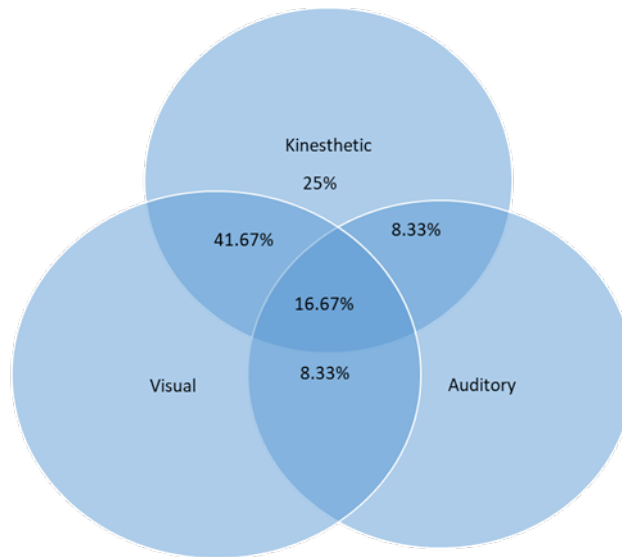
3.2 Learning Style Preferences and Expectations

Table 2 is a presentation of thematically analysed students' expected learning outcomes upon completion of the biotechnology module.

Table 2. Thematically Coded Student Responses about Their Anticipated Learning Outcomes

Student #	Student response	Coding
1	I hope to learn ways of identifying microorganisms both in culture and in the environment, learn techniques that will help me	LT
2	How to use technology to actually alter genes for the benefit of humans	LT
3	Improvement of human health, biofuels, industrial development and other more life-based technologies.	LT
4	Hopefully make a mobile diagnostic kit that is realistically comprehensive. One that a person can use without prior study. The human body is a mystery. If we can get a way to constantly check up on our own health status, maybe humans will try and live better. The need for doctors will still be there, it's just we will assist them with identification of diseases and infections in our own bodies. Much like how women do pregnancy tests but still have to check in at the hospital.	LT&A
5	Different techniques used in science and not just in microbiology.	LT
6	Different techniques used in science and not just in microbiology.	LT
7	Different techniques used in science and not just in microbiology.	LT
8	New technology and techniques in biology that better the life of all living organisms.	LT
9	The skills and importance of the techniques involved in biotechnology.	LT
10	How to manipulate natural processes in order to obtain my goal. Or get close enough to it.	LT&A
11	I don't really know coz it seems like a subjective subject, there doesn't seem to be a unified agreement on anything	NS
12	How to apply technology in the different disciplines of biological sciences to benefit humans and other living organisms.	LT&A

Students' responses fell into three themes. The first comprised of students who hoped to learn the different techniques used in biotechnology (LT); the second comprised of those who hoped to learn the techniques and use (apply) them to produce products (LT&A). Responses for the latter group typically contained the words 'use', 'make', and/or 'apply'. The third category comprised of those who were not sure of what to expect (NS).

Next was the students' learning style preferences, which are presented in Figure 2.

Figure 2. Learning Style Preferences of Students in a 2020 3ʳᵈ Year Biotechnology Class at the University of Namibia

Seventy-five percent (75%) of the students had multimodal learning preferences as shown in Figure 2. While 25% of the students indicated only kinesthetic learning as their preferred learning style (unimodal), no students preferred visual or auditory learning alone. Also, and rather surprisingly, no students preferred the reading/writing learning mode at all.

Students' personality traits and perceived skill sets

Students' perceived learning-related skills are shown in Figure 3.
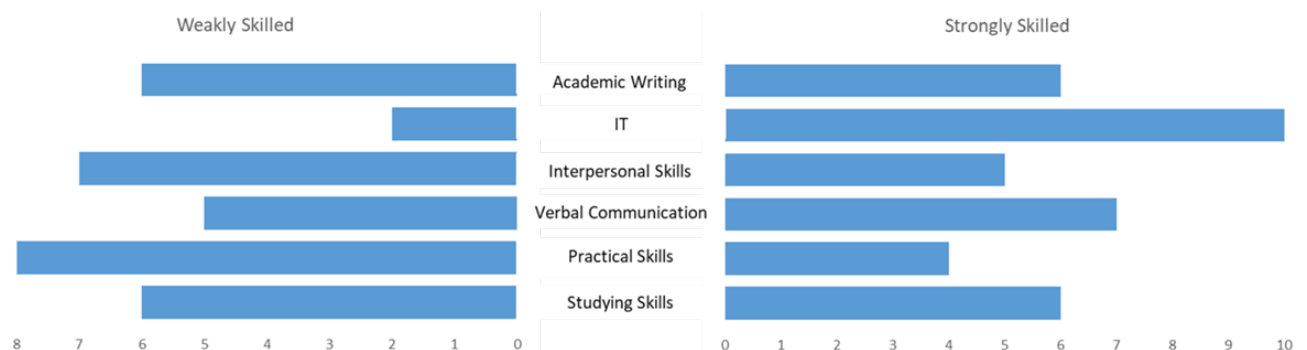
Figure 3. Students' Appreciation of Different Learning Related Skills

Eighty-three percent (83%) of the students indicated that they were strongly-skilled in Information Technology (IT), and 58% in Verbal Communication (VC). Fifty Percent (50%) of the students respectively indicated that they were strongly-skilled in Academic Writing (W) and Study Skills (S). Only 41.7% of the students were strongly skilled in interpersonal skills (Int) and 33.3% in laboratory-based practical skills (P).

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Students' personality taxonomies were deduced by weighing their perceived strengths against their perceived weaknesses as presented in Table 3.

Table 3. Students' Personality Traits as Deduced from Their Strengths and Weaknesses

Student #	Students' perceived strengths	Student's perceived weaknesses	Dominant personality trait(s)
1	1. Curious, like to learn new things	1. Poor time management 2. Lack of motivation in the online studying we are currently doing	Openness (O)
2	1. Cooperative 2. Not easily distracted	1. I do not learn easily as I require further explanations or information	Agreeableness (A)
3	1. Attendance 2. Punctuality	1. (*Fear of*) Asking questions 2. (*Lack of*) Studying before lecture begins.	Introversion (I)
4	1. I am constant - my test results remain within a small range 2. I am always trying to participate in class	1. I need to improve my time management skills.	Conscientiousness (C)
5	1. Visual learning and listening	1. Memory failure 2. Fear of exams	Introversion/ Neuroticism (I+N)
6	1. Visual learning and listening	1. Memory failure 2. Fear of exams	Introversion/+ Neuroticism (I+N)
7	1. Visual learning and listening	1. Memory failure 2. Fear of exams	Introversion/ Neuroticism (I+N)
8	1. Not sure yet	1. Being overwhelmed by work 2. Not doing everything to the best of my ability even though I know I can.	Neuroticism (N)
9	1. Listening and gathering information	1. Keeping up with the pace 2. Opening up about my difficulties	Introversion (I)

10	1. Designing experiments and indicating what applications to use during the experiment. 2. Understanding the methodology behind experimental applications.	1. Have a hard time keeping up with other students socially	Openness (O)
11	1. Finding resources when I'm stuck	1. It's hard to get used to a lecturers teaching method 2. Asking questions	Neuroticism (N)
12	1. Enthusiasm 2. Organized	1. Time management 2. Perfectionist	Conscientiousness (C)

All the big five personality traits (or variations thereof) were identified among the students as shown in Table 3. The Introversion (I) personality is a variant of the Extraversion (E) personality type.

For the purposes of determining the possible correlations between the students' preferred learning styles versus their backgrounds, personality traits, learning related skills, and their anticipated learning outcomes, the coded questionnaire data was cross-tabulated as shown in Table 4.

Table 4. Cross Table Generated from Participating Students' Responses

Student #	Learning Style	Learning related skills	Language	Median age	Place of origin	Live with parents	Residence during semester	Anticipated learning outcome	Personality
1	K	WP	Afrikaans	24	Karasburg	Yes	Renting	LT	O
2	K	IntPS	Otjiherero	21	Okakarara	No	Renting	LT	A
3	VA	ITIntP	Oshiwambo	23	Ohangwena region	No	Family home	LT	I
4	VAK	ITPS	Afrikaans	23	Windhoek	Yes	Family home	LT&A	C
5	VK	WVCP	Oshiwambo	21	Windhoek	Yes	Hostel	LT	I+N
6	VK	WVCP	Oshiwambo	21	Windhoek	Yes	Hostel	LT	I+N
7	VK	WVCP	Oshiwambo	21	Windhoek	Yes	Hostel	LT	I+N
8	AK	IntVCP	Oshiwambo	21	Namibia	Yes	Family	LT	N

			o				home		
9	K	WIntS	Swati	30	Manzini	No	Renting	LT	I
10	VK	ITIntVCP	Afrikaans	21	Windhoek	Yes	Family home	LT&A	O
11	VK	IntPS	English	21	Malawi	Yes	Hostel	NS	N
12	VAK	WIntS	Oshiwambo	24	Ongwediva	No	Family home	LT&A	C

The Chi-square test of association revealed no significant relationship between students' preferred learning styles and any of the other variables including age, place of origin, home language, home setting, residence during school semester, pre-course anticipation, skills set, and personality traits ($P > 0.05$).

4. Discussion

The students' biographical information showed that students in this Biotechnology class came from diverse backgrounds and cultures. A similar observation was made by Kwembeya and Mbukusa (2019) while profiling students in a Biometrics class at the University of Namibia. With increasing student diversity also comes the need for flexible teaching approaches to accommodate students who utilise a wide range of learning style preferences (Cekiso, 2011). With regard to students' learning expectations, we noted that 75% of the students came to class expecting only to learn module content (LT), possibly in preparation for the examinations, with only 25% of the students anticipating channeling their newly-gained knowledge and skills into making products (LT&A) (Table 2). Interestingly, two of the students with LT&A learning expectations had conscientiousness personality taxonomies while the third one had an openness personality (Table 3). Further, these students were amongst those staying with their biological parents, both during the school semester and vacation (Table 4). Khurshid (2014) points out that personality patterns are important for determining students' success, arguing that "students with higher consciousness and openness to experience may be more enthusiastic for success." Khurshid further points out that the home environment plays a critical role in developing personality taxonomies, and may be a major determining factor in leading individuals towards "higher self-concept, positive self-esteem and confident personality."

We also observed that a student's learning preferences do not necessarily equal their perceived strengths, and vice-versa. For example, while 92% of the students indicated kinesthetic learning mode among their preferred learning styles, only 33% of the students indicated laboratory practical skills as one of their strong areas of study (Figure 2 and 3, Table 4). We interpreted the message from the students as saying; *we would learn best by doing something, but when it comes to the practical classes, we need help in learning how to do*. Having this knowledge beforehand prepared us for better teaching this class. For instance, when teaching finally commenced, we set a strong bias towards the practical

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component of the course. We also made more room for enquiry-based learning, making sure that all students were involved in researching about concepts well before they were covered in class.

Statistically, there was no relationship between students' preferred learning styles and any other variables shown in Table 4 including personality traits. This is despite Duffin and Gray (2010)'s observation that the "personality traits of any individual will impact on and influence his or her learning behaviours and dispositions." Based on our findings, we here hypothesise that that relationship could perhaps depend on other factors such as setting.

5. Conclusions

In conclusion, we contend that profiling students' learning preferences prior to teaching and learning in any course/module helps "lecturers to match instructional strategies to learning style preferences of students, and also to design learning material and activities that respond to the needs of learners in order to enhance student engagement and promote academic success" (Cekiso, 2011). In view of student diversity in terms of their backgrounds, skills base, learning styles and expectations, we argue that student profiling is a handy tool for effective design of teaching and learning approaches that maximise epistemological access as well as enhance inclusivity, equality and equity; putting every effort in place to mimimise factors that may constrain or inhibit learning.

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