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The Methodological Consistency of Master's of Education Dissertations at Eduardo Mondlane University (2013 - 2018)

Octavio Zimbico and Arsenia Manuel

Abstract

This study examined the methodological consistency of Master of Education dissertations defended at Eduardo Mondlane University (EMU) from 2013 to 2018 using the typology of educational research proposed by Postlethwaite (2005), Norman et al. (2002), and Creswell (2012). The qualitative, comparative study employed a grounded theory design. Data were gathered from a purposive sample of 33 dissertations, available on the university's Open Institutional Repository. Coding and anonymous analysis were performed of the dissertations' title, research methodology, and findings. The findings reveal that a large number of these dissertations are not methodologically consistent and thus do not lay the foundation for further research and other interventions for school improvement. They thus point to the need to improve the quality of supervision and research in postgraduate studies in Education at EMU.

Key words: EMU, Master's dissertations, educational research, methodological consistency, supervision

Cette étude a examiné la cohérence méthodologique des mémoires de maîtrise en éducation soutenus à l'Université Eduardo Mondlane (EMU) de 2013 à 2018 en utilisant la typologie de la recherche en éducation proposée par Postlethwaite (2005), Norman et al. (2002) et Creswell (2012). L'étude qualitative et comparative a utilisé une conception théorique ancrée. Les données ont été recueillies à partir d'un échantillon intentionnel de 33 thèses, disponibles sur le référentiel institutionnel ouvert de

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l'université. Le codage et l'analyse anonyme ont été effectués sur le titre des thèses, la méthodologie de recherche et les résultats. Les résultats révèlent qu'un grand nombre de ces thèses ne sont pas cohérents sur le plan méthodologique et ne jettent donc pas les bases d'autres recherches et d'autres interventions pour l'amélioration de l'école. Ils soulignent ainsi la nécessité d'améliorer la qualité de l'encadrement et de la recherche dans les études de troisième cycle en éducation à l'UEM.

Mots clés: EMU, mémoires de master, recherche pédagogique, cohérence méthodologique, encadrement.

Introduction

The international literature suggests that the characteristics and trends of education have significant implications for training and research. Maynard et al. (2012) state that the lack of applied research by doctoral candidates reflects a deficit in research capacity within university schools. In order to engage in relevant and applied research, faculty members need to be skilled in advanced research methodologies.

Furthermore, schools need to be committed to conducting applied research, building community-university partnerships, and securing funding to provide opportunities for students to engage in applied research. Maynard et al. (2012) recommend building a research culture and infrastructure within schools to facilitate the training and professionalisation of candidates to engage in practice-relevant research, build the knowledge base and advance the profession's efforts to build research capacity after they graduate. On the other hand, Mohajan (2018, p. 1) asserts that "every research must involve an explicit, disciplined, systematic (planned, ordered, and public) approach to find out most appropriate results".

According to Langa (2018), Higher Education (HE) in Mozambique is in an incipient stage as it grows to become a more complex social institution. However, "it is not possible to establish whether this complexity has already ignited a functioning field of HE research" (Langa, 2018, p. 58). Mário et al. (2003, p. 59) recommended that Mozambican HE institutions should promote "a closer link between teaching and research through applied research" to improve the relevance of their curricula. There is a strong link between Mozambican HE and Eduardo Mondlane University (EMU). The university was established in 1962 in what was then Lourenço Marques (now Maputo), the capital of Portugal's overseas province of Mozambique. Initially known as Mozambique General University Studies; in 1968 it became the University of Lourenço Marques. Following Mozambique's independence in 1975, the university was renamed in honour of Mozambique Liberation Front leader, Eduardo Mondlane, in 1976 (Mário et al., 2003; Langa, 2018).

Eduardo Mondlane University's vision is to be a national and international reference in knowledge production and innovation in Education and Psychology¹ (EMU, 2013). The Master's degree in Education is expected to "train professionals with skills of research, teaching, and management"; enabling them to act at "public and private institutions, including universities, primary and secondary schools" (EMU, 2018, p. 6). Given that "research" means orderly investigation of a subject to add to knowledge, it implies that the subject matter is already known but, for some reason, needs to be studied again (Postlethwaite, 2005). Educational research plays "the role of providing attested information to improve the quality of decision-making for educational policy" (Livingstone, 2005, p. 1).

From its inception, HE in Mozambique was always public, in line with the socialist ideology of its first post-independence governments (Langa and Zavale, 2015). Following the liberalisation of the economy, private HE emerged in the mid-1990s, leading "to an increase in the number and type of HE institution suppliers, which inevitably created an environment of competition among the different institutions" (p. 89). Within this environment, student numbers increased, putting the system under pressure and posing the risk of a drop in the quality of educational offerings.

Ever-increasing human needs and technological advances mean that passive knowledge transmission is not sufficient and that students should be taught in a manner that enables them to develop their research skills (Ali and Abbas, 2018).

The Study Group on Educational Law and Policy at EMU that brings together lecturers and researchers undertaking studies on the right to education (i.e., access, financing, and management) at different levels (primary, secondary, and higher)² has engaged in much discussion on the role of educational research. As research expectations of universities increase, competitiveness also increases (Robles, 2016) and faculty members are thus under pressure to produce research in their fields.

One of the key issues raised in the education literature is the extent to which research should be chiefly directed towards school improvement, in general, and facilitating effective classroom practice, in particular. Some scholars, such as Carnine (2000), believe that, like medicine, education should be an "evidenced-based" field, in which findings are used in line with the contexts in which different schools operate. This concurs with Hemenstall (2006), who interpreted educational research as "the art of searching in education" rather than a "science" per se (Postlethwaite, 2005). Our study examined the methodological consistency of the Master

¹ Available online at: <https://www.uem.mz/index.php/faculdades-e-escolas/faculdades/faculdade-de-educacao>.

² More details on this group are available at: <http://www.faced.uem.mz/index.php/grupos-de-pesquisa>.

of Education dissertations defended at EMU from 2013 to 2018 in light of the methodological trustworthiness of educational research proposed by Postlethwaite (2005), Norman et al. (2002), and Creswell (2012).

Problem statement

Funding challenges faced by “Sub-Saharan African universities are likely to impact on the nature of and motive for undertaking academic research, resulting in different orientations from those of Western universities” (Kaweesi et al., 2019, p. 3). In Mozambique, EMU promotes excellence “based on the postulates of quality and trustworthiness of production of knowledge through research” (EMU, 2007, p. 3). However, it is reported that research conducted at this institution suffers from “weaknesses in several aspects of research management, such as quality of research output” (p. 1). The type of research will dictate the research methodologies that should underpin the methods. Regardless of the methodology, data collection techniques must fit with the study’s objectives. Moreover, “it is important that the technique used to collect data is adequate to provide the information required to accomplish the overall goals of the study” (Opoku et al., 2016, p. 32). As such, research-oriented teaching is an emerging trend in HE and is widely used in developed countries (Ali and Abbas, 2019).

Training at EMU should be based on principles and methods that enable students to develop an academic attitude towards reflection, analysis, and critical thinking (EMU, 2013). As noted by Langa (2014, p. 370), “at all levels of Mozambique predominates a more experiential knowledge of HE and there is a shortage of a scientific-based knowledge”. Due to the shift from traditional methods to research-oriented teaching, changes are occurring in teaching styles. Our study was motivated by the fact that no research has been conducted on the scientific trustworthiness of Master’s dissertations in Education at EMU. There is thus a need to verify the methodological consistency of these dissertations. The problem raised the following question:

How consistent are the Master’s dissertations defended at EMU from 2013 to 2018 in light of the methodological trustworthiness of educational research proposed by Postlethwaite (2005), Norman et al. (2002), and Creswell (2012)?

Operational definition

According to Newman and Covrig (2017, p. 79), “there is no perfect research, but building consistency into a research plan and reflecting on the alignment between the title, purpose, problem, and research questions will greatly improve the quality of the research”. When consistency is achieved, contradictory conclusions cannot be derived from the research. However,

if “there is no coherence and consistency within the approach, the processes cannot be followed and theory generation is impossible” (Holloway and Todres, 2005, p. 98). This “does not mean that the same result would necessarily be found in other contexts but that, given the same data, other researchers would find similar patterns” (Hammarberg et al., 2016, p. 500). Therefore, consistency refers to the extent “to which repeated administration of a measure will provide the same data or the extent to which a measure administered once, but by different people, produces equivalent results” (Krefting, 1991, p. 216).

Each approach has to demonstrate consistency with its foundations and will reflect them in data collection, analysis, and knowledge claims. If consistency is achieved, “the whole thing ‘hangs together’ as coherent; that is, the kind of knowledge generated in the results or presentation section does what it said it would do under the aims of the project” (Holloway and Todres, 2005, p. 93). Thus, an independent researcher should arrive at similar findings (Noble and Smith, 2015).

According to Brown (2017, p. 23), “consistency in research design falls in three categories: quantitative reliability, qualitative dependability, and mixed methods research dependability”.

Quantitative reliability is the degree to which the results of observations are consistent in a study, but the study as a whole is also consistent internally and externally. Two primary strategies should be used to enhance the reliability of a quantitative study (Brown, 2017). First, the reliability of observations can be enhanced by calculating reliability estimates for measures or agreement estimates for ratings and coding. Second, the reliability of the results of the study as a whole can be enhanced internally (by carefully monitoring and controlling issues that might contribute to inconsistency) and externally (by inspecting the statistical tests that are run to determine the degree to which the results would be likely to be stable if the study were replicated).

According to Brown (2017), *qualitative dependability* involves enhancing the consistency of observations and the effects of changing conditions in the study by using one or more of three strategies. The first is method triangulation, which involves multiple data gathering techniques. The second strategy is time triangulation, with data gathered multiple times and the third is investigator triangulation, which means that multiple investigators are involved in the study.

Objective of the study

The study’s objective was to examine the methodological consistency of the Master’s in Education dissertations defended at EMU from 2013 to 2018, in light of the methodological trustworthiness of educational research proposed by Postlethwaite (2005), Norman et al. (2002), and Creswell (2012).

3 In 2013 the EMU launched a new vision of being “a research-oriented university”.

Method

This was a qualitative (grounded theory design) and comparative study (Tie et al., 2019). Grounded theory design is a systematic, qualitative procedure that researchers use to generate a general conception (grounded in the views of participants, called a grounded theory) that explains a process, action, or interaction among people (Creswell, 2012). The procedures to develop this theory include collecting data (from dissertations), developing and relating categories (or themes) of information, and composing a figure or visual model that portrays the general explanation.

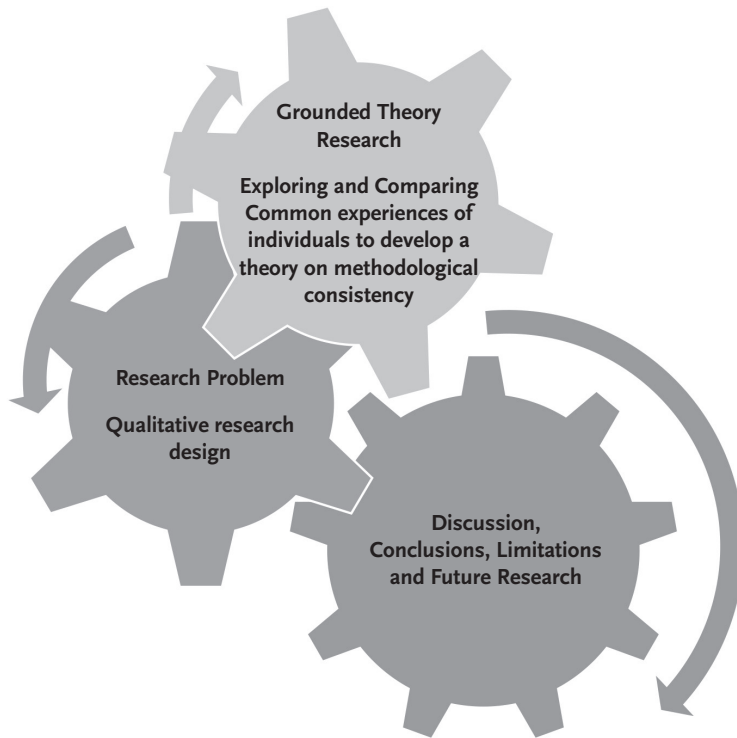


Figure 1. Visual model of the research design and general explanation

In terms of comparisons, we selected particular units and aspects (such as the research title, educational research methodology, and findings) rather than others (why and how a given phenomenon is analysed in the dissertations). As a construction, “comparison thus helps to create an ordered perception of this reality, i.e., an organized way to see it in one rather than in many other alternative ways” (Azarian, 2011, p. 123). Comparisons were, therefore, based on checking the methodology of the dissertations

under the types of educational research proposed by Postlethwaite (2005), which enables identification of the type of research and how it should be conducted. Comparisons emerged as the data analysis proceeded as in grounded theory, through relating categories of information that allowed propositions (Creswell, 2012).

Population and sampling strategy

Electronic versions of the dissertations were accessed on EMU’s institutional repository. Only dissertations that meet specific quality requirements are made available on the repository. From a population of 90 dissertations defended from 2013 to 2018 (see Table 1), a purposive sample of 33, available on the repository, was selected, “based on the assumption that these elements represent a ‘typical sample’ from the appropriate target population” (Ross, 2005, p. 7).

Table 1: Students enrolled and graduated by cohort

Year	Registered				Graduates (True cohort)				Graduates (False cohort)				Total of graduates
	EAM	ENSM	AE	CID	EAM	ENSM	AE	CID	EAM	ENSM	AE	CID	
2009	6	5	0	6	0	0	0	0	0	0	0	0	0
2010	0	11	16	13	0	0	0	0	0	0	0	0	0
2011	16	6	0	10	2	0	0	0	5	2	4	5	18
2012	20	8	7	17	0	0	1	0	2	1	0	1	5
2013	15	0	13	13	0	0	0	0	3	1	3	2	9
2014	19	7	19	6	8	0	0	2	0	2	1	0	13
2015	17	0	0	7	1	0	0	1	3	1	2	2	10
2016	13	0	6	8	0	0	0	0	2	1	5	5	13
2017	0	0	0	0	0	0	0	0	6	0	2	4	12
2018	0	0	0	0	0	0	0	0	4	0	0	6	10
Total	106	37	61	80	11	0	1	3	25	8	17	24	90

EAM: Educational Administration and Management
 ENSM: Education in Natural Sciences and Mathematics
 AE: Adult Education
 CID: Curriculum and Instructional Development

Source: University Librarian Services (2020)

With permission from the Library Services, these dissertations were downloaded and their titles, objectives, methods, and conclusions were analysed.

Material

Data collection commenced with a systematic literature review on educational research and identification of the 33 dissertations. This was followed by construction and validation of the analytic model based on the descrip-

tion of eight types of educational research proposed by Postlethwaite (2005). This typology (i.e., historical, descriptive, correlational, causal, experimental, case study, ethnographic, and research and development) was validated through “investigator triangulation” (Norman et al., 2002; Creswell, 2012). The eight types of educational research were drawn from *Educational Research: some basic concepts and terminology*, jointly produced by International Institute for Educational Planning (IIEP) and the Southern and Eastern Africa Consortium for Monitoring Educational Quality (SACMEQ). These types were also adopted by the College of Social Sciences and International Studies of Exeter University in the United Kingdom, and by the University of Sao Paulo in Brazil. This was deemed an appropriate methodological lens to understand educational research from a Southern African perspective.

Data analysis

Data analysis was based on a comparison of each type of research with the corresponding description and definition (Norman et al., 2002; Postlethwaite, 2005; Creswell, 2012). We adopted a two-stage comparison to firstly, verify the types of educational research; and secondly, to determine whether these types of educational research matched the methodology adopted by EMU students. In terms of ethical issues, dissertations were coded and analysed anonymously.

Findings and discussion

The eight types of educational research proposed by Postlethwaite (2005), Norman et al. (2002) and Creswell, (2012) were identified to verify the methodological consistency of the dissertations defended at EMU from 2013 to 2018 (see Table 2).

Table 2: Dissertations defended from 2013 to 2018 by code, gender, and type of educational research

Code	Area of study	Year	Gender		Supervisor (area of study)		Co-supervisor (area of study)		Type of educational research adopted by the students	Type of educational research as per Postlethwaite (2005), Norman et al. (2002), and Creswell (2012)
			Male	Female	Male	Female	Male	Female		
Dissertation 01	ENSM	2013	•		PhD in Education (Quality Assurance)				Mixed methods	Descriptive study
Dissertation 02	AE	2013	•		PhD in History of Education		PhD in Adult Education		Case study	Descriptive study
Dissertation 03	EAM	2013	•		PhD in Physics		PhD in EAM		Descriptive study	Case study
Dissertation 04	CID	2013	•		PhD in Educational Technology			PhD in Educational Technology	Case study	Case study
Dissertation 05	CID	2013	•		PhD in Sociology of Education				Case study	Case study
Dissertation 06	EAM	2013	•		PhD in Philosophy of Education				Case study	(Multiple) Case study
Dissertation 07	ENSM	2014	•			PhD in ENSM			Mixed methods	Case study
Dissertation 08	EAM	2014		•	PhD in EAM				Mixed methods	Descriptive study
Dissertation 09	EAM	2014	•		PhD in Physics				Case study	(Multiple) Case study
Dissertation 10	EAM	2014	•		PhD in Physics				Descriptive study	Co-relational
Dissertation 11	AE	2014		•	PhD in Psychology			PhD in Psychology	Quantitative	Causal study
Dissertation 12	EAM	2015		•	PhD in EAM				Mixed methods	Case study
Dissertation 13	CID	2015		•		PhD in ENSM			Mixed methods	Co-relational
Dissertation 14	EAM	2015	•		PhD in Linguistics				Mixed methods	Co-relational
Dissertation 15	AE	2015		•	PhD in History of Education		PhD in AE		Case study	(Multiple) Case study
Dissertation 16	AE	2015		•		PhD in Psychology		PhD in Psychology	Descriptive study	Descriptive study
Dissertation 17	AE	2015		•	PhD in Psychology		PhD in Psychology		Descriptive study	Causal study
Dissertation 18	CID	2015	•		PhD in Physics		PhD in CID		Quantitative	Co-relational
Dissertation 19	AE	2015		•	PhD in AE				Case study	Case study
Dissertation 20	EAM	2015		•		PhD in Sociology	PhD in EAM		Case study	Causal study

Code	Area of study	Year	Gender		Supervisor (area of study)		Co-supervisor (area of study)		Type of educational research adopted by the students	Type of educational research as per Postlethwaite (2005), Norman et al. (2002), and Creswell (2012)
			Male	Female	Male	Female	Male	Female		
Dissertation 21	ENSM	2015	•		PhD in Physics				Mixed methods	Descriptive study
Dissertation 22	EAM	2016		•	PhD in Sociology of Education		PhD in Sociology of Education		Case study	(Multiple) Case study
Dissertation 23	EAM	2016	•		PhD in Physics				Case study	Descriptive study
Dissertation 24	CID	2016		•	PhD in CID	PhD in CID			Qualitative	Descriptive study
Dissertation 25	AE	2016		•		PhD in Sociology		PhD in AE	Bibliographic research	Case study
Dissertation 26	CID	2016	•			PhD in ENSM			Bibliographic research	Descriptive study
Dissertation 27	AE	2016	•			PhD in Psychology		PhD in Psychology	Ex-post facto research	Ethnographic research
Dissertation 28	CID	2016	•			PhD in CID	PhD in CID		Mixed methods	Descriptive study
Dissertation 29	AE	2016	•		PhD in AE				Qualitative	Research and development
Dissertation 30	CID	2016	•			PhD in CID			Exploratory	Descriptive study
Dissertation 31	AE	2016		•	PhD in Education (Quality Assurance)	PhD in AE			Mixed methods	Case study
Dissertation 32	EAM	2017	•		PhD in Sociology of Education		PhD in Sociology of Education		Case study	Case study
Dissertation 33	EAM	2018	•		PhD in Education		PhD in EAM		Descriptive study	Descriptive study
			20	13						

EAM: Educational Administration and Management.

ENSM: Education in Natural Sciences and Mathematics.

AE: Adult Education.

CID: Curriculum and Instructional Development.

Source: EMU Open Institutional Repository

Table 2 above lists the 33 dissertations by code, year, gender, area of study, supervisor, and type of educational research. Within this sample, 18 dissertations were supervised and/or co-supervised by specialists, i.e., by supervisors whose training areas are related to students' degree programme areas. Of these, only four are methodologically consistent. On the other hand, despite the fact that the remaining 15 dissertations were supervised by non-specialists, five of these are methodologically consistent. These findings suggest that, being a specialist is an important but not sufficient condition for adequate supervision. This implies the need for on-going training of supervisors on educational research methodology, whether or not they are specialists.

Historical research generates descriptions and sometimes explanations of conditions, situations, and events that occurred in the past, because "time passes between the beginning of the experiment and the end, and events may occur between the pretest and post-test that influence the outcome" (Creswell, 2012, p. 304). To assess the methodological consistency of historical research, one should ascertain if preliminary research took place, and whether the topic or research question has been identified and refined. There is also a need to ensure the adequacy of the methods and data sources, to enable the use of research evidence to support or reject a hypothesis. Based on this, the researcher is expected to formulate a thesis statement, analyse the data and develop a narrative exposition of the findings.

We did not identify any historical research in the sample. There are two possible reasons: students may have privileged other interests rather than seeking to understand educational events that have already occurred; or they didn't feel methodologically prepared to undertake historical research.

Descriptive research provides information on current conditions, situations, and events. Based on "descriptive statistics, means, standard deviations, and the range of scores to show useful information about results" (Creswell, 2012, p. 197), its consistency is assessed by determining the degree to which cases that share a given condition or combination of conditions produce the same outcome. However, "descriptive studies lack the powerful controls needed to establish credible links between exposures and outcomes" (Norman et al., 2002, p. 58). For this reason, many researchers that seek to establish possible links between the variables do not consider a simple descriptive study sufficient and therefore focus on co-relational or causal linkages. We identified 11 dissertations written employing descriptive analysis (Table 2). This number is reasonable given that the descriptive research design is the second most common methodological option, suggesting that this is the methodological procedure students feel most comfortable with, or that their supervisors direct them to this type of educational research.

Correlational research involves the search for relationships between variables through the use of measures of statistical association. Co-relational designs enable researchers to predict scores and explain the relationships among the variables under study. Such researchers “use the correlation statistical test to describe and measure the degree of association (or relationship) between two or more variables or sets of scores” (Creswell, 2012, p. 338). To assess the consistency of co-relational research, one might check whether participants’ scores in the brief test strongly correlate with their scores in the longer one. This is important considering that neither test score is thought to cause the other and there is thus no independent variable to manipulate. Thus, having fulfilled all the relevant steps, the researcher is expected to ensure that the terms *independent* and dependent variables do not apply to this type of research. We registered four co-relational studies where the variables are associated to verify possible trends. This is an eighth of the total, suggesting that there is little preference for this type of educational research, or that students feel underprepared to undertake it.

Causal research suggests plausible causal linkages between variables. It establishes the *underlying* causes of events, i.e., the reasons *why* a particular phenomenon occurred in the way it did and when it did (Norman et al., 2002). Three causal research studies were identified. The consistency of causal research is assessed considering several paths to the same outcome. In this context, consistency assesses the degree to which instances of an outcome agree in displaying the causal condition thought to be necessary, but not sufficient, whereas coverage assesses the relevance of the causal condition. Thus, adding the four co-relational studies to the three causal ones, seven dissertations, or a fifth (20%) of the total, aimed to establish associations between the variables under study.

In *experimental research*, variables defining one or more ‘causes’ are systematically manipulated to discern their ‘effects’ on other variables. An example is an experimental study in which the “experiment yields useful information about educational outcomes, but the additional collection of qualitative data develops a more in-depth understanding of how the experimental intervention on it worked” (Creswell, 2012, p. 535). The consistency of experimental research is assessed by ascertaining the degree to which a measurement supplies reliable results with equal values. It measures the precision, repeatability, and trustworthiness of research and indicates the extent to which it is free from bias, and hence ensures consistent measurement across time and the various items in the instruments. We did not identify any experimental research in this study. It is possible that the differentiated conception of educational sciences, in comparison to others, such as biomedical sciences, may be why students do not adopt experimental research to understand phenomena within the educational sciences.

However, such a conception weakens educational research, because it loses sight of the need to think more in terms of practical application, pragmatic consequences, and outcomes.

The *case study* is a research design that is “a variation of ethnography in that the researcher provides an in-depth exploration of a bounded system, based on extensive data collection” (Creswell, 2012, p. 617). To assess the methodological consistency of case study research, whether the researcher is an outsider or insider, the issues one should pay attention to for valid data, procedures, and results are: (i) investigating a contemporary phenomenon within its real-life context; (ii) when the boundaries between phenomenon and context are not evident; and (iii) in which multiple sources of evidence are used. When necessary, “case studies can include, and even be limited to, quantitative evidence” (Norman et al., 2002, p. 67). Thirteen dissertations are case studies, constituting the majority of the sample. Because case studies focus attention on certain entities, taken as unities, they seem to be easy. However, this is a misleading, because case studies are also highly demanding.

Ethnographic research consists of a description of events that occur within the life of a group – individuals’ interaction in the context of the socio-cultural norms, rituals, and beliefs shared by the group. The consistency of ethnographic research is assessed by ascertaining if, beyond the procedures, data are internally consistent when the researcher records behaviours that are consistent over time and in different social contexts (Sangasubana, 2011). This qualitative procedure describes, analyses, and interprets a cultural group’s shared patterns of behaviour, beliefs, and language that develop over time. We identified one ethnographic research study, which may point to weak appropriation of anthropological issues.

Research and development focuses on the interaction between research and the production and evaluation of a new product (Postlethwaite, 2005). The consistency of this research is assessed through a rigorous, valid, and credible examination of the quality of proposed solutions, which have the potential to contribute significantly to the improvement of practices and outcomes of the primary process that is the focus of the research. With one dissertation identified, this type of research is related to the production, testing, and presentation of new products or services.

In summary, of the 33 dissertations in the sample, nine were mixed methods; 11 case studies; five descriptive studies; two quantitative, qualitative and bibliographic research studies, respectively, and one ex-post facto research, and exploratory study, respectively. According to Postlethwaite (2005), Norman et al. (2002), and Creswell (2012) only case studies and descriptive studies can be considered valid types of educational research. In terms of this typology, mixed methods, quantitative, qualitative, bibliographic, ex-post-facto, and exploratory research are not types of educational

research but are instead, kinds of educational research. Based on these findings, and due to the misleading research design adopted in the majority of the dissertations, the theories the students claim to confirm are falsified. The theoretical implications of these findings are the need to design educational research in such a way that the procedures deliver the most correct results, recommending appropriate action for school improvement. The practical implications are the need for specialists in educational research to identify strengths and weaknesses and design specific interventions for improvement at EMU.

Data for four of the studies (dissertations 6, 9, 15, and 22) were collected from more than one school and students considered them “multiple case studies”. It is important to distinguish between a simple case study and a multiple one. As noted by Gustafsson (2017, p. 11), “with a multiple case study ... the researcher can analyze the data within each situation and across different situations”. It thus enables the researcher to understand the similarities and differences between the cases, and generate strong, reliable evidence to clarify if the findings are valuable. The misleading classification of case studies denotes methodological limitations when students design their research projects. Furthermore, we identified a significant number of “mixed methods studies”, suggesting that many students feel comfortable conducting quantitative and qualitative research at the same time, based on the idea that mixed methods research provides better results than a single approach.

As shown in Table 2, 20 dissertations were by male and 13 by female students. There were 13 case studies, 11 descriptive studies, four co-relational studies, three causal studies, and one ethnographic and research and development study, respectively.

Improved completion rates are pursued by research-focused academics because they one of the measures of research excellence in some countries. However, we did not identify any systematic study at EMU on educational research methods, resulting in a scarcity of “research findings upon which sound evaluation strategies might be grounded” (Seymour et al., 2004, p. 493). A possible reason might be the lack of a theoretical framework in terms of which to assess educational research.

As research and the development of research skills are both a product and a process at university, this should involve students learning how to research within a specific discipline: “research-orientated teaching” (Ali and Abbas, 2019); it should also involve students conducting their research: “research-based teaching” (Rosenshine, 2012). This is not surprising considering that postgraduate education has been historically linked with academics’ research agenda (Jepsen and Varhegyi, 2012).

Motivated by the desire to break out of the tired old teaching versus research debate, a recent conceptualisation of scholarship suggests possi-

bilities other than the seemingly entrenched ‘truth’ of research and teaching as necessarily competing endeavours (Kyvic, 2015). Thus, teaching and research may not be in opposition but linked (Robles, 2016), corresponding with Zieger and Pulichino’s vision of “Establishing a Community of Learners” (2004, p. 1).

Table 3 describes the typology used to determine whether or not a particular dissertation “matched” the typology proposed by Postlethwaite (2005), Norman et al. (2002), and Creswell (2012).

Table 3: Typology of Educational Research used by the authors and students

Types of Educational Research used by the authors as their typology			Types of Educational Research used by students		
Type	N	%	Type	N	%
Historical Research	0	0.0	-	0	0.0
Descriptive Research	11	33.5	Descriptive Research	2	6.0
			Case Study	2	6.0
			Mixed Methods	4	12.1
			Qualitative Study	1	3.0
			Bibliographic Research	1	3.0
Exploratory Study	1	3.0			
Co-relational Research	4	12.1	Descriptive Research	1	3.0
			Mixed Methods	2	6.0
			Quantitative Research	1	3.0
Causal Research	3	9.0	Case Study	1	3.0
			Quantitative Study	1	3.0
			Descriptive Study	1	3.0
Experimental Research	0	0.0	-	0	0.0
Case Study	13	39.4	Case Study	8	24.2
			Mixed Methods	3	9.7
			Descriptive Research	1	3.0
			Bibliographic Research	1	3.0
Ethnographic Research	1	3.0	Ex-post facto research	1	3.0
Research and Development	1	3.0	Quantitative Study	1	3.0
Total	33	100.0	Total	33	100.0

Table 3, shows that 10 dissertations (i.e., two descriptive studies and eight case studies), match the typology of educational research used by the authors. Together, they represent 30% of the 33 dissertations. The remaining 23 dissertations (representing 70%) do not match the typology used by Postlethwaite (2005), Norman et al. (2002), and Creswell (2012).

Table 4: Dissertations defended from 2013 to 2018 by area, supervisors' specialisation, types of educational research, and methodological consistency.

Dissertation	Year	Area of study	Supervisor	Co-supervisor	Type of educational research used by students	Type of educational research used by the authors	Consistency
03	2013	EAM	Non-specialist	Specialist	Descriptive study	Case study	
06	2013	EAM	Specialist	-	Case study	(Multiple) Case study	Consistent
08	2014	EAM	Specialist	-	Mixed methods	Descriptive study	
09	2014	EAM	Non-specialist	-	Case study	(Multiple) Case study	Consistent
10	2014	EAM	Non-specialist	-	Descriptive study	Co-relational research	
12	2015	EAM	Specialist	-	Mixed methods	Case study	
14	2015	EAM	Non-specialist	-	Mixed methods	Co-relational	
20	2015	EAM	Non-specialist	Specialist	Case study	Causal study	
22	2016	EAM	Non-specialist	Non-specialist	Case study	(Multiple) Case study	Consistent
23	2016	EAM	Non-specialist	-	Case study	Descriptive study	
32	2017	EAM	Non-specialist	Non-specialist	Case study	Case study	Consistent
33	2018	EAM	Specialist	Specialist	Descriptive study	Descriptive study	Consistent
01	2013	ENSM	Specialist	-	Mixed methods	Descriptive study	
07	2014	ENSM	Specialist	-	Mixed methods	Case study	
21	2015	ENSM	Specialist	-	Mixed methods	Descriptive study	
02	2013	AE	Non-specialist	Specialist	Case study	Descriptive study	
11	2014	AE	Non-specialist	Non-specialist	Quantitative study	Causal study	
15	2015	AE	Non-specialist	Specialist	Case study	(Multiple) Case study	Consistent
16	2015	AE	Non-specialist	Non-specialist	Descriptive study	Descriptive study	Consistent
17	2015	AE	Non-specialist	Non-specialist	Descriptive study	Causal study	
19	2015	AE	Specialist	-	Case study	Case study	Consistent
25	2016	AE	Non-specialist	Specialist	Bibliographic research	Case study	
27	2016	AE	Non-specialist	Non-specialist	Ex-post-facto research	Ethnographic research	
29	2016	AE	Specialist	-	Quantitative study	Research and development	
31	2016	AE	Non-specialist	Specialist	Mixed method	Case study	
04	2013	CID	Non-specialist	Non-specialist	Case study	Case study	Consistent
05	2013	CID	Non-specialist	-	Case study	Case study	Consistent
13	2015	CID	Non-specialist	-	Mixed method	Co-relational study	
18	2015	CID	Non-specialist	Specialist	Quantitative study	Co-relational study	
24	2016	CID	Specialist	Specialist	Qualitative study	Descriptive study	
26	2016	CID	Non-specialist	-	Bibliographic research	Descriptive study	
28	2016	CID	Specialist	Specialist	Mixed method	Descriptive study	
30	2016	CID	Specialist	-	Exploratory	Descriptive study	

EAM: Educational Administration and Management.

ENSM: Education in Natural Sciences and Mathematics.

AE: Adult Education.

CID: Curriculum and Instructional Development.

Source: EMU Open Institutional Repository

Table 4 above illustrates that ten dissertations were deemed to be methodologically consistent, four of which were supervised by specialists, and six by non-specialists. Eight of the ten dissertations are case studies, and two are descriptive studies. Thus, 23 dissertations were not found to be methodologically consistent, although 14 of these were supervised by specialists. These figures can be synthesised as follows:

1. In the area of Educational Administration and Management (EAM), six of the 12 dissertations were supervised by specialists; and five of the 12 dissertations were deemed methodologically consistent, with three of these supervised by non-specialists.
2. In the area of Education in Natural Science and Mathematics (ENSM), none of the three dissertations are methodologically consistent, although the supervisors are all specialists.
3. In the area of Adult Education (AE), five of the ten dissertations were supervised by specialists, of which three are methodologically consistent. Of these three, two were supervised by specialists.
4. In the area of Curriculum and Instructional Development (CID), two of eight dissertations are methodologically consistent, both of which were supervised by non-specialists. In this area, four dissertations were supervised by specialists.

These figures suggest that EAM has more methodologically consistent dissertations than any other area, due to producing the highest number of dissertations during the period under review.

The fact that 23 dissertations can be considered methodologically inconsistent calls for consideration of the extent to which teaching and research are linked at EMU. Only when the profession embraces scientific methods to determine efficacy and accepts accountability for results will education acquire the status – and the rewards – of a mature profession (Carnine, 2000). Educational researchers are regarded as those who participate in the process of discovery and communication of knowledge (Livingstone, 2005). Universities are, therefore, scholarly communities (Huber and Hutchings, 2004) where the goal is to prepare students for research and practice in their communities. Hickey and Zuiker (2005) state that learning is configured through the process of the learner becoming a full participant in a socio-cultural practice. They add that, “learning involves meaningful participation in the practices that characterize a community” (p. 278). Thorne et al. (2004) cite one of the ‘best examples’ of the integration of teaching and research as leading to a process of inquiry. Such studies often build upon “relatively small samples, using such data collection methods as interviews, participant observation, and documentary analysis to articulate a coherent and meaningful account of the experiential knowledge” (p. 3).

According to Haguette (2002), postgraduate studies must familiarise students with epistemological and methodological principles for knowledge generation. If research underlies the centrality of the Master's degree, it is necessary to pay more attention to its theoretical, empirical, and methodological demands. However, "many programs are silent regarding the requirement about the empirical nature of the dissertation, which also requires the theoretical-methodological field exercise" (Haguette, 2002, p. 376).

Wangenge-Ouma et al. (2015) observe that lecturers at EMU show little commitment to research. They note that, "from a remuneration point of view, it is more lucrative to follow a teaching track than a research career track" (p. 136). Wangenge-Ouma et al. (2015) add that, less than 100 of the 1700 academic staff at EMU have chosen the research career track. Hockey (1996) asserts that a good supervisor-student relationship is a key factor in students' success or failure in their studies or research. Therefore, supervision is concerned with the mechanics of ensuring that students are making good progress towards completion.

Conclusion

There is a need for a strong research-teaching nexus, which refers to the "relationships and interactions that may exist between teaching and research in HE, through curriculum designs and teaching practices" (Covele, 2017, p. 1). The findings of our study show that a large number of Master's in Education dissertations defended at EMU are not methodologically consistent, although some of the results may be useful for reflection on methodological consistency. Thus, these studies do not lay a reliable foundation for future research or interventions for school improvement. The findings reinforce the claim that Mozambican universities "are weak and informal" (Zavale and Macamo, 2016, p. 257).

Zavale (2013) compared the pro-liberal curricula introduced in the 2000s in Mozambique with those from the 1990s, and identified differences and specificities. He states that the 1990s curricula were mainly disciplinary based, insular and rigid, and based on a-social realist epistemology. In contrast, the 2000s pro-liberal curricula are mainly interdisciplinary, hybrid, flexible, centred on practical/professional knowledge or skills, and inspired by a socio-constructivist epistemology and by claims of socio-economic relevance (Zavale, 2013).

Empirical evidence on methodological consistency at EMU should be of interest to the entire academic community, researchers, policymakers, and decision-makers. The lack of historical and experimental research noted by this study weakens the methodological options adopted by students. The historical design uses experiences of the past to understand the present and possibly project the future, whereas experimental research is expected to recommend measures to address a specific problem.

Although the results of this research cannot be generalised to the entire university, they suggest that migration from a teaching-centred to a research-based university demands sound theoretical and methodological preparation of researchers, lecturers and students, so that research becomes a practice and an important part of the university's organisational culture. Such migration should not only be an intention but also practice and, therefore, part of the university culture.

Recommendations

The supervision literature indicates that ethical, technical, and methodological problems can be minimised or prevented if all the participants in the relationship strive to enter it with clear expectations of their respective roles and the rules for their interaction (Goodyear et al., 1992). In particular, students require guidance on when to stop data collection and analysis, when to start drafting the dissertation and how to structure it. Therefore, supervisors are expected and assumed to be guides and critical friends (Hockey, 1996).

The findings of this study highlight the need for in-depth research to capture and explore perceptions of the types of educational research for future academic interventions. According to Zavale and Langa (2018), developing countries in Africa suffer from double neglect, not only because they are under-researched, but are also ignored when research on them is produced. Thus, concerns about the quality of training, especially in postgraduate studies, should not only be located within the borders of the university and the country, but also a broader agenda, especially since the modern world is a global village, with professionals moving from one place to another. It is, therefore, possible to take advantage of synergies and different experiences in research capacity building in postgraduate studies between universities located in the country, but also with those of other countries.

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Experiences of Student Affairs Professionals in Facilitating Co-Curricular Leadership Development Programmes in South African Universities

Gugulethu Xaba

Abstract

Despite the important role that student affairs practitioners play in supporting universities to produce well-rounded graduates, few studies have been conducted on their lived experiences. This article examines the challenges confronted by these professionals in interacting with student leaders and facilitating leadership programmes in South African universities. A qualitative methodology was adopted and semi-structured interviews were conducted with 20 student affairs practitioners responsible for facilitating student leadership development programmes. A focus group discussion was also held with six student affairs experts. The findings point to a lack of seamlessness in the structure, staffing, and operation of these programmes, as well as a lack of university support to professionalise student affairs. Furthermore, student leadership development programmes were found to lack proper theoretical grounding.

Key words: Student leadership development programmes, students, student affairs professionals

Malgré le rôle important que jouent les praticiens des affaires étudiantes pour aider les universités à produire des diplômés bien équilibrés, peu nombreuses sont les études qui ont été menées sur leurs expériences vécues. Cet article examine les défis auxquels sont confrontés ces professionnels dans l'interaction avec les leaders étudiants et la facilitation

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des programmes de leadership dans les universités sud-africaines. Une méthodologie qualitative a été adoptée et des entretiens semi-structurés ont été menés avec 20 praticiens des affaires étudiantes chargés de faciliter les programmes de développement du leadership étudiant. Une discussion en groupe a également eu lieu avec six experts en affaires étudiantes. Les résultats soulignent un manque de transparence dans la structure, dans la dotation en personnel et dans le fonctionnement de ces programmes, ainsi qu'un manque de soutien universitaire pour professionnaliser les affaires étudiantes. En outre, les programmes de développement du leadership des étudiants n'ont pas une base théorique adéquate.

Mots clés: programmes de développement du leadership étudiant, étudiants, professionnels des affaires étudiantes

Introduction and background

Student affairs practitioners enjoy flexibility in providing leadership education because they do not face the limitations of classroom availability, course enrolment management, or faculty teaching rotations that confront curricular leadership programmes (Dunn et al., 2019, p. 94). Currently, more students receive leadership education from student affairs offerings than academic leadership courses, yet little is known about the leadership educators who work in the more than 2 000 leadership programmes worldwide (Jenkins, 2019, p. 141; Dunn et al., 2019, p. 94). Student affairs professionals can play a vital role in the daily lives of students and institutions since they interact with students throughout their studies rather than being limited to a single year or semester of course instruction as is the case with many faculty-to-student interactions (Martin, Smith, Takewell and Miller, 2020, p. 149; Selznick, 2013, p. 12). The study on which this article is based sought to understand the challenges experienced by student affairs professionals in delivering these programmes. Its findings will be useful in planning and reviewing the programmes offered.

Student affairs plays a critical role in the student experience and the professional knowledge, skills, attitudes, and commitments that define the profession are expected of professionals across all areas of specialisation (ACPA and NASPA, 2015). The following research question guided the study:

What are the challenges and experiences of leadership educators as they execute their responsibilities of facilitating co-curricular leadership development programmes at various South African universities

Literature review

Leadership as a discipline, leadership education as a field, and the leadership

educator as a profession are still in their infancy, but are rapidly evolving (Guthrie and Jenkins, 2018, p. xxvi). Hence, there is a paucity of research on the experiences of student affairs professionals that facilitate student leadership development programmes (SLDPs) in universities, particularly in the South African context. Indeed, Speckman and Mandew (2014, p. 1) note that there is a lacuna in home-grown student affairs research in South Africa and that there is little that is original about the practice and philosophy of most professionals in this field. Wilson (2013, p. 49) asserts that the increasingly dynamic nature of the student population calls for dynamic student affairs professionals who are capable of understanding, interacting, and working with diverse students.

Guthrie and Jenkins (2018, p. 3) define leadership education as the pedagogical practice of facilitating leadership learning with the goal of building human capacity. It is informed by leadership theory and research, which takes place in both curricular and co-curricular educational contexts. Leadership educators are responsible for presentation of curricular and co-curricular leadership programmes to students. This study focused on leadership educators who are student affairs professionals that are responsible for SLDPs offered outside the classroom environment. According to Dunn et al. (2019, p. 107), student affairs leadership educators have a responsibility to develop leadership competencies in others. However, such development begins with self; once they have demonstrated competence, they work with emerging student affairs professionals, and expand their efforts to other members of the campus community.

Wilson (2013) explored the multicultural competence of student affairs professionals responsible for leadership education. The sample included full-time student affairs professionals with at least a bachelor's degree, and self-identified faculty in higher education. The study found that student affairs professionals responsible for leadership education are in a unique position to facilitate and foster a campus environment that is inclusive and affirming. Therefore, multicultural competence is an essential competency that they should seek to enhance and infuse in their daily practice.

Dunn et al. (2019) investigated the characteristics of a collegiate student affairs leadership educator. As this study was part of a larger study to elicit and refine group opinions or judgements, a classic Delphi approach was used to purposively select participants based on their substantial experience or expertise in the subject matter. The participants included student affairs practitioners responsible for hiring and training, and student affairs preparatory programme coordinators responsible for curriculum design and instruction. The study found that student affairs practitioners are leadership educators who are familiar with and practice leadership theories, teach academic credit-bearing leadership courses, and/or conduct leader-

ship research; none of which are typical job responsibilities of entry-level student affairs practitioners.

Jenkins' (2019) phenomenological study explored the lived experiences of becoming and being a leadership educator in higher education. A snowball sample of 13 leadership educators from four states and 11 universities participated in the study. They described how their interest in a development focused field often serendipitously led them to leadership education and described their work as rewarding and as enabling them to exercise creative authority.

Nkonoane (2015) sought to identify desirable competencies of student affairs professionals in South African higher education institutions, while Harding and Matkin's (2012) phenomenological inquiry focused on educators' experiences of teaching leadership and Seemiller and Priest (2017) explored leadership educators' professional identities. However, there is a lack of research on the student affairs professionals responsible for the delivery of SLDPs in the South African context. This study aimed to fill this gap by focusing on the lived experiences of student affairs professionals from six of the country's universities.

Research methodology

The purpose of the study was to explore the lived experiences of student affairs professionals who deliver SLDPs at various South African universities and to solicit their views with respect to the design, presentation, evaluation and reporting mechanisms in relation to such programmes. A qualitative research design was appropriate as it enables the researcher to understand participants in terms of their own description of the world (Mouton, 2001, p. 194).

Data was collected by means of face-to-face and telephonic interviews with 20 student affairs professionals in six South African universities, with each interview lasting between 30 and 45 minutes. Table 1 below lists the number of participants per university.

Table 1: Number of participants per university

University one	4 participants
University two	2 participants
University three	3 participants
University four	3 participants
University five	5 participants
University six	3 participants

The student affairs professionals were purposively selected as they play a major role in designing, presenting, evaluating and communicating the various SLDPs offered in the universities and thus have in-depth knowledge of such programmes. Given that the data was collected by means of semi-structured interviews, data collection was guided by saturation point. The point of saturation was reached when the twentieth participant was interviewed. Cluster sampling was employed to select the universities. The researcher divided the universities into groups or clusters, identified convenient, naturally occurring groups rather than individual subjects, and randomly selected some of these units (McMillan and Schumacher, 2010, p. 134). Three clusters were formed based on the different categories of universities in South Africa, namely, traditional universities, universities of technology and comprehensive universities.

A focus group was conducted to obtain a detailed understanding of the issues (Nyumba et al., 2017, p. 20) and to test the completeness, suitability and plausibility of the framework for evaluating SLDPs informed by the research process. It comprised of experts who were purposely selected for their knowledge and experience. They included:

- A director of student affairs and curriculum design specialist at a research university;
- A senior academic and student leadership development specialist and a counselling psychologist at a research university;
- A senior student affairs researcher and quality development specialist at a university of technology;
- A leadership development specialist and experienced senior student affairs officer, and professional speaker employed as the executive director of a training organisation; and
- A director of development grants and higher education policy consultant and quality assessment specialist at a health sciences university.

As suggested by Wibeck et al. (2007, p. 266), the focus group discussion was facilitated by an interview guide and was held by video using the Webex (Cisco) online platform. The meeting was recorded and the researcher took notes which were used in data analysis.

Data from the interviews and the focus group discussion were analysed using Tesch's method of qualitative analysis as described in Creswell (2009). The recorded information was transcribed verbatim and content analysis was employed to identify themes and categories, followed by coding. Tesch (1992, pp. 142-145) provides detailed guidelines to develop a system for unstructured qualitative data following eight steps, namely, reading the entire transcript carefully to obtain a sense of the whole and to jot down ideas; selecting one case and understanding what it is about and then recoding thoughts in the

margin; making a list of all the themes and clustering similar ones; applying the themes to the data, abbreviating them as codes, and writing them in appropriate segments of the transcripts to determine whether new categories and codes emerge; finding the most descriptive wording for the themes and categorising them to show the relationships; making a final decision on the abbreviation for each category and alphabetising the codes; assembling the data belonging to each category before preliminary analysis is performed; and recoding material if necessary.

Findings

This section presents the study's findings under 11 themes, each with sub-themes. The themes were developed on the basis of the questions posed to the student affairs professionals on their challenges and experiences as they facilitate co-curricular leadership development programmes at South African universities.

Perceptions of the ideal SLDP educator

The participants were asked to share their opinions on what they considered to be an ideal SLDP educator. Three themes emerged from their responses, namely, *qualifications*, *characteristics* and *adaptability to change*.

Qualifications

The participants suggested that an ideal leadership educator should have a degree in Education or Student Affairs Studies. Alternatively, those who have qualifications in other fields should register for a postgraduate degree in Student Affairs to gain knowledge on the student development theories and techniques. This view is supported by Nkonoane (2015, p. 89) who highlighted the importance of a formal preparation programme for student affairs practitioners. The participants also stated that a leadership educator should have sound research acumen, and writing and presentation skills. Furthermore, he/she should be able to conduct training needs analysis, and have the ability to design and develop learning materials. Furthermore, they should be familiar with a variety of methodologies (workshops, tours, seminars, adventure-based learning, technology, etc.). The educator should be able to evaluate programmes and assess students' levels of development on an on-going basis. The participants added that a leadership educator should demonstrate competence in managing projects and be able to communicate with students when they plan and organise activities and events. Finally, they stated that a leadership educator should be well acquainted with student leadership development and coaching theories.

The qualifications and competencies highlighted above closely resemble the ten professional competency areas that the American College Personnel

Association (ACPA) and National Association of Student Personnel Administrators (NASPA) consider as essential knowledge, skills, and dispositions for student affairs educators, regardless of their functional area or specialisation. These are (1) Personal and ethical foundations (PPF); (2) Values, philosophy, and history (VPH); (3) Assessment, evaluation, and research (AER); (4) Law, policy, and governance (LPG); (5) Organisational and human resources (OHR); (6) Leadership (LEAD); (7) Social justice and inclusion (SJI); (8) Student learning and development (SLD); (9) Technology (TECH); and (10) Advising and supporting (A/S) (ACPA and NASPA, 2015).

Characteristics

Most (n=15) of the participants believed that a leadership educator should enjoy working with students. He/she should understand students' basic needs, contemporary views and sentiments and be able to accommodate those that might not be easy to work with. Some added that he/she should have been actively involved in youth and student development programmes in their student days. Leadership educators should be activists in their own right, with a natural inclination for student development work and the ability to engage with topical issues affecting young people. They should be passionate about student development and self-development. The participants also proposed that a leadership educator needs to have certain personality traits such as being easily approachable and making students feel at ease and comfortable. They suggested that he/she needs to be a peacemaker and a neutral person who is able to address conflict between students. The leadership educator was described as a life coach and a mentor. These descriptions are in line with the desired professional behaviours identified by Jenkins and Owen (2016) for those who direct or coordinate co-curricular leadership programmes. Figure 1 below sets out these behaviours.

Figure 1: Suggested competencies for leadership educators

- Knowledge of the history and current trends in leadership theories, models, and philosophies;
- An understanding of the contextual nature of leadership;
- Knowledge of organisational development group dynamics, strategy for change, and principles of community;
- Knowledge of how social identities and dimensions of diversity influence leadership;
- The ability to work with a diverse range of students;
- The ability to create, implement and evaluate student learning as a result of leadership programmes;
- The ability to effectively organise learning opportunities that are consistent with students' stages of development;
- The ability to use reflection in helping students understand leadership contexts;
- The ability to develop and assess student learning outcomes.

Source: Jenkins and Owen, 2016

Adaptability to change

All the participants stated that it is crucial for a student affairs professional to be flexible and be able to adjust to change. They noted that the higher education environment is prone to change due to the fact that members of Executive Management are appointed on five-year contracts. Each new management team introduces new ways of doing things. This requires student affairs professionals to be adaptable to change and to anticipate such changes. The participants added that the profiles of university students are also changing. Universities South Africa (2018, p. 4) notes that student populations are becoming more diverse, representing vastly different backgrounds; many students are poor; are first-generation students and are older. The large majority are also tech-savvy, calling for different approaches, modes of communication and forms of engagement. While diversity brings new challenges to higher education institutions, it also creates opportunities. The participants indicated that it is important for student affairs professionals to remain up-to-date by reading the professional literature, building their skills, attending conferences, enhancing their technological literacy, and engaging in other professional development activities. All the participants agreed that adaptability should include understanding diverse international dynamics, different cultures, various global environments and how different people across the world view things. This finding concurs with Major and Mangope's (2014, p. 24) study that concluded that student affairs professionals are decision-makers who play a vital role in addressing multicultural issues on campuses; their unique positions call for the integration of multicultural awareness, knowledge and skills in practice.

Theoretical models for grounding SLDPs

The participants were asked to indicate what theoretical model they used to ground the programmes that they present to students. The theme that emerged from this section is lack of *proper theoretical grounding*. Most (n=16) of the participants indicated that their universities had not adopted any specific theory for the grounding of their SLDPs. All of them indicated that they primarily base their philosophical orientation on their strategic overview and the adopted graduate attributes. Only two participants stated that they were using some theory and models to ground their programmes. It is clear from the interviews that some participants were not familiar with the various student development theories although they had worked in student affairs for a number of years. The participants' experience ranged from three to 23 years in this field. This does not fit well with Long's (2012, p. 42) assertion that student affairs exists as a profession to support student learning and success; thus student development theories, which describe how students grow and change throughout their college experience, are the cornerstone for the theoretical framework of student affairs.

The elements of ideal SLDPs

The participants were asked to share their thoughts on what they considered to be the elements of an ideal SLDP. Three sub-themes emerged, namely, *adequate resources; balanced content and meeting students' needs and aspirations*.

Adequate resources

All the participants pointed to the need for additional funding that would enable them to enrol more students in SLDPs and improve their delivery using multiple methods. They noted that most of their units are underfunded and understaffed and rely on inexperienced volunteers, which compromises the quality of their output. UNESCO (2009) states that the main challenges confronting student services are internationalisation of higher education, a lack of network resource professionals, and funding; and students' diverse and growing needs due to massification of higher education. The participants highlighted the need for additional staff as well as skilled development facilitators to design, present and evaluate SLDPs. They also pointed to the need to link with researchers in order to enrich their programmes. These findings are in line with those of Pansiri and Sinkamba (2017, p. 56) who observe that universities' budget priorities and decisions are skewed towards academic departments. Nkonoane (2015, p. 114) maintains that, while it is generally accepted that universities' core business is the "academic project", student affairs practice plays an equally significant role in ensuring that students achieve their academic

goals. There is thus a need to adopt a Resource Allocation Model (RAM) to ensure that student affairs divisions are adequately equipped to develop and sustain development programmes.

Balanced content

The participants also raised the need for balanced content in well-structured SLDPs that offer both contact and virtual sessions. Furthermore, students should be provided with opportunities to practice what they learn by engaging in community service. Lin and Shek (2019, p. 1159) argue that class contact learning is more effective than leadership programmes that involve outside activities because it can reach more students and is less costly. They therefore state the need for balance between content presented through contact sessions and that presented virtually. Contact sessions help to develop rapport between the facilitators and students, while online provision develops independence among student participants. Some of the participants suggested that some of the content should be offered online in order to address timetable challenges and take advantage of the fourth industrial revolution. They agreed with Universities South Africa's (2018) observation that today's students are tech-savvy, but noted that only a few universities utilise online platforms and blackboards for SLDPs. Furthermore, providing content online would enable students to participate in the programme in their own time at their own pace. However, Ahlquist (2015, p. 83) cautions that, students may have grown up in the presence of technologies and digital advances, but this does not necessarily mean that they are literate or competent in using them. The participants proposed that universities should offer digital training to student affairs professionals and ensure that the university digital infrastructure has the capacity to include SLDP offerings.

Meeting students' needs and aspirations

The participants stated that students' needs and aspirations are a key element that guides the design of SLDPs. All of them indicated that it is important for the facilitator to ascertain students' expectations and their reasons for enrolling in the programme before designing and presenting it. When expectations are met, participation improves. This is in line with Robinson and Glanzer (2016, p. 10) who note the need to understand students' expectations. The participants also agreed that the programme design should be student-centred from the beginning to the end. In the beginning, a needs analysis should be conducted, while at the end, feedback should be obtained from the participants as part of the evaluation of the programme. Continuous assessment should occur throughout the programme to determine if the desired learning is taking place.

The study found that only two of the six institutions involved students and other stakeholders in their planning process. Larson and Eccles (2005, p. 163) highlight the need for programme participants to be involved in the planning. Morgan and Orphan (2016) propose that campus stakeholders need to dedicate more time and attention to intentionally crafting programmes and practices that leverage democratic student engagement. Johnson (2019, p. 608) argues that student affairs professionals should meaningfully involve students in resolving the problems that they face, such as creating inclusive environments on campus.

The ideal content for SLDPs

The participants were asked to share their ideas on what they considered to be the ideal content of SLDPs. Four sub-themes emerged, namely, *Personal Development*, *Communication Skills*, *Leadership Development* and *General Organisational Skills*.

Personal development

The participants agree that students should be introduced to personal development by focusing on *Ubuntu*, personal mastery, and advancing university graduate attributes, with some of the view that *Ubuntu* should be a compulsory module. According to Msila (2015, p. 1), *Ubuntu* is an old African concept, a way of life that can be useful to teach leadership and management skills. It involves sacrificing for others, and caring and protecting fellow human beings. *Ubuntu* is based on the premise that everything in one's environment is crucial for one's existence as well as that of one's fellow human beings. The participants indicated that it is a uniquely South African concept that is relevant to inculcate respect for oneself and others in student leaders.

Other participants noted the need to introduce student leaders to the principles of personal mastery which, amongst others, addresses personality traits, a personal strategic plan and living a balanced life. Bui, Ituma and Antonacopoulou (2013, p. 169) note that personal mastery has attracted growing interest in recent years due to its association with learning capability; hence, it is hypothesised by a set of antecedents such as competence, personal values, personal vision, motivation, individual learning, training and development, and organisational culture. Finally, some of the participants argued for the use of their university's graduate attributes as a key subject to set a benchmark for personal development. Osmani, Weerakkody and Hindi (2017, p. 55) argue that the first step in getting graduates to think about what they can offer to the world and potential employers is that they recognise the importance of soft skills.

The participants also maintained that it is important to address areas

that the university has identified as requiring attention to either address emerging risks amongst young people or national or even international issues. During the Fees Must Fall (#FMF) movement, student leadership programmes incorporated issues of social justice and in recent times, the topics of toxic masculinity and sexual orientation have become critical. Finally, there was overwhelming agreement among the participants that promoting academic success should be central in all programmes since the students are first and foremost at university to obtain training and an academic qualification.

Communication skills

The participants highlighted that there should be a compulsory module on communication in all SLDPs. They noted that leadership depends on the leader's ability to communicate a message and vision. Students also need to learn how to engage respectfully with others and handle disagreements in a civil manner. They thus need to master the skill of reasoning. The aspects of communication listed by the participants included being street smart, understanding different cultures and people, learning the importance of verbal and nonverbal communication and the value of listening to others. Osmani, Weerakkody and Hindi (2017, p. 56) list communication as the number one graduate attribute valued by potential employers, while Seemiller (2014, p. 87) includes it among the six student leadership competencies that are necessary in the 21st century. The latter notes that being able to communicate enables leaders to fully express their intended meaning, show that they care and that they are listening and to inform, inspire, influence and negotiate in a non-written format.

Leadership development

The participants agreed that a variety of methods can be used in SLDPs. According to the Council for the Advancement of Standards in Higher Education (CAS) (2006), institutions should design a range of student leadership-related activities. The participants proposed that the leadership module should be grounded in well-researched student development philosophies, theories and standards. It should aim to develop ethical leadership, respect, team building and humility and should include activities to demonstrate what students have learned, such as community development initiatives and projects. Rosch, Spencer, and Hoag (2017, p. 132) propose that a comprehensive model for leadership education in a university context should include: (1) a philosophy of leadership, (2) an explicit set of competencies, (3) a list of spaces for learning and practicing leadership behaviours, and (4) a plan for assessment and evaluation of developmental efforts at the student and campus unit level.

General organisational skills

The participants felt that it is important to include general organisational skills as a basic module in all programmes. Students should be taught how to run successful organisations and they thus need to learn how to plan, organise and manage projects. All participants also indicated that student leaders need to acquire administrative skills like report writing, presentation, time management, management of meetings and management of organisational finances. Weiss (2019, p. 41) lists soft skills such as operational thinking and decision making among the top ten skills that facilitate students' career success. Lebrón et al. (2017, p. 85) argue that students can gain such organisational and operational skills by participating in universities' Professional Based Organisations (PBOs), since their unique context offers an on-campus space to learn the leadership skills required for a particular profession.

Student affairs professionals' perceptions on the impact of SLDPs

The participants were requested to share their perceptions on the impact of the SLDPs they presented. The theme that emerged was *reliance on circumstantial evidence to assess impact*. While they all described their unit's programmes as having an impact, they relied on circumstantial evidence to reach this conclusion. This includes feedback from previous participants and staff members from departments that refer students to the programmes. The participants indicated that students who completed the SLDP became more active on campus and took up leadership positions in student societies, clubs and governance structures. Some participants based their assumptions on feedback from evaluation forms and portfolios of evidence compiled by students. However, there was no evidence that these tools provide relevant data, use multiple data-gathering techniques and disaggregate the data as suggested by Oburn (2005, p. 19). Most of the respondents indicated that they did not have a proper system to evaluate the impact of their programmes.

Students' preferred learning environment

The participants were requested to share their opinions on what they considered to be students' preferred learning environment. Three themes emerged: *Experiential and involved learning environment; safe spaces to freely engage and express themselves and an off-campus outdoor learning environment*.

Experiential and involved learning environment

The participants stated that students prefer an environment that allows them to engage in conversations, group activities, role playing and simulations. MacGregor and Semler (2012, p. 242) claim that such an environment

provides students with opportunities to develop the critical thinking, analytic skills, judgment, insight, and sensitivity they require to confront the many situations they will face in their future roles. Other participants noted that students also enjoy a classroom set up, but interaction should be facilitated differently from the normal academic set up. In the classroom, students engage in practical exercises, interactive dialogues, presentations and group discussion. One respondent indicated that the classroom environment is most enjoyable for students when it is casual, laid back, and encouraging, with approachable facilitators.

Safe spaces to freely engage and express themselves

The participants also indicated that students prefer a safe space where they can freely express their views. Kisfalvi and Oliver (2015, p. 12) argue that learning spaces should be challenging and supportive, welcome dissent and difference in a spirit of hospitality and should allow students to enter into safe communication with one another, drawing on their respective life experiences in order to grow. Sinclair (2007:460) states that a safe classroom climate promotes deeper learning.

Off-campus outdoor learning environment

The participants indicated that students display enthusiasm when programmes are presented in an outdoor environment especially in camping facilities off campus. They noted that off-campus programmes attract a large number of participants. Boettcher and Gansemer-Topf (2015, p. 49) argue that Outdoor Recreation Programmes (ORPs) help students to develop advanced leadership skills and identities which equip them to be more successful citizens and community members. Komives and Wagner (2017, p. 117) state that powerful, compelling experiences build trust and establish respect among group members. Such experiences include challenge courses, rope courses, outdoor challenge trips, and interesting classroom projects.

Challenges experienced in the delivery of SLDPs

The participants were requested to share the challenges they encounter in delivering SLDPs in their universities. The themes that emerged were: *The academic timetable does not allow space for effective delivery of SLDPs; university shutdowns negatively impact delivery of SLDPs; insufficient funding for SLDPs; and lack of buy-in and visible support from senior management*.

The academic timetable does not allow space for effective delivery of SLDPs. All the participants agreed with this statement. They noted that their universities have removed the lunch hour free period from the timetable. This

hour used to be used to run most student affairs programmes. As a result, programmes have to be scheduled after hours and over the weekends. However, the university bus schedules, and residence rules have not been adjusted to enable students to attend these programmes. The participants were of the view that those who design the timetable lack appreciation of the contribution made by SLDPs in achieving the institutional objectives which include the development of university graduate attributes and work readiness. This sentiment is echoed by Ching and Agbayani (2019) who argue that although student affairs' positive impact on students' educational success is well-known within student affairs units, this is often not acknowledged in the broader campus community. It is for this reason that Desai (2011) argues that during the timetable generation process, numerous aspects have to be taken into consideration especially the hard constraints and soft constraints. Most of the participants indicated that they are pursuing multiple strategies to navigate these challenges. These include presenting programmes after hours, and during holidays and weekends. On some campuses, transport is provided to commuter students to attend the programmes. Student timetables are analysed to identify free times and programmes are presented during such times. In other universities, Student Affairs units have reduced their contact session hours and posted significant content online for students. Others engage with various academic departments to lobby for a more accommodating timetable.

University shutdowns negatively impact delivery of SLDPs

University shutdown periods in response to student protests also disrupt SLDPs. Furthermore, catch-up plans only consider academic programmes. This makes it difficult for student leadership practitioners to complete their planned activities. Czerniewcz and Trotter (2019) observe that student protests and university shutdowns have resulted in some universities using blended and online delivery as a strategy to enable the academic year to be completed.

Insufficient funding for SLDPs

The participants stated that their SLDPs are under-funded. Gansemer and Englin (2015, p. 73) and Hamrick, and Klein (2015, p. 16) point to the challenging financial environment in higher education. This has direct implications for student affairs, as it not only reduces resources for its programmes, but results in new waves of student protest. The participants identified their units' different sources of funding, including (1) Compulsory student levies that are solely reserved for on-campus student services; (2) donor funding; (3) third stream income from renting out their facilities and charging fees for their services; (4) fundraising activities, including internal fundraising from sympathetic departments within the university; and (5) grants from

the Department of Higher Education and Training. Despite this matrix of funding efforts, they felt that there was still insufficient funding for SLDPs. One of the participants indicated that they receive funding from organisations that fund student scholarships, as the scholarship beneficiaries are offered certain programmes provided by student affairs.

Lack of buy-in and visible support from senior management

All the participants indicated that what is most needed is buy-in and support from senior management. They stated that they seemed to be unable to persuade senior management of the importance of the work that they do. The participants pointed out that while their universities' strategic plans place students at the centre of all their efforts, in practice senior management is distant from the programmes offered by Student Affairs units. They argued that this was clearly reflected in funding decisions, space allocation and decisions on academic timetables. However, the participants in Ching and Agbayani's (2019) study suggested that student affairs professionals need to engage in self-reflection on whether the lack of support from university management might not be due to their failure to communicate the importance of their role using evidence-based methods. Nevertheless, Pule (2017, p. 288) suggests on-going communication among different stakeholders, including student leaders and university management, as well as Student Affairs departments and the Department of Higher Education and Training. Davis (2014, p. 110) highlights the need to involve senior leaders in leadership initiatives since this is an excellent way to transfer knowledge, values, attitudes, and corporate identity. It also adds gravitas to a programme when busy senior executives are involved as speakers or facilitators. This sends a message to the entire organisation that leadership development is a priority and that it is taken seriously.

Conclusion

The above findings suggest that the leadership educator may be summarised as a someone who is suitably qualified in Student Affairs with basic skills, competencies and attributes such as (i) sound research acumen, (ii) good writing ability, (iii) presentation and facilitation skills, (iv) ability to conduct a needs analysis, (v) ability to design training programmes, (vi) ability to design learning experiences and materials, (vii) capacity to assess and gauge training, (viii) skills to plan and manage events and projects, (ix) report writing skills and (x) general understanding of student development theories; and someone who is adaptable to change.

The results also showed that most of the student affairs professionals that participated in the study lack knowledge of student affairs theories and models. The participants identified adequate resources, balanced content

and programmes that address students' needs and aspirations as critical elements for the successful delivery of SLDPs. In terms of essential content of such programmes, they highlighted community service, personal development, communication skills, leadership development and general organisational skills.

The majority of the participants assumed that the programmes they offered were impactful, yet, they lacked proper instruments and evidence in this regard. Only a few institutions employ systems, tools, and records backed by scientific data and proper tracking to evaluate the impact of their SLDPs. This suggests the need to develop scientific methods to assess the impact of these programmes.

Turning to students' preferred learning environment in relation to SLDPs, the participants stated that students prefer a casual and encouraging environment, with programmes presented in an outdoor environment, especially in off-campus camping facilities. Finally, the challenges confronted by the participants in facilitating SLDPs included timetable congestion, lack of venues dedicated to SLDPs, commuter students being unable to attend sessions after hours and weekends, insufficient funding, the impact of shutdowns and student protests, and a lack of buy-in from management.

Recommendations

Based on the study's findings, it is recommended that:

- Universities should contribute to the development of an undergraduate qualification in Student Affairs. Furthermore, to ensure that all incumbents are properly equipped a one-year postgraduate diploma should be introduced. Nkonoane (2015, p. 130) proposes that "a four-year foundational study programme could be structured at undergraduate level for the preparation of entry-level Student Affairs practitioners." The senior student affairs officers to whom leadership educators report should also develop educators' capacity in research, writing skills, presentation, and facilitation, needs analysis, programme design, the design of learning experiences and materials, assessment and evaluation, planning and managing events and projects, report writing skills and general understanding of student development theories.
- Student affairs professionals should be made aware of relevant SLDP theories and models. Long (2012, p. 41) notes that, although this profession is highly practical, the design of educational experiences and programmes should be grounded in theories of student development. Partnerships should be developed between South African universities and those in other countries to facilitate programmes to train staff in South African universities. Local benchmarking exercises should be facilitated in order to enable exchange of information and sharing of

resources between universities. This should include staff exchange programmes to facilitate knowledge transfer and transactional learning. Mosier and Schwarzmüller (2002, p. 111) explain that "benchmarking is an effective way to improve services and programmes and can assist with uncertainty and rapid change through the discovery of best practices, greater efficiencies, and a clearer understanding of what works most effectively in student affairs."

- An audit should be conducted of all the units responsible for SLDPs to ascertain whether they are adequately resourced with the identified enablers. There should be engagement on these areas to further develop the list. Leadership educators should consider including the following five subject areas as baseline compulsory offerings in the SLDP curriculum: community service, personal development, communication skills, leadership development and general organizational skills.
- Each university should adopt a proper mix of methods to evaluate the impact of their programmes. This should integrate those that are already in use at other universities. Deliberate strategies should be adopted to justify the worth of programmes offered by Student Affairs divisions. This should be led from the top by senior student affairs professionals, flowing down to the most junior member of staff. A practical value proposition for SLDPs needs to be developed by all Student Affairs units, including monitoring of attendance, linking programmes to university strategies, justifying return on investment, documenting positive stories, and tracking former participants.
- Student affairs professionals should design programmes with due consideration for the type of learning environment that will produce the best results for students, taking into account students' preferred learning environments. Leadership educators should be trained to facilitate outdoor and adventure-based programmes.
- Proposals need to be formulated and broader university discussions should be held between Student Affairs, academic faculties, and other operational divisions to address the issue of timetable congestion. There should be a broader university effort to enable maximum participation of commuter students in SLDPs. These efforts should include extending the student bus shuttle timetable and providing other support to commuter students.

Limitations of the study and future research

The study was based on the experiences of student affairs professionals from six universities in South Africa. As such, the findings cannot be generalised to all universities in the country.

The study relied on the participants' experiences, raising the possibility of bias. Furthermore, it did not solicit the views of others who might be involved in presenting SLDPs, such as senior students and external facilitators.

In terms of future research, this could include a study on developing a qualification for student affairs professionals. The National Research Foundation (NRF) could be approached to fund a Chair for Student Affairs Professionalisation at one of the universities.

Future research could also focus in more depth on what constitutes a suitable and enabling environment for presenting SLDPs in the South African context, including the use of new technologies and outdoor learning.

Finally, studies should be conducted on the creation of a seamless student affairs environment in South African universities. This would facilitate a more equitable student affairs environment that could form part of the quality assessments performed by the Council for Higher Education. Such research would help to build appropriate systems and structures to enhance the quality of this environment and place the sector in a strategic position to be taken seriously by university management and funders.

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Social Innovation in the Academic Curricula of Chemical Science Degrees in South Africa

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Abstract

Social innovation is growing internationally and is a focus area for sub-Saharan Africa. While studies have been conducted on the factors that contribute to the failure to incorporate social innovation in academic curricula, there is a paucity of such research in the South African context, especially in relation to university curricula. This qualitative study explored chemical scientists' perceptions on the interventions required to introduce social innovation to the academic curricula of the chemical science degree in South African universities. Semi-structured interviews were conducted with 14 chemical scientists and the data was analysed using thematic analysis. The key findings included the overall lack of awareness and understanding of social innovation and the social challenges confronting South Africa. These factors hamper the development of sustainable academic curricula, effective community engagement and societal change. Furthermore, academic institutions' reluctance to embrace change is cause for concern.

Key words: Social innovation, chemical sciences, academic curriculum, South African universities

L'innovation sociale se développe à l'échelle internationale et constitue un domaine d'intérêt pour l'Afrique subsaharienne. Des études ont été menées sur les facteurs qui contribuent à l'absence d'intégration de l'innovation sociale dans les programmes scolaires ; ces recherches sont pourtant peu nombreuses dans le contexte sud-africain, plus particulièrement en ce qui concerne les programmes universitaires. Cette étude qualitative explore les perceptions des chimistes sur les interventions nécessaires pour introduire

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l'innovation sociale dans les programmes universitaires du diplôme en sciences chimiques dans les universités sud-africaines. Des entretiens semi-structurés ont été effectués avec 14 chimistes et les données ont été analysées à l'aide d'une analyse thématique. Parmi les principales conclusions figurent le manque général de sensibilisation et de compréhension de l'innovation sociale et les défis sociaux auxquels l'Afrique du Sud se trouve confrontée. Ces facteurs entravent l'élaboration de programmes d'études durables, l'engagement communautaire efficace et le changement sociétal. En outre, la réticence des établissements universitaires à accepter le changement est préoccupante.

Mots clés: innovation sociale, sciences chimiques, programme scolaire, universités sud-africaines

Introduction

While South Africa has witnessed many policy innovations since the transition to democracy in 1994, the country still faces serious development challenges. Social innovation is a potential solution to these challenges.

The role of innovation in spheres of society other than economics has gained considerable interest (Andion et al., 2017; Bersin and Chamorro-Premuzic, 2018). A body of specialised literature in this field is emerging (Phillips, Lee, Ghobadian, O'Regan, and James, 2015), with social innovation considered a crucial issue in public policy (Sinclair and Baglioni, 2014). Taylor (1970) defined social innovation as a practice-led field where people do things in a new way rather than learning about them academically. Blodgett, Melconian, and Peterson (2015) note that social innovation takes on different forms in different environments, resulting in it being interpreted and defined in different ways. For example, it will differ in rural (Bock, 2016) and urban areas (Moulaert, Martinelli, González, and Swynedouw, 2007), as the social context and needs will be different. Murray, Mulgan, and Caulier-Grice (2008) state that, because it cuts across different industries and fields of practice, social innovation is multidisciplinary in nature. This has also contributed to the diverse meanings and uses of the term (van der Have and Rubalcaba, 2016). It has been applied in terms of social enterprise and social entrepreneurship, socially beneficial technological innovations, corporate social responsibility, and open innovation (Dees and Anderson, 2006).

Over the past decade, increasing interest has been shown in social entrepreneurship throughout the world as a means of achieving sustainable economic growth (Daud et al., 2018). In the United States, former President Barack Obama launched the Social Innovation Fund, which provides grants to intermediaries who identify and fund promising programmes

(Phills, Deiglmeier, and Miller, 2008). In South Korea, Seoul Mayor Park Won-Soon is incorporating approaches to social innovation into city government (Kim, Rim, Han, and Park, 2015). The European Commission has established guidelines to encourage and extend social development across Europe (Atkinson and Da Voudi, 2000). In Japan, social innovation is rapidly taking root in reconstruction efforts following the 2011 tsunami and nuclear disaster which devastated the country's physical, cultural, and socio-political landscape (Matanle, 2011).

As a nation, South Africa is in dire need of fundamental social, economic, and cultural transformation (Oosthuizen, 2016). The traditional model of government support is insufficient to meet the challenges (Gelb, 2006) and creative and innovative approaches are required to foster sustainable growth, secure jobs, and improve competitiveness (Van Niekerk and Viviers, 2014).

While the 1996 White Paper on Science and Technology (Department of Arts, Culture, Science and Technology, 1996) endorsed social innovation, it was not consciously applied or promoted outside the political arena (Hart, Ramoroka, Jacobs, and Letty, 2015). Furthermore, notions of what social innovation should include range from social welfare benefits, to public goods, and a primary focus on disadvantaged members of society (Hart et al., 2015). More recently, the focus has shifted to sustainable growth that supports disadvantaged community members as innovators and integrates social and economic development elements (Baker and Mehmood, 2015). While confusion persists with regard to terminology, evidence suggests that community actors are engaged in various forms of social innovation in South Africa's rural areas despite limited government involvement that is exacerbated by institutional constraints, and poor understanding of contemporary ideas around innovation and social innovation (Mulder et al., 2008). In most cases, the goal is to improve the social and economic well-being of the poor (Patel and Hochfeld, 2013).

As the following examples illustrate, social innovation is being put into practice and delivering the desired results in finance, agriculture, government, and higher education institutions (HEIs) in different countries.

Microfinance is a form of social innovation that provides financial services to low-income clients, including those who are self-employed as a means of poverty alleviation (Armendàriz and Morduch 2005). Another example of social innovation is Fair Trade Products, a trading partnership that promotes greater equality in international trade based on dialogue, transparency and respect. It contributes to sustainable development by providing improved trade conditions for marginalised producers and workers, especially in the Global South (Raynolds and Wilkinson 2007; Moore 2004; Nicholls and Opal 2005).

Transformative social innovation in Indian agriculture includes the

System of Rice Intensification (SRI) developed by Prasad (2016). Through this initiative, farmers in India reclaimed control of their livelihoods. Vulnerable communities participate in collective exploration, action, and adaptation. Indian agriculture has been associated with deskilling, agricultural individualisation, and a high suicide rate.

In Europe, the Transformation Towns Network (TTN), which emerged in small towns like Totnes and has since expanded to larger cities, is proof of growing interest in social innovation (Aiken, 2012). It's approach to socio-ecological systems focuses on permaculture linked to Resilience Thinking (Walker and Salt 2006) and places the community at its core. The network is a good example of the rise and character of 'community' responses to climate change and the campaign to reduce carbon emissions.

Social innovation initiatives in Seoul, South Korea have led to Sustainable Metropolitan Governance (SMG). Seoul has improved its residents' quality of life by introducing social innovation programmes that have made the city more competitive at the global scale. A variety of creative ideas, including providing free Wi-Fi in the city to make the Internet easily accessible (O'Byrne et al., 2014) have encouraged citizens to engage more with fellow citizens, especially educators, through on and off-line interactions. An Internet Addiction Prevention Education programme, which focuses on students, teachers, and parents, was also introduced.

The iShack initiative in Stellenbosch, South Africa, is a social innovation initiative that upgraded informal settlements as opposed to relocation. A group of postgraduate students at Stellenbosch University engaged with the community and designed social and system innovation responses to water scarcity, land grabbing, soil degradation, slum urbanism, energy poverty, and food insecurity (Swilling, 2016). What started as a relatively small technological intervention developed into a larger community-based social innovation process.

It is against this background that our study investigated the possibility of integrating similar forms of social innovation into the chemical science curriculum for the benefit of communities.

Social innovation is a multidisciplinary field that involves a broad range of activities, including non-profit and social enterprise programmes (Brock and Steiner, 2009), social development initiatives (Sekliuckiene and Kisielius, 2015), facilities, and corporate social responsibility practices (Rexhepi, Kurtishi, and Bexheti, 2013). This calls for specific academic competencies, and personal and managerial skills to develop sustainable models that ensure consistent community engagement, and the necessary change.

It has been more than two decades since the end of apartheid and South Africa's first democratic elections. On taking up office in 1994, the African National Congress government committed to the social, economic, and

political transformation and development of South Africa, and to address the legacies and imbalances of the apartheid system. However, progress has been mixed. South Africa remains one of the world's most unequal countries, scoring 63.4 on the Gini index (Sulla and Zikhali, 2018). Although declining, poverty levels remain stubbornly high, with 31% of the population living below the national poverty line (Central Intelligence Agency World Fact Book, 2014). Creative and innovative solutions are thus required to promote sustainable growth, secure jobs, and increase the country's competitiveness.

Social innovation aims to respond to a variety of challenges, including scarce resources and a lack of innovative thinking (McGowan and Westley, 2015). Disruptive social change is not a new phenomenon, but one that has been experienced throughout human history. Finegold and Notabartolo (2010) state that in the twenty-first century, education will be the foundation of material as well as intellectual progress. They add that the challenge is to develop an educational system that responds to the economic and social demands of this century and fosters innovative capabilities that will spread throughout the population. Universities are well-placed to respond to this need by embedding social innovation and entrepreneurship in their curricula. This would assist in narrowing the gap between the theoretical and practical aspects of these approaches.

Chemical scientists' development is one of the least explored topics in scientific studies and theory (Levine, 2018). However, the literature notes that scientists generally lack business acumen and social innovation. This study examined the possibility of integrating social innovation in South African universities' chemical science curricula. It thus adds to the body of knowledge that supports combination degrees in chemical science and social innovation as an integrative approach to scientists' development that is flexible and agile. While acknowledging the difficulties and complexities of the South African economy (Rodriguez and Rodriguez, 2015), the study also adds to the literature by examining chemical scientists' experiences of social innovation and investigating what could be added to the usual science degree offerings to enhance their professional success. It thus offers an understanding of how social innovation could impact the curricula of chemical science degrees (Galego, Soto, Carrasco, Amorim, and Ferreira Dias, 2018b). In particular, it lays the foundation for the development of a theoretical framework to explain the impact of social innovation education on chemical scientists by examining it from the participants' perspectives.

The results of the study will benefit chemical industries, as they require employees that have scientific training as well as skills in social innovation. Universities will also gain insights from the views of chemical scientists on how social innovation could impact the careers of such scientists. Finally,

chemical science students will gain by developing an understanding of how social innovation can be used to address the social challenges confronting South Africa, thus preparing them for a globally competitive science future.

At the national level, the government is seeking ways to reduce unemployment (Omarjee, 2019). A workforce with a degree in chemical sciences and social innovation could be used as leverage in this regard. The unique attribute of such a combination degree is that it provides the individual with flexibility and ability to adapt quickly to economic changes (Baxter, 2009).

The study did not aim to assess all the professions in chemical sciences, but only the careers of science in chemistry. For the purpose of this study, the term '*scientist*' refers to a professional with a chemistry degree (Kovac, 2018). Given the large number of prospective research participants, the population for this study was restricted to chemistry graduates from different universities in South Africa, but not all universities, as well as academics from the department of chemistry and employees in chemical industries. It is assumed that the participants responded honestly and factually to the interview questions, as it would take significant time and effort to validate each participant's responses. To promote honesty, the participants were assigned pseudonyms and confidentiality was protected through a confidentiality agreement.

The study's objective was to explore chemical scientists' perceptions of the interventions required to introduce social innovation to the academic curricula of the chemical science degree in South African universities. The primary research questions were: (1) What do chemical scientists perceive as necessary interventions to introduce social innovation to the academic curricula of the chemical science degree in South African universities? (2) How would social innovation enhance the academic curricula of the chemical science degree at South African universities? (3) What are the barriers to the introduction of social innovation in the field of chemical sciences in South African universities? (4) What impact could a chemical science-social innovation degree have on the careers of chemical scientists?

Data were gathered by means of semi-structured interviews with chemical science graduates including academic staff members, individuals working in chemical industries, and current postgraduate students.

Literature review

Social innovation in academic curricula

The education system, especially basic and higher education in South Africa, has been considered as slow in responding to the need for social and economic development (Spaull, 2013). Higher education institutions have processes in place for regular curriculum renewal and these are usually in line with each institution's mission and profile. An effective curriculum should be driven by student needs, the mission of the institution and

programme, discipline standards, and partners' needs. To ensure that core skills and knowledge are covered, key stakeholders should be involved in curriculum development.

Scholars argue that universities should embed social innovation and entrepreneurship in their curricula (Kummitha and Majumdar, 2015) in order to address the gaps between the theoretical and practical aspects of a discipline (Alden Rivers, Armellini, Maxwell, Allen, and Durkin, 2015). Universities have demonstrated extraordinary resilience as organisations and have proven that they are able to change and adapt (Sporn, 1999). However, modern universities confront a variety of challenges. A common thread that characterises many of these problems is the interaction between universities and market forces (Leydesdorff and Etzkowitz, 2001). Finegold and Notabartolo (2010) state that the challenge is to establish an educational system that responds to future economic and social demands as well as the spread of technological capabilities across the population.

Academic curricula enhanced through social innovation

The development of new curricula in academic institutions

While today's world is changing faster than at any point in history (Cukier and Mayer-Schoenberger, 2013), few changes have been made to undergraduate degrees (Tomlinson, 2017). The Institute for the Future forecasts that 85% of jobs that will exist in 2030 have not yet been created (Tencer, 2017). Brougham and Haar (2018) note that it is difficult for academic staff to understand the impact of the rapidly changing workplace on students' future career prospects when so little has changed in how universities function. The question that arises is, how can students be better prepared for a future that cannot be predicted in a world that is rapidly changing? Traditional education lays the foundation for technical knowledge, but given the rapid pace of change, this is not sufficient.

The modern labour market demands entrepreneurial, dynamic problem-solving skills, creativity, and cognitive flexibility (World Economic Forum (2016). The current generation needs to learn new ways of working and this can be achieved by offering them opportunities to shape their future (Rainie and Anderson, 2017). Some will start their own businesses, while for those that are employed, these skills and perspectives will enable them to change the way the organisations that employ them operate.

It is not certain how universities will prepare students for the uncertain future ahead (de Villiers Scheepers, Barnes, Clements, and Stubbs, 2018). Moreover, it is not apparent if traditional teaching methods and degree courses will continue to exist or will become part of a diverse learning environment (Fry, Ketteridge, and Marshall, 2008). While there is no single solution, it is clear that universities will need to embrace new ways of working to remain relevant.

Windeløv-Lidzélius (2018) highlights that it is not simply a matter of adopting new technology, but about rethinking the role of the lecturer, as well as what happens in the classroom and the relevant academic methods. This implies that academic institutions should co-create education with students (Bergmark and Westman, 2016). Davey et al. (2018) emphasise that academic models need to shift from teaching to facilitating and leading through social innovation. However, this requires a new mindset and skills set. Field (2000) observes that, if the future of education is lifelong learning, it should go beyond institutional walls to the societies in which academic institutions are situated.

The development of new competencies and skills in academic institutions
Universities are increasingly criticised by their stakeholders for not responding to the skills needs of modern economies (Tremblay, Lalancette, and Roseveare, 2012). Disagreements and tension, including conflict between educational institutions and businesses about what kind of knowledge and skills students bring to the labour market are not new and contribute to productive dialogue (Ruben, 2018). However, in the current situation, tensions have accumulated and could become explosive. An example is multinational consulting company Ernst and Young's public announcement in 2015 that it would no longer look at university credentials when hiring talent, as there was "*no evidence that success at university correlates with achievement later in life*" (Davey et al., 2018). Universities do relatively well in translating changes in scientific knowledge into course content, but they do not recognise equally significant changes in the demand for skills in the outside world, particularly in the societies they operate in, and transform their education programmes accordingly (Fry et al., 2008). The complex and unpredictable shifts in demand for skills will increase the importance of those such as higher-order cognitive skills, complex communication skills, and emotional skills (Bughin et al., 2018). Most universities have yet to acknowledge that such skills should no longer only be required of researchers and academics, but should be part of all university education.

While some universities have taken heed of employer-driven demands (Sharma, 2017), the question is whether this will be sufficient to change societies and impact current economies? Universities should be able to address the skills development needs of economies and communities that are highly volatile and unpredictable (Reddy, Bhorat, Powell, Visser, and Arends, 2016). Employees should be able to work with communities and interdisciplinary groups (Nancarrow et al., 2013). They should be able to understand and creatively solve the problems faced by their societies and be eager to learn.

Proposition 1: Social innovation enhances the academic curricula of chemical science degrees in South African universities.

Barriers to social innovation in academic curricula

Discussion in government forums in South Africa has not focused on social entrepreneurship and the quality of life (Littlewood and Holt, 2018). However, the economic crisis has resulted in a growing number of social entrepreneurship initiatives in the country (Manyaka, 2015) in the form of small, medium, and micro enterprises (SMMEs) (Mabotja, 2019). This was also the case in Latin America, where Galego, Amorim, Dias, and Sarmiento (2018a) noted that the economic crisis led to the adoption of social innovation to create jobs for the youth.

South African universities have undergone structural changes and mergers to promote equity, quality, development, efficiency, and effectiveness (Hay and Fourie, 2002). However, much remains to be done to create a new identity as inclusive and equitable institutions (Mabokela, 2003).

Proposition 2: Universities in South Africa confront barriers to the integration of social innovation in the chemical science field.

Integration of the chemical science degree and social innovation

Sustainable, practical and affordable solutions are required to address the social and environmental issues confronting the world (Matus, Clark, Anastas, and Zimmerman, 2012; Melles, de Vere, and Misic, 2011). Scientific and technological innovation continues to play a key role in catalysing new industries, spawning job growth (Ayres, 1996), and improving the quality of life of people around the world (Shuzi, 2002). In many respects, improving the quality of life in South Africa through technological innovation has been taken for granted (Walwyn and Cloete, 2018).

Scientific innovation has contributed to many of the greatest social achievements in human history (Núñez Jover and López Cerezo, 2008). These include, but are not limited to, chlorination of drinking water (Masri, 1986), oral rehydration therapy (Santosham, 2002), solar energy (McEachern and Hanson, 2008), pasteurisation (Mújica-Paz, Valdez-Fragoso, Samson, Welti-Chanes, and Torres, 2011), and many other technological innovations. It is thus evident that science-based and technology-based approaches are integral to meet societal needs. In order to create a path for social innovation, scientists and engineers must find ways to build paths for potential innovators (Lettice and Parekh, 2010).

It is clear that science has shaped almost every domain of social life, leading to what is known as the rise of the knowledge society. However, if science is

overwhelmingly shaping society, why shouldn't society also shape science? Why should scientists' 'own selection of research topics' go unchallenged? Should society not assert its priorities? The problem may be familiar, but new circumstances mean that it cannot be solved using the same formula. Social participation is called for where social transformation is driven by science. Embracing social innovation as part of their social responsibility would enable South African universities to work as a force for good in society.

Proposition 3: An integrated chemical science with social innovation degree will have a significant effect on the careers of chemical scientists.

Methodology and procedures

Research approach

An exploratory and descriptive qualitative research method was employed to investigate scientists with chemical science degrees' perceptions of the interventions required to introduce social innovation to the chemical science degree curriculum in South Africa. This method was chosen due to its flexibility in enabling an exploration of the experiences of others (Miles, Huberman, and Saldaña, 2014). The exploratory approach was selected to gain new perspectives and unearth new concepts with regard to increasing social innovation awareness throughout academic curricula.

Sampling

A purposive sampling technique was employed. According to (Omona, 2013), a purposeful sample enhances the quality of data obtained, thereby promoting reliability. Careful thought was given to who would be invited to participate in order to ensure representation of a wide range of experiences. Data were gathered from three different groups of participants, namely, chemical science lecturers; chemical science postgraduate students; and scientists working in the chemical industry. The sample consisted of 14 participants.

Data collection

A questionnaire was administered to the participants, followed by face-to-face semi-structured interviews to obtain their opinions and views on the phenomena under review. A letter was attached to the questionnaires outlining the purpose of the study as well as a letter of consent. The participants were assured that their privacy and anonymity would be maintained. An interview schedule was used to promote higher level understanding and explanation (Kvale and Flick, 2007). The interview approach also helps to break down and simplify complicated answers. Each interview lasted 35 to 45 minutes. A digital recorder was used and the researcher also took notes during the interviews.

Research instrument

The qualitative interviews enabled in-depth information to be collected on the research topic. Therefore, a limited number of questions were posed in order to enable the participant to have time to talk at length. A list of open-ended questions was composed with no numbering, so that the questions were not asked in the order they were listed, enabling them to fit easily into the interview. The interview started with small talk that evolved into asking a neutral question that invited the participants to describe something related to the topic. All aspects of the participants' experience with and perspectives of the topic were addressed. The interview questions were subdivided into four sections:

Part 1 focused on general information. The three questions (Q1-3) identified the universities attended by the scientist and his/her primary reasons for studying chemical sciences. The type of work currently done by the scientist was also identified.

Part 2 (Q4 and 5) focused on the scientists' practical knowledge of social innovation and examples of social innovation initiatives in their day-to-day work. The goal was to enable them to share their own experiences of social innovation in their careers.

Part 3 (Q6-8) solicited the scientists' views on social innovation and if they felt it would improve the academic curriculum of a degree in chemistry at universities in South Africa. The aim was to encourage scientists to share their thoughts on social innovation and their future careers.

Part 4 (Q9) contained a question on the scientists' perceptions of the steps that universities should take to introduce the social innovation content required to address socio-economic challenges in South Africa.

Data analysis and interpretation

Thematic content analysis was used to analyse the transcribed data and identify common themes. The interviews were translated and transcribed. The researchers then read and re-read the interviews, reflecting on them as a whole. Castleberry and Nolen (2018) state that a researcher should then summarise the interviews, bearing in mind that in a series of interviews, there could be more than one theme. Once defined, the themes that seemed to be important concepts were recorded.

The questions posed to the participants were used to formulate codes derived from the answers, which were further categorised to formulate themes. According to Leedy and Ormrod (2005), qualitative data analysis

involves reading transcripts, developing codes, coding data, and drawing links between discrete pieces of data.

Results and discussion

The findings presented and discussed here are the results of the thematic content analysis of the interview data. The aim was to understand scientists with chemical science degrees' perceptions of the interventions required to introduce social innovation to the chemical science curriculum in South Africa. The themes and categories that emerged during data analysis are summarised in Figures 1 and 2. Each category yielded several themes that are discussed in more detail following the figures. The top theme per category (see Figure 2) is discussed, followed by proposed interventions.

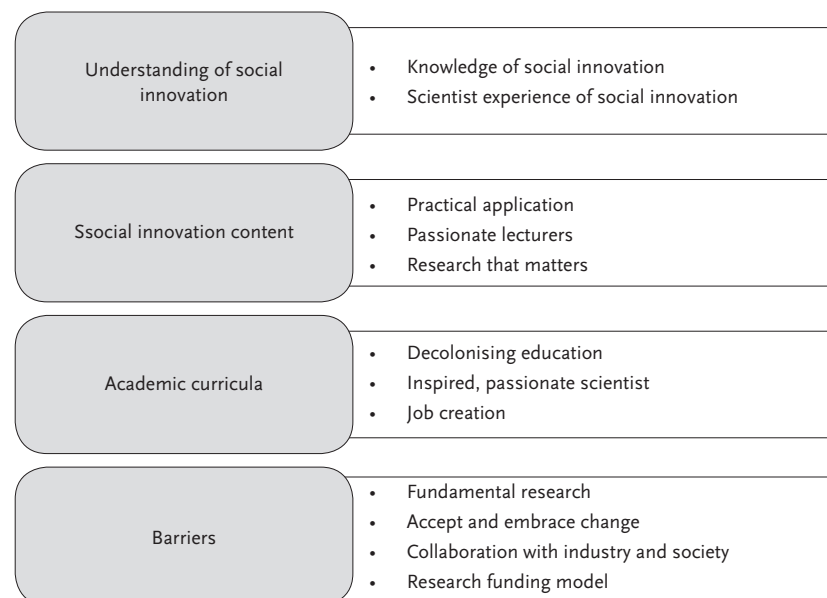


Figure 1: Themes relating to the four social innovation categories

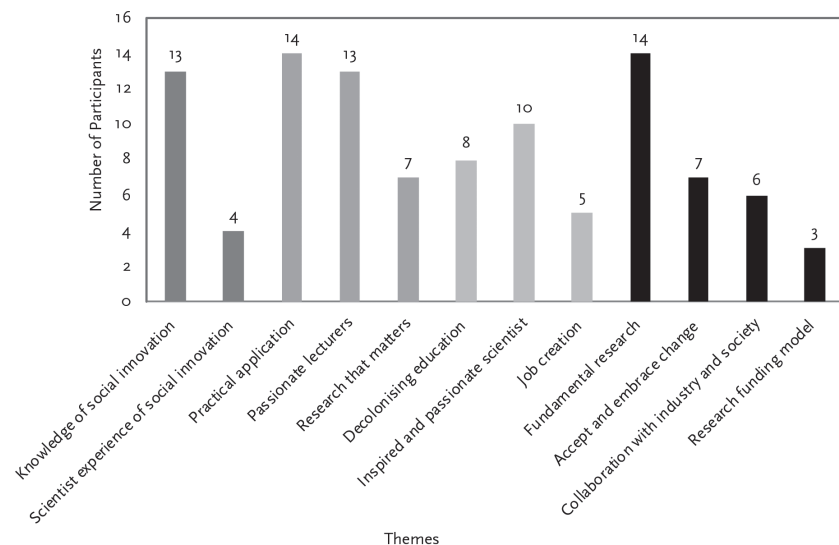


Figure 2: The 12 themes with the total number of participants who identified the themes and the top theme in each category

Understanding of social innovation

Theme 1: Knowledge of social innovation

Thirteen of the fourteen participants said that they did not know about social innovation during their undergraduate and postgraduate studies. This was due to many factors, including:

- Lecturers' lack of knowledge on social innovation
- Lack of knowledge on South Africa's current social problems
- Lecturers who are not optimistic and passionate about their communities
- Lecturers that focus only on fundamental issues
- Lecturers that have no vision beyond the chemistry laboratory
- Research which is not driven by societal issues

One participant commented on lecturers' lack of knowledge on social innovation as follows:

"I don't know where this idea of social innovation goes when it comes to academics. Because I wonder how many academics will even understand the concept of social innovation, just the understanding of social innovation. Because if they do not understand the concept, it is unlikely that they will introduce it into their curriculum." – Dr M

Although many participants were of the view that social innovation is a 'new topic', it was defined by Taylor (1970) in the seventies as a practice-led

field where people do things in a new way rather than learning about them academically. Because the definition of social innovation varies in different environments, its practice may look and feel different (Blodgett et al., 2015).

These findings imply that much needs to be done to create awareness and understanding of social innovation. The suggestions made by the participants to achieve this are partially supported by Caulier-Grice, Davies, Patrick, and Norman (2012), who propose the following common features and core elements of social innovation:

- Novelty: Social innovations need to be new in some way.
- From ideas to implementation: Social innovation is concerned with the practical application or implementation of a new idea.
- Meets a social need: It should be designed to meet a social need.
- Effectiveness: Social innovation should be more effective than existing solutions.
- Enhances society's capacity to act: The process of social innovation enhances society's capacity to act.

While many of the participants were involved in outreach programmes and community projects during their university education, only a few participated in projects which had a social innovation aspect. According to Preston, Ogenchuk, and Nsiah (2014), the most meaningful and powerful impact of social innovation is often the personal transformative changes that occur in participants in such programmes. The study participants suggested that university leadership should present on-going workshops to raise awareness of social innovation as well as the social challenges currently facing South Africa. They added that South Africans should consciously seek to become part of the solutions to these problems.

Content on social innovation

Theme 3: Practical application

Tomlinson (2017) notes that, while the world is changing rapidly, undergraduate degrees have not changed much. All 14 participants agreed that the undergraduate chemical science degree lacks practical application as it is still based purely on the fundamentals of science. The comment by Dr B emphasises this:

"...a lot of lecturers mostly just focus on the textbook content and there is minimum appreciation of the application side on what you can use this knowledge in your society which I think is a pity" – Dr B

However, examples were cited of specific lecturers including aspects of social innovation in their teaching. Mr G, a PhD student, gave an example

of such a project in chemistry. His passion and excitement shone through when he spoke about his experience of doing scientific work that matters:

“Even the reports that came out of that practice you could see that people were passionate about what they did because they had to think outside the box” – Mr G

He added that projects like this should be replicated as knowing that they can be part of the solution gives scientists a sense of belonging in their community.

The participants were asked if there was social innovation content in the curricula of their chemical science degrees. The findings showed that these curricula lack practical application, which is the core element of social innovation. The literature confirms that the South African education system, especially in terms of basic and higher education, has been considered inadequate in terms of social and economic development (Spaull, 2013). While HEIs have processes in place for regular curriculum renewal and such processes are usually in line with each institution’s mission and profile, social innovation does not seem to be a focus area. Instead, the social innovation identified in universities appears to be a mainly ‘tick box’ activity undertaken by a few people through outreach programmes and community initiatives.

There is general agreement that the current chemical science curriculum does not enable scientists to come up with innovative solutions to address some of South Africa’s current social challenges. An effective chemistry curriculum should be driven by the country’s needs, the institution and programme’s mission, discipline standards, and business partners’ needs. In order to ensure that core skills and knowledge are covered, key stakeholders should be involved in curriculum development.

Brougham and Haar (2018) highlight that it may be difficult for academic staff to understand the impact of the rapidly changing workplace on their students’ future career prospects when so little has changed in how universities function. The question that arises is, how can students be better prepared for a future that cannot be predicted in a rapidly changing world? Traditional education offers an important foundation for technical knowledge, but given the rapid pace of change, this is not sufficient. Universities do relatively well in translating changes in scientific knowledge into course content, but they do not give equal recognition to significant changes in the demand for skills in the outside world, particularly the societies they operate in, and transform their education programmes accordingly (Fry et al., 2008). The participants suggested that universities should increase applied science research without sacrificing fundamental research and also design research that can address some of the social challenges.

Academic curricula

Theme 7: Inspired and passionate scientists

Ten of the fourteen participants noted that education in the chemical sciences together with knowledge of social innovation could have a positive impact on their performance as scientists. Skills learned in the field of chemical science and social innovation could help scientists to solve some of the prevailing social challenges. Below are some of the comments made by participants:

“... we all want to make a difference in our communities... by not having social innovation in our education we fall short of being the solution givers” – Ms E

“I would think of the satisfaction it will bring as a PhD student, designing polymer nanofibres that can be used to filter and clean a water system in a township somewhere where people are struggling with poor quality of drinking water.” – Dr A

The participants felt inspired and motivated by the possibility of including social innovation in chemical science curricula. However, it was noted that there will always be competing issues for academics. Dr N indicated:

“... firstly, the academic environment is a cut-throat industry. The pressures of publishing in high-impact factor journals can very easily sidetrack the academics even though they started with good intentions because for you to publish in a high-impact journal it has to be new and it should have never been done before ... just that can easily take you away from social innovation” – Dr N

It is clear from the above that the participants agreed on the need for education that makes a difference in communities. However, concerns were expressed about the lack of awareness of social innovation among South African scientists. Moreover, where there is awareness, lack of support compounded by not being taken seriously frustrates scientists and they become demotivated.

The literature shows that science has shaped almost every domain of social life (Núñez Jover and López Cerezo, 2008). This is often labelled as the rise of the knowledge society. However, if science is overwhelmingly shaping society, why should society also not shape science? Why should “own selection of research topics” by scientists remain privileged? Why should society not assert its priorities? The problem may be familiar, but there are new complications that cannot be solved using old formu-

lae. There is a need for social participation where social transformation is driven by science.

Barriers to the introduction of social innovation

Theme 10: Accepting and embracing change

All the participants indicated that it is very difficult for academics to accept or embrace change. As the comments below indicate, the reasons range from ageing academic staff in charge of chemical science departments to fear of universities losing respect and fear of failure associated with the risk of doing something new.

“Social innovation seems like a very new kind of an approach and universities have a legacy of how they do things ... changing that would need a few people to come together to drive this change” – Dr C

“Our professors are old and they do not want to change. They still have the same mark sheet that was handwritten more than 30 years ago because that is what they know works and they are not willing to try something new even though outside we have different challenges.” – Mr G

All the participants expressed frustration about the rigid structures of academia, with some expressing hope that change will come from young, up-and-coming academics. This is of concern because it suggests that until the older generation exits academic institutions, social innovation will not be introduced in chemical science curricula.

Although South African universities have undergone structural changes and mergers to promote equity, quality, development, efficiency, and effectiveness (Hay and Fourie, 2002), major transformation is required to create a new identity as inclusive and equitable institutions (Mabokela, 2003) and to transform their academic curricula.

While the study identified five main barriers to the introduction of social innovation in the field of chemical sciences, two common threads emerged. The first is a lack of the information required to develop, implement, and measure social innovation. This is exacerbated by a lack of general awareness of social innovation.

The second thread is academics' reluctance to embrace change, which could be caused by many reasons. Butler (1997) characterised learning as “a disturbing and uncomfortable process”, but suggested that being uncomfortable is a necessary aspect of learning. If learning is to be transformative, there must be moments when the participants are unsettled, challenged, and questioned.

Integrated chemical science degree

The participants were asked if they thought a combined chemical science and social innovation degree would have a significant effect on the careers of chemical scientists and what such effects might be. Twelve of the fourteen participants agreed that a combined degree might benefit South Africa. However, they raised different issues relating to combined degrees. Some stated that it would enable scientists to adopt a holistic approach when it comes to applying their skills in business and communities. However, most importantly, they indicated that it would create many opportunities; for example, entrepreneurial skills where people start thinking about how they can be employers rather than employees.

However, although they concurred that combination degrees offer significant advantages, some participants felt that South Africa is not ready for this due to inequality in education, and that combined degrees would only benefit a few. Below are some of the participants' inputs.

“I have been trained as a chemical scientist and as soon as I step out of the university walls I am confronted with how do I convert what I have learned into something of commercial business ... if you do not have those business skills you are immediately on the back foot” - Dr N

“Just thinking now in my current work, I have a handle on the science part but I am grappling with the business side of things ... you do not understand how and why certain decisions are made and why we can't continue with certain projects.” – Dr B

Asked what kind of combined degree would interest them and benefit their communities, the majority suggested those set out in Figure 3. The most popular combined degree among the participants was the combination of chemical science with business management and social innovation. This fits with the World Economic Forum's (2016) observation that entrepreneurial skills are essential in the modern world. The current generation needs to learn new ways of working and this can be achieved by offering them opportunities to shape their own future (Rainie and Anderson, 2017). This is especially true of those that will be starting their own businesses. For others, these skills and perspectives will be used to change the way that the organisation that employs them operates.

Some participants stated that a supportive framework for SMMEs is required to grow the South African economy. Thus, it would be of benefit to incorporate business management into any degree. Nevertheless, some participants felt that South Africa is not ready for 'prestige' degrees, as literacy levels remain low and the unemployment rate is very high.

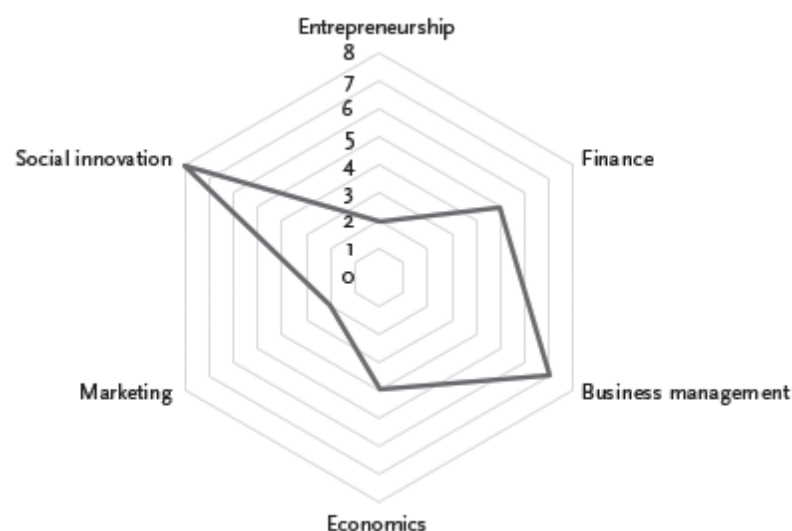


Figure 3: Suggested subjects to be combined with chemical science

The literature identifies combined degrees as a way to develop new competencies to address the skills needs of modern economies. However, de Villiers Scheepers et al. (2018) note that it is difficult for universities to prepare students for an uncertain future. Will traditional teaching methods and courses still exist or will they become part of a diverse learning environment? (Fry et al., 2008). While there is no simple answer to these questions, as with any complex challenge, universities will need to embrace new ways of working to remain relevant.

Windeløv-Lidzélius (2018) points to the need to rethink the role of the lecturer as well as what happens in the classroom and the relevant academic methods. This implies that academic institutions should start co-creating education with students (Bergmark and Westman, 2016). On the other hand, Davey et al. (2018) emphasise that academic models need to shift from teaching to facilitating and leading through social innovation.

Conclusions and recommendations

The findings of this study point to the need to incorporate social innovation into chemical science curricula and that this will benefit the South African economy. Many of the issues identified as barriers to the implementation of social innovation are daunting, but could be addressed by academics if they are willing to change. The participants noted that chemical scientists

need more than just a chemical science qualification to remain competitive in any industry. They also expressed concern about the future of scientists, as there is no longer a need for 'specialised' scientists. It is clear that much needs to be done to increase knowledge and understanding of what social innovation is. There was general agreement that the current chemical science curriculum does not enable scientists to come up with innovative solutions to address some of South Africa's current social challenges. The curriculum is still largely based on fundamental teaching that does not translate into practical application for the betterment of society. It was also apparent that the chemical scientists that participated in this study want education that makes a difference in the communities that they come from.

Based on these findings, it is recommended that South African universities should promote specific academic competencies, especially in the field of chemical science. These should include social innovation in order to enable the development of sustainable models that ensure consistent community engagement and the necessary societal change.

An area of concern is the reluctance to embrace change among both HEIs and their academic staff. It is imperative that universities abandon this attitude and identify opportunities to build a prosperous society. Failure to do so runs the risk of them becoming obsolete.

One of the study's key findings is the need to create awareness of social innovation and the social challenges that are facing South Africa among HEIs. Senior academic leadership should drive awareness campaigns on these issues. They should also encourage faculties and departments to introduce social innovation in their curricula and research. The government has a significant role to play in enabling this through engaging with research funding bodies to make social innovation part of their requirements for research funding.

Combination degrees were identified as a mechanism to produce scientists who adopt a holistic view in applying their skills in business and communities. Most importantly, such degrees could advance entrepreneurial skills whereby people start thinking about how they can be employers rather than employees.

To the best of our knowledge, this is the first empirical study on chemical scientists' perceptions on the interventions required to introduce social innovation to the academic curricula of chemical science degrees in South African universities. It is hoped that the findings will be of practical value to the chemical science industry, academia, chemical science students, and the government, and that they will lay the foundation for future research.

Practical implications

This study identified several factors that hinder the introduction of social innovation in the chemical science curriculum. Aspiring chemical scientists could learn from these findings to achieve a realistic view of their careers and to help them plan how they could be better scientists in the future. Established scientists and academics could adapt their approach to their research by incorporating the findings from this study in their research strategy and teaching. Chemical science lecturers are encouraged to expose chemical science students to the findings as part of preparing them not only as scientists, but also as scientists who contribute to the communities they come from.

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The Impact of Tertiary Students' Entry Characteristics and their Academic Performance

Maame Afua Nkrumah

Abstract

This article examines the effect of tertiary students' entry characteristics on academic performance using the 'value added' approach and MET Polytechnic, Ghana as a case study. The input-process-output-context framework presented in the Global Monitoring Report (2005) by Scheerens was used to select appropriate variables for the study. The study focused on three generic courses - African Studies, Communicative Skills and Computer Literacy. Data from different sources, including secondary data and administrative records from the Polytechnic were analysed using multilevel analysis. The overall effect of the selected variables was mixed and outcomes specific. For example, English language impacted positively on African Studies but negatively on second semester Computer Literacy, while age and gender had a negative effect on first semester Computer Literacy. Although the findings may not directly benefit analogous institutions, several lessons, including the need to create appropriate institutional datasets for future comparisons across institutions can be learnt.

Key words: Age, gender, department context, previous achievement, SES, 'value added'.

Cet article examine l'effet des caractéristiques d'entrée des étudiants de l'enseignement supérieur sur les résultats scolaires en utilisant l'approche de la « valeur ajoutée » et le MET Polytechnic, au Ghana, comme étude de cas. Le cadre entrée-processus-sortie-contexte présenté dans le *Rapport mondial de suivi* (2005) par Scheerens a été utilisé pour sélectionner les variables appropriées pour l'étude. L'étude s'est concentrée sur trois cours génériques - études africaines, compétences communicatives et connaissances informatiques. Des données provenant de différentes sources, y compris les données secondaires et les dossiers administratifs de l'École

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polytechnique, ont été analysées à l'aide d'analyses à plusieurs niveaux. L'effet global des variables sélectionnées était mitigé et les résultats étaient spécifiques aux institutions. Par exemple, la langue anglaise a eu un impact positif sur les études africaines, mais négatif sur les connaissances informatiques du deuxième semestre, tandis que l'âge et le sexe ont eu un effet négatif sur les connaissances informatiques du premier semestre. Les résultats pourraient ne pas profiter directement à des institutions analogues, mais plusieurs leçons, y compris la nécessité de créer des ensembles de données institutionnels appropriés pour les comparaisons futures entre les institutions, peuvent être tirées.

Mots clés: âge, sexe, contexte du département, réalisations antérieures, SSE, « valeur ajoutée »

Introduction

This article focuses on the effect of tertiary students' entry characteristics on academic performance using the 'value added' ('VA') approach and MET Polytechnic, Ghana as a case study.

The literature associates student performance with many factors, some directly associated with student characteristics and others with the context of teaching and learning and the classroom teacher (Chiao and Chiu, 2018; Erdogdu and Erdogdu, 2015; Kupermintz, 2003; Rutter and Maughan, 2002). More specifically, factors like students' gender, age, prior attainment, and peer group, etc. have been identified as affecting performance at the pre-tertiary level (Scheerens and Bosker, 1997; Thomas and Mortimore, 1996). At the tertiary level, students' entry characteristics, commitment, experiences after entry, academic and social integration, the nature of the institution (e.g., residential, size, disciplines, etc.) have been found to influence their performance (Evans, 2000; Kuh, 2001; Gardner, 2005; Mills et al., 2009). Additional factors include dominant norms and values, purposeful student-faculty contact, active and collaborative learning and clearly communicated high expectations (Kuh et al., 2006; Pascarella, 2001; Pascarella and Terenzini, 2005).

For the purpose of this study, four main groups of student entry characteristics were selected: (1) *previous attainment* (English, Maths and Science), (2) *background* (gender, age, local language spoken), (3) *socio-economic status* (SES) (place of residence and language spoken) and (4) *department context* in the form of the mean prior attainment. These variables were considered important due to their significant contribution to a better understanding of student success (Kuh et al., 2006; Yu and Thomas, 2008).

Prior achievement

Prior attainment has been identified as the single most important explanatory variable that explains students' academic achievement (Rodger, 2007; Bratti et al., 2004; Rodgers and Ghosh, 2001). This is due to the fact that knowledge and skills in areas relevant to the curriculum are required to serve as baseline knowledge to which subsequent progress or knowledge can be added (see Sammons, 2007; Thomas, 2001). The percentage of total variance in student achievement explained by prior attainment at the tertiary level is 11-12% in the Pure and Applied Sciences and 7-8% in the Social Sciences and the Arts (Johnes, 2006).

Background and socioeconomic status (gender and age)

Yu and Thomas (2008) examined the importance of a wide range of explanatory variables (e.g., pupil gender, age, SES) using a secondary dataset from 14 member countries of the Southern and Eastern Africa Consortium for Monitoring Educational Quality (SACMEQ) and multilevel modelling statistical techniques. The study found that students' gender, age and SES had little or no influence on performance. At the tertiary level, inclusion of these factors only explained 3% of the total variance, although it was statistically significant (Johnes, 2006; Hoskins et al., 1997).

The study on which this article is based focused on Higher National Diploma (HND) students' performance (examination scores) in three generic courses - African Studies (AFS), Communication Skills (CS) and Computer Literacy (CL) for three academic years (2007/2008 to 2009/10). These courses were chosen because the overall purpose of this study was quality improvement. Knight (1996) identified five discrete but interrelated notions of quality in HE, namely quality as exceptional, perfection, fitness for purpose, value for money and transformation. The notion of transformation adopted for this study involves enhancing and empowering students. Interestingly, this notion is also associated with the concept of VA because the HE sector is expected to add value to students by developing in them generic competencies, including oral communication, teamwork and interpersonal skills, self-management, problem solving and leadership skills to better prepare them for the world of work (Marginson, 1993). The study thus examined how the institution was developing and empowering students in the three generic courses, Communicative Skills, Computer Literacy and African Studies.

The scores were for examinations conducted and marked under the supervision of the National Board for Professional and Technician Examinations (NABPTEX) that is responsible for all HND programmes in Ghana.

Unlike discipline specific courses for which examinations may not be comparable, examinations for these generic courses were common and compulsory for all first-year students, regardless of their field of study.

Communication skills are necessary to negotiate and create new understanding, interact with others, and promote personal learning. Computer literacy is essential in an increasingly digital world, including teaching/learning and training (Santos and Serpa, 2017). African Studies aims to foster critical thinking and equip students with resources/tools/methods that enhance their understanding and appreciation of issues pertinent to African cultures, societies, and development.

Similar courses identified in the literature include research and inquiry, critical problem-solving skills, teamwork skills, continuous learning and information management, entrepreneurship skills, professional ethics and moral and leadership skills (Muslim et al., 2012; Barrie, 2006). These courses are generally expected to facilitate the learning process by providing both form and function to disciplinary specific knowledge (Bowden, 2000; Barrie, 2006).

The VA approach that was employed differs from two other approaches that also rely on student test scores to predict their performance. The first uses the average test scores or pass rates while the second focuses on the *rate of each school's improvement during the year* (measured by changes in student test scores after say, a year relative to a specific target of improvement). The main drawback of these approaches is their failure to account for differences in the mix of students upon entry in terms of for example, previous achievement, background, SES, etc. (Ladd and Walsh, 2002).

The VA approach has mainly been used at the pre-tertiary level across different institutions. For instance, Thomas (2001) employed six datasets relating to different regions in the United Kingdom and abroad (Lancashire, London, Jersey, Scotland, the Netherlands and England) to examine the differences between schools. The study found that prior attainment alone accounted for 48% of the total variance among schools (see also, Jung Peng, 2006; Rumberger and Palardy, 2005; Sammons, Thomas and Mortimore 1997). Jung Peng et al. (2006) used the VA approach to illustrate how assessment data from a Chinese educational authority could be used to improve the quality of teaching and learning. The study highlighted the lack of evidence in China on the size and extent of school effects and the lack of teacher engagement in the use of such data to inform practice. Singh (2013) used panel data to estimate VA models of learning production in private and government schools in Andhra Pradesh (India). The study showed that attending a private school had no effect on Mathematics; but a positive effect on English, and a mixed effect on Telugu (the official language of the Indian states of Andhra Pradesh and Telangana) for children aged 8-10 and 15. In urban areas, no effect was noted. However, teachers' absence, effort, and teaching practices, and class size significantly affected learning. As noted earlier, within the African

context, the importance of a wide range of explanatory variables such as pupil gender, age, and socio-economic factors, etc. were investigated by Yu and Thomas (2008).

However, the VA approach has not been extensively used at the tertiary level within a single institution. It was employed in this study for a number of reasons.

Firstly, the variables usually examined at the pre-tertiary level are also common to tertiary education (e.g., prior attainment, student SES, background, etc.). Secondly, comparisons across different institutions may be problematic as their context and examinations even for the same courses may differ. For this reason, the study's findings are limited to departments within MET Polytechnic (this is considered as a pilot study until comparable data is available on other institutions). Thirdly, measuring VA has long been a goal of higher education (Rogers, 2007). For instance, Universities UK's review of the United Kingdom's White Paper on *The Future of Higher Education* stated: "We have asked HEFCE [Higher Education Funding Council for England] to review current methodologies for recording student achievement and to develop more sophisticated ways of measuring 'value added' – the distance travelled by the individual learner" (Teichler, 2003, p. 48).

The VA approach has also been used in further education. Armstrong and McVicar's (2000, p. 4) study on the performance of Northern Ireland's vocational education and training sector in terms of qualifications and value added outcomes concluded that, "it is necessary to account for initial conditions (i.e. qualifications and skills on entry along with socio-economic background characteristics) if we are to correctly monitor the contribution of the various routes and institutions involved in improving the skill levels of young people".

This approach is also preferred by many educational researchers due to its ability to capture institutions' progressive, positive influence on students' learning by measuring their pre- and post-attainment at different points in time (Rumberger and Palardy, 2004; Thomas, 2001; Rubenstein et al., 2003). It enables estimation of the contribution that factors within the control of schools (e.g., teachers, policies, context) make to student learning. The VA approach's complex statistical techniques also provide estimations of teacher and school effects free from distortions due to powerful non-educational factors such as the family (Koedel, Mihaly and Rockoff, 2015; Tam, 2001).

The VA approach has only recently been employed to examine quality issues in African higher education. Furthermore, in other parts of the world, it has primarily been applied at pre-tertiary level. This study posited that, if its principles are carefully applied and replicated, it could be employed

at tertiary level. The main objective was to gather empirical evidence in support of quality improvement within the framework of self-evaluation, given that quality initiatives emanating from institutions that focus on their unique context can enhance students' educational experience and promote and sustain quality over time (Houston, 2008; Tam, 2001). The study thus contributes to existing knowledge by presenting evidence from a 'new' context.

Materials and methods

A case study was considered appropriate as the research involved an in-depth investigation of a single institution (Yin, 2009). However, this could mean that the findings may not be generalisable to other contexts. Nonetheless, the findings add to the body of knowledge in this field from a Ghanaian perspective.

The EFA Global Monitoring Report's (2005) input-process-output-context framework for assessing educational quality was adopted to select appropriate variables. This framework associates hypothetical effectiveness-enhancing conditions with output, usually calculated in terms of student achievement. The framework has also been used by many researchers to examine similar issues in the African context (see Fuller and Clarke, 1994; Heneveld and Craig, 1996). According to Creemers and Schereens (1994), inputs consist of a range of variables associated with financial or personal resources such as students' prior attainment and background, teachers' characteristics and level of education and training, facilities, the curriculum and financial and other resources. Process refers to factors within the school that distinguish effective from less effective schools e.g., the forms of interaction between teachers, students and administrators, material and educational technology. Context, on the other hand, refers to the socio-economic and educational context of schools (e.g., guidelines and regulations for schools and the characteristics/structure of formal educational systems). Outputs typically refer to changes in student achievement, completion rates, certification, skills and certain attitudes and values. The specific aspects of the model examined were the inputs (e.g., prior attainment, background, SES) and output (students' end-of-semester results) and the relationship between them. The framework therefore provided a broader perspective on quality within the institution by assisting the selection of appropriate variables for the study as well as the statistical models. The VA approach was selected due to its ability to take into account differences in the student mix and capture institutions' positive impact on students' learning (Thomas, 2001).

Datasets

The study used two separate cohort datasets for 2009 and 2007-2009. The reason was that age and gender were not statistically significant when the 2009 dataset was used, perhaps because of its relatively small size. Although age and gender were significant in the 2007-2009 dataset, it did not contain SES information. The 2009 dataset included information on SES gathered via a student survey that elicited information on a variety of issues including the language spoken by students and their place of residence. The total population for the 2009 dataset was between 1 757 (CL) and 1 822 (AFS). For the 2007-2009- datasets, the total population ranged from 5 879 (CL) to 5 944 (AFS). Permission was granted by MET Polytechnic to access the datasets on the understanding that the study's findings could benefit the institution in terms of improving teaching and learning. For this reason, a pseudonym, MET Polytechnic, is used. The datasets were created using data from the following three sources:

- a) Secondary data
 - i) From end-of-first-semester examination scores in AFS, Communication Skills (CS1) and Computer Literacy (CL1).
 - ii) Second semester scores in Communication Skills (CS2) and Computer Literacy (CL2). CS2 is a continuation of CS1 and the same is true of CL1 and CL2.
- b) Administrative records in the form of students' grades in English, Maths and Science.
- c) Student survey data on background and SES.

A dataset was created for each outcome – AFS, CS and CL. For more details, see Table 2 in the Appendix. The significance of the individual variables tested is set out in Table 3 in the Appendix. The individual variables examined were prior attainment, background factors, SES factors and department context.

Prior attainment

Students' previous grades (A - F) in English language (simply called English), Maths and Science in the West African Senior Secondary School Certificate Examinations (WAEC) were collected from individual student files and used as prior attainment measures (entry level attainment into tertiary education). The WAEC is a consortium of five African countries responsible for all national pre-tertiary examinations in member countries. Obtaining the actual scores instead of grades was a bureaucratic and difficult process. Moreover, sifting the raw scores (with the WAEC's permission) from the thousands of students who wrote the exams across the country in different years (but were part of the group under consideration);

and matching them with their semester results was problematic. The ideal choice was to convert the grades into class-midpoint averages.

Nevertheless, the grades and their numerical equivalents were available (the ranges of scores and their numerical equivalences are attached in Table 1 in the Appendix). Class-mid-point equivalents were therefore entered for each student and used as entry level scores to predict the student's performance at tertiary level. This reduced the variability in the dataset. The limitation of this approach or the crude nature (not highly differentiated) of the prior attainment measures used is thus acknowledged and careful consideration and use of the findings is recommended. Furthermore, the study is a pilot of the VA approach in HE in Ghana. It is therefore anticipated that future studies will address this challenge. CS₁ and CL₁ as prior attainment, in addition to English, Maths and science proved superior predictors for CS₂ and CL₂, probably because of their direct relatedness. This highlights the importance of prior attainment measures that are directly relevant to an outcome.

Background

The following student background variables – gender, age, and language spoken – were statistically adjusted for:

Student gender

Gender was treated as a binary dummy variable. Females were used as the reference category (female = 0, males = 1).

Student age

Age was measured in months (to decrease the possibility of aggregation of the variable since most of the students were around the same age) and entered for each student.

Language

Language was treated as a dummy variable (Akan = 0, Ewe = 1, Mole-Dagbani [simply called Dagbani] = 2, Guan = 3, Ga-Adangbe [simply called Ga] = 4). However, some of the variables were re-coded in the multilevel analysis as all of them except the Ga language proved statistically significant. The re-coding was as follows: Ga = 0, all other languages = 1.

SES

Socioeconomic status included type of secondary school attended, educational/employment status of both mother and father, language spoken and where the student lived during vacations (residence). Only residence proved statistically significant at .050 level when tested individually and in

a group and it was thus included in the analysis. This variable was treated as a dummy (city = 0, district capital = 1, town = 2, and rural area = 3).

Department context

Mean prior attainment in English, Maths and Science and/or CS₁/CL₁ were used as department context/peer factors. For the first semester courses (AFS, CS₁ and CL₁), prior attainment in English, Maths and Science was used. For the second semester courses (CS₂ and CL₂), English, Maths and Science and CS₁/CL₁ were used, respectively.

Modelling strategy

The datasets were analysed using multilevel modelling in line with the hierarchical structure of the datasets (students within departments). This offered several advantages. Firstly, it allowed the variation in student achievement to be classified into individual-level and group-level components that facilitated the calculation of intra-class correlations. Secondly, it enabled the explanatory variables to be placed at their correct levels in the data hierarchy instead of aggregation or disaggregation of the data to a single level of analysis (Heck, 2007). MLwiN2.24 software was used to generate the different statistical models called Models 1 - 4 across the courses. A two-level statistical model with department at level 2 and student at level 1 was developed for all the courses.

For the 2009 dataset, the following models were developed:

- a. Model 1 with no explanatory variable.
- b. VA Model 2 adjusting for prior attainment only (English, Maths, Science and CS₁/CL₁).
- c. VA Model 3 additionally adjusting for background (language) and SES (residence).
- d. VA Model 4 (4A) additionally adjusting for department context (mean prior attainment).

For the 2007-2009 dataset, the VA Model 4A controlling for the following were:

- a. Model 1 with no explanatory variable
- b. VA Model 2 Prior attainment (English, Maths, Science and CS₁/CL₁)
- c. VA Model 3 Background (gender and age)
- d. VA Department context (mean prior attainment).

These variables were first added individually to the fixed part of the models to establish if they were statistically significant (at .05 significance level). Significant individual variables were then added in groups to assess their

relevance in explaining the students' performance. A consistent set of explanatory variables for the models was selected based on the criterion that they were statistically significant (1.96 times larger than the associated standard error) when tested individually and together for at least one of the outcomes (Yu and Thomas, 2008). Table 3 in the Appendix presents the list of significant explanatory variables included in the final models. The table also displays those variables that were excluded due to non-significance.

Results

The results of the study are presented as follows: The descriptive statistics are presented, followed by a discussion on the 'goodness of fit' of the models, and the variables' effect on performance. It is important to note that constant comparisons are made between the first semester outcomes (AFS, CL1 and CS1) on the one hand; and the second semester outcomes (CL2 and CS2) on the other in order to avoid repetition. Furthermore, most of the comparisons were based on the estimates of Model 4. Model 4A (using the 2007-2009 dataset) is only used to examine the effect of age and gender on performance because these were not significant when using the 2009 dataset.

Tables 2 and 3 in the Appendix present descriptive statistics for both datasets on: (1) the outcomes and (2) previous achievement. For example, the students' average scores using the 2009 dataset were between 60% (CS2) and 71% (AFS). Thus, on average, the scores were comparatively high in AFS and lowest in CS2. The standard deviations (SD) were in the range of 9.3 (CS1) and 10.6 (CL1/CL2). In other words, scores in CL1/CL2 were more dispersed from the mean than in CS1. The highest and lowest averages in the case of the 2007-2009 dataset were 69% in AFS and 60% in CS2. The highest and lowest SDs were 12.3 (CS2) and 9.1 (CL1), respectively.

In terms of prior attainment, the highest and lowest averages were between 55% (Science) and 59% (English) using the 2009 dataset. Equivalent values in the case of the 2007-2009 dataset were 57% (Maths) and 55% (Science). The average age in years using the same dataset was 21.6 (3.5). According to the 2009 dataset, many students (75%) spoke the Akan language while very few (1%) spoke the Dagbane language. The majority (58%) also lived in cities while few (9.40%) stayed in rural areas (see Table 4 in the Appendix).

Model 2: Adjusting for prior attainment only (2009 dataset)

With respect to the 'goodness of fit' of the models, Model 1 was used as the baseline model to calculate the total percentage variance explained by the VA models. The total variance explained by Model 2 was on average 3% for AFS, CL1 and CS1 and 14% for CL2 and CS2 (see Table 6 in the Appendix).

Clearly, English, Maths and Science were very poor at predicting the students' performance in AFS, CL1 and CS1 (see the discussion for possible reasons). Nevertheless, the addition of CS1/CL1 for CS2/CL2 improved the 'goodness of fit' (14%); perhaps highlighting the important role played by prior attainment measures directly related to a course in this kind of analysis (see Table 6 in the Appendix).

Model 3: Additionally, adjusting for background and SES (2009 and 2007-2009 datasets)

Model 3 explained 2% and 14% of the total variance for the first and second semester outcomes, respectively (see Table 7 in the Appendix). A comparison of Model 3 with Model 2 in terms of equivalent values shows a slight decrease (0.7 percentage points). This suggests that the variables adjusted for by Model 3 were poor at predicting the students' performance. Indeed, the majority of the SES factors examined by the study were statistically insignificant at .05 significance level when tested individually and together. These included the type of secondary school attended, the location of the secondary school the student attended (rural/urban) and the educational/employment status of both mother and father.

The students' ethnic group and residence were statistically significant at .05 significance level; indicating that these two variables were perhaps important in understanding differences in their VA performance. As demonstrated by the Model 3 estimates (accounting for students' background and SES) on average, Ga-Adamgbe students underachieved in African Studies by .215 units compared to the performance of the other four ethnic groups together (Akan, Ewe, Mole-Dabagbane and Guans).

With regard to the *students' residence*, the Model 3 estimates showed that, on average, students who resided in district capitals obtained .157 more units in CS1 than those who lived in cities. This finding suggests that, overall, students who lived in cities had lower levels of academic performance than those who resided in district capitals.

Model 4: Additionally, adjusting for department context (2009)

The average total variance explained by Model 4 using the 2009 dataset was 9% (AFS, CL1 and CS1) and 18% (CL2 and CS2) (see Table 8 in the Appendix). Comparatively, Model 4 explained more of the total variance. On average, Model 4A (using the 2007-2009 dataset) explained 2% (AFS, CL1 and CS1) and 23% (CL2 and CS2) of the total variance (see Table 9 in the Appendix).

The Effect of the selected variables (Model 4A and 4)

This section focuses on the effect of statistically significant variables in the

fixed part of the model using both datasets, but most often the 2009 one. The fixed effects of prior attainment, background, SES and mean prior attainment (department) are examined.

Prior attainment (Model 4)

The fixed effects of the prior attainment measures of mean English, Maths and Science (across all five outcomes) and CS₁/CL₁ for CS₂ and CL₂ are examined here. Using the 2009 dataset (Model 4), *English* impacted positively on AFS but negatively on CL₂. On average, an increase of one standardised unit (simply called a unit) in *English* resulted in an increase of .161 units in AFS but a decrease of .071 units in CL₂. The finding that, those with lower attainment in English performed relatively better in CL₂ is surprising. However, as De Keyser, Van Patten and Williams (2007, p. 96) explain in their Skill Acquisition Theory, “A central concept in the study of skill acquisition is the power law of learning which formalizes mathematically what has been observed many times. That both reaction time and error rate decrease systematically as a consequence of practice”. Based on this theory and the fact that CL is a predominantly practical course, it is possible that those with low English attainment practiced more (e.g., at school computer laboratories or sought help through private tuition) than those with good grades in English. Further research is required on this issue.

Science also impacted positively on AFS. Thus, an average increase of one unit in Science increased the students’ performance in AFS by .080 units. The effect of CS₁ on CS₂ was also positive, and the same was true of CL₁ on CL₂. Not surprisingly, an average increase of one unit in CS₁ increased the students’ performance in CS₂ by .384 units. A one-unit increase in CL₁ similarly increased the students’ performance in CL₂ by .323 units (see Table 8 in the Appendix).

Student background and SES (Model 4 Model 4A)

The fixed effects of the individual background factors of language and residence are examined here. *Language* impacted negatively on AFS. Thus, Ga-speaking students obtained .222 less units in AFS relative to those who spoke Akan, Ewe, Dagbani and Guan put together. The effect of age on three of the outcomes (CS₁, CL₁ and CS₂) was negative using the 2007-2009 dataset. On average, older students obtained .018 less units in CS₁, .032 less units in CL₁ and .012 less units in CS₂ than younger students (see Table 9 in the Appendix). Students’ gender impacted positively on AFS but negatively on CL₁. On average, females outperformed their male counterparts in AFS by .114 units. However, males obtained .100 more units in CL₁ than their female counterparts (see Table 9 in the Appendix).

Department context (Model 4 and Model 4A)

The variables examined here include mean prior attainment in English, Maths, Science and CS₁/CL₁. The overall effect of these variables was mixed and outcome specific (Appendix: Tables 7 and 8). Using the 2009 dataset, mean *Maths* impacted positively on AFS. Thus, one SD increase in mean Maths increased performance in AFS by 1.422 units of a SD. As expected, mean CS₁ impacted positively on CS₂, i.e., one SD increase in mean CS₁ enabled students to improve their scores in CS₂ by .384 units of a SD. The positive effects generally suggest that students in departments with high mean prior attainment gained more in terms of learning than those in departments with low mean prior attainment. This finding is consistent with previous studies that reported a significantly positive association between peer quality and academic achievement (Hoxby, 2000a; Winston and Zimmerman, 2003).

In terms of negative effects, mean *English* impacted negatively on AFS. That is, an increase of one SD in mean English resulted in a decrease of .487 units of one SD in AFS. Mean *Science* similarly impacted negatively on AFS. That is, an increase of one SD in mean Science resulted in a decrease of .939 units of one SD. The negative effects generally suggest that students in departments with high mean prior attainment measures gained less in terms of learning than those in departments with low mean prior attainment measures (see Appendix: Table 9). In other words, if a low achieving student is among students with high mean achievement, s/he is more likely to perform worse. Rutter and Maughan (2002) explain that students who attend schools with high average attainment tend to have lower self-esteem and possibly, perform poorly (due to negative contrast effects), although there may also be a counterbalancing positive assimilation effect (e.g., glory or pride in the school).

Discussion

The following two key findings are discussed in line with the existing literature and contextual evidence; (1) the ‘goodness of fit’ of the models; and (2) the effect of the selected variables on performance.

Broadly speaking, Models 1-3 were not very good at predicting the students’ performance in the selected courses. For instance, the total variance explained by Model 2 adjusting for prior attainment only was 3% (AFS, CL₁ and CS₁) and 14% (CL₂ and CS₂). Compared to similar studies at tertiary level, the estimates were particularly low for the first semester outcomes. For instance, Johnes’ (2006) investigation of the distribution of degree results across four broad subject categories using students’ entry scores, explained 11-12% of the total variance for the Pure and Applied Sciences and 7-8% for the Social Sciences and the Arts subject categories after adjusting

for prior attainment. Similarly, Chapman (1996) found that the proportion of variability in student performance explained by entry qualifications was between 5% and 24% for Mathematics.

The poor goodness of fit of the models could be due to several reasons. In the case of Model 2 that considered the first semester outcomes (AFS, CLI and CSI), it could be due to the class mid-point averages used for English, Maths and Science (that were not highly differentiated). Another possibility could be differences in *support for examinations at the secondary and tertiary levels*. For example, the WAEC exams are high-stake exams. Hence, most Ghanaian secondary schools tend to focus on specific curriculum areas (becoming results-oriented) and neglect other aspects of the curriculum that promote students' total development. Students are also exposed to past/likely examination questions through school or privately organised extra tuition (usually after school hours, and during weekends and vacations). Simply put, the WAEC exams are made relatively easy for students compared to exams at the tertiary level where self-discipline and hard work are the key to success.

Another possible explanation is *changes in teaching methods* between pre-tertiary and tertiary levels. The predominant teaching method at pre-tertiary level (student-centred) is usually replaced by the lecture method (teacher-centred) at the tertiary level. Thus, instead of students being passive listeners jotting down notes while the teacher teaches, they become active listeners, noting important points with little opportunity to ask questions or become involved in the learning process (Maduewesi, 1999). Tertiary teachers may also cover a great deal of material within a short period of time without consideration for differences in students (some of whom might be slow learners, or have low levels of ability) (Vin-Mbah, 2012). The 'new' responsibility of having to independently digest large volumes of information within a short period of time might have been daunting for some. It is thus possible that slow adaptors achieved less academically despite the fact that they entered the polytechnic with good grades.

Furthermore, students who enter tertiary education may need to adjust to a number of other challenges in their personal and academic lives. For example, increased self-regulation is expected from tertiary students if they are to cope with the time pressure inherent in higher education (Eggens, Werf and Bosker, 2008). In school, their time was managed by the school authorities and parents who mainly directed it towards academic work. Thus, it is possible that previously high achieving students could underperform at tertiary level due to poor time management. Some students might devote more time to non-academic activities such as entertainment, religious and sporting activities, vying for position, politics, fashion/grooming, etc. due to the apparent freedom offered by the tertiary environment.

A comparison of the equivalent values of Model 3 and Model 2 shows that the total variance between departments decreased by an average of one percentage point across the first semester outcomes but remained the same across the second semester outcomes, indicating that the students' background and SES were not good at predicting the students' performance. This is in contrast to numerous studies that found that students with high SES perform better academically than those with low SES (see Yu and Thomas, 2008; Muijis and Reynolds, 2003; Horn and Bobbitt, 2000). In terms of SES, to a greater or lesser extent, the majority of the individual variables did not prove statistically significant at .050. This included the type of secondary school attended and the educational/employment status of both mother and father. It is possible that these factors did not affect the students' performance because the Polytechnic was able to identify and respond to potentially disruptive situations in order to prevent low performance especially for those at greatest risk (Auwarter and Aruguete, 2008). Further research is recommended on this issue.

The students' language and residence was statistically significant at .05 significance level, suggesting that these variables were important in understanding their VA performance. As demonstrated by the Model 3 estimates (accounting for students' background and SES), on average, Ga-Adamgbe students underachieved in African Studies by .215 units compared to the performance of the other four ethnic groups together (Akan, Ewe, Mole-Dabagbane and Guans). Although further research is necessary to ascertain why Ga-Adamgbe students underachieved, Eggens, Werf and Bosker (2008, p. 553) explain that "the extent to which students succeed in integrating into a new tertiary environment and the amount of social support they receive from network members possibly determine part of their academic success or failure." Lesser and Storck (2001) observe that people who share a common language although not co-located, may form relationships based on a sense of trust and mutual obligation and this may facilitate access to people and information.

The students' *residence* (city, district capital, town or rural area) also impacted positively on CSI. On average, students who resided in district capitals obtained .156 more units in CSI than those who lived in cities (see Table 8 in the Appendix). This suggests that, in general, students who lived in cities achieved lower levels of academic performance than those who resided in district capitals. According to Zhang (2006), such differences may be due to discrepancies in the resources available in rural and urban areas. In Ghana, communities have differential access to infrastructure such as libraries, the Internet, and electricity as well as opportunities to learn (e.g., resource persons, attachment, placement, etc.). This suggests that pre-tertiary students who lived in areas with limited resources were

disadvantaged academically. However, once they enter tertiary education where all students have equal access to available facilities, they are more likely to take advantage of opportunities and improve their performance. Those from less endowed areas may also be more motivated to improve their performance because members of their community look up to them.

Model 4, statistically adjusting for students' prior attainment, background and department context explained more of the total variance - 9% (AFS, CL1 and CS1) and 18% (CS2 and CL2). In terms of equivalent values, Model 4 registered an improvement over Model 2 of six and four percentage points, respectively. Improvements of seven and four percentage points were similarly seen in the case of Model 3. These small improvements highlight the important role played by school-related factors (e.g., department context) compared to out-of-school factors when it comes to explaining differences in student performance (Fuller and Clarke, 1994; Al Nhar, 1999).

However, the effect of individual factors on performance was mixed and outcome specific. For example, age impacted negatively on three of the outcomes (CS1, CL1 and CS2). In general, younger students performed better than their older counterparts. This finding is consistent with those of Richardson (1994) who concluded that mature students are at a disadvantage when pursuing higher education. Wößmann (2003), who used an international database of more than 260 000 students in 39 countries, also found that age was negatively related to performance. Students' gender also had mixed effects. Evidence on the differences in the performance of male and female students in higher education have often proved highly controversial or inconclusive (Chapman, 1996; Rodgers, 2007). However, some studies have found that females have a marginal edge over males (Rodgers and Ghosh, 2001; Smith and Naylor, 2001a). Explanations offered in the literature include bias in markers and stereotypes such as markers expecting males to do well (Hartley and Lapping, 1992).

Conclusion

On average, Model 4 (controlling for prior attainment, background, SES and mean prior attainment) explained more of the total variance (9%) and (18%) across the first and second semester outcomes than Model 3 controlling for students' background and SES (2% and 14%, respectively) and Model 2 adjusting for prior attainment measures only (3% and 14%, respectively). However, in contrast to the findings of numerous other studies, weak correlation was established between the selected predictors (prior attainment, background and SES) and the outcomes measures. Possible reasons include the use of class mid-point averages as prior attainment; high-stake exams, changes in teaching methods between the pre-tertiary and tertiary levels; levelling in facilities and opportunities to learn; and the extent to which students succeed in integrating into the tertiary environ-

ment. These estimates further indicate that other factors apart from the above may be responsible for the VA differences in the performance of tertiary students. However, the effect of the selected variables on performance was mostly mixed and outcome specific, suggesting that specific student variables may be related to specific courses (e.g., CS1 and CS2; CL1 and CL2).

The students' ethnic group and residence tested statistically significant; perhaps suggesting the importance of these variables in understanding tertiary students' VA performance. Although further research is necessary to ascertain why the Ga-Adangbe students underachieved, support from fellow students who spoke similar languages or otherwise, possibly, explains the observed differences. With regard to the students' residence, the study generally suggested that, students who lived in cities achieved less academically relative to those who resided in district capitals. A probable explanation is equal access to resources at the tertiary level as against the pre-tertiary level.

Recommendations

The following recommendations are made:

1. A key finding of this study was that prior attainment measures directly related to an outcome may be a better predictor of students' performance in similar prospective courses. Based on this, it is recommended that the relatedness of previous knowledge to a prospective course/programme should be considered in selecting students for courses/programmes during admission or teaching/learning.
2. Further research using finely differentiated 'raw' scores as prior attainment measures (possibly from WAEC) is necessary to clarify and explain why the prior attainment measures proved poor at predicting the students' performance.
3. Based on the study's limitation that it was difficult to obtain equivalent data from analogous institutions, it is recommended that a national body like the National Board for Professional and Technician Examinations should establish a relevant institutional database to support future research on how to support student learning drawing on factors that influence their learning.

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Appendix

Table 1: WASSCE Grades and Their Numerical Equivalents

Grade	Numerical representation	Interpretation	Percentage mark obtained/%	Class Mid-points/%
A	1	Excellent	70 and above	70
B	2	Very good	65 – 69	67
C	3	Good	60 – 64	62
D	4	Credit	55 – 59	57
E	5	Pass	50 – 54	52
F	0	Fail	49 and below	49

Source: WAEC, 2009

Table 2: Missing Data and Descriptive Statistics on the Datasets (SD in Brackets)

	2009	2007-2009 (Total)
Sample size		
African Studies (AFS)	1822	5944
CS1 and CS2	1759	5881
CL1 and CL2	1757	5879
Total	5338	
Descriptive Statistics		
Means of Outcomes		
African Studies	71.0 (9.9)	69.1 (10.7)
CS1	60.2 (9.3)	60.6 (9.1)
CL1	65.0 (10.6)	64.9 (10.6)
CS2	59.8 (10.1)	60.1 (12.3)
CL2	63.0 (10.6)	64.2 (11.5)
Means of Outcomes (Missing Data) n = 449		
African Studies	68.1 (10.3)	
CS1	59.4 (8.7)	
CL1	60.3 (9.9)	
CS2	66.2 (11.2)	
CL2	64.8 (12.0)	
Prior attainment and Age (Main Study)		
English	59.2 (3.1)	55.2 (2.3)
Maths	57.1 (5.2)	56.9 (5.4)
Science	55.4 (4.2)	55.0 (4.2)
Age (years)	21.7 (2.4)	21.6 (3.5)
Prior attainment and Age (Missing Data) n = 449		
English	56.3 (4.2)	
Maths	56.3 (5.4)	
Science	54.9 (4.5)	
Age (in months)	21.9 (2.7)	

Table 3: The Significance of the Selected Variables for Models 1-4 and model 4A for Each Outcome (2009 and 2007-2009 Datasets)

Model		Tested		Included (√) / Excluded (×)	
		2009 Dataset	2007-9 dataset	2009 Dataset	2007-2009 Dataset
2	Prior attainment	All	All	√ All	√ All
	English				
	Maths				
	Science				
	CS1/CL1				
	Quadratic	All	All	× all	× all
	English squared				
	Maths squared				
	Science squared				
	CS1 squared				
3	Background	All			
	Gender		√	×	√
	Age in months		√	×	√
	Language		N/A	√	N/A
	SES	All	N/A		N/A
	Type of secondary school attended			×	
	Location of secondary school			×	
	Where the students lived			√	
	Mother's educational level			×	
	Father's educational level			×	
4	Context	All	All	√ All	
	Mean English				√
	Mean Maths				×
	Mean Science				√
	Mean CS1/CL1				√

Note s = significant ns = Not significant

Table 4: Frequencies/Percentage of Students' Background and SES

	AFS Frequency	%	CS1 and CS2 Frequency	%	CL1andCL2 Frequency	%
Background – Language						
Akan	1364	74.90	1324	75.30	1317	74.90
Ewe	239	13.10	220	12.50	223	12.70
Mole-Dagbane	15	.80	15	.90	15	.90
Guan	20	1.10	20	1.10	21	1.20
Ga-Adamgbe	184	10.10	180	10.20	181	10.30
SES						
Residence of student						
City	1066	58.50	1024	58.20	1020	58.10
District capital	349	19.20	337	19.20	334	19.00
Town	237	13.00	234	13.30	238	13.50
Rural area	170	9.30	164	9.30	165	9.40

Table 5: Model 1 – The Null Model

	AFS	CS1	CL1	CS2	CL2
Fixed Part (Coefficient)					
Cons/ intercepts	0.177 [0.141]	0.049 [0.114]	0.174 [0.090]	0.049 [0.114]	0.242 [0.119]*
Random Part (Variances)					
Between Depts.	0.298 [0.112]*	0.187 [0.073]*	0.110 [0.045]*	0.187 [0.073]*	0.209 [0.081]*
Between Students	0.870 [0.029]*	0.827 [0.028]*	0.909 [0.031]*	0.827 [0.028]*	0.751 [0.025]*
Total	1.168	1.014	1.019	1.014	0.960
% Variance attributable to Departments	26	18	11	18	22

Note: * = Statistically significant at .050 significance level

Table 6: Model 2 Controlling for Prior Attainment Measures

	African Studies	CS1	CL1	CS2	
Cons/ intercepts	0.185 [0.129]	0.047[0.115]	0.178[0.091]	0.014[0.104]	0.178 [0.103]
Prior attainment					
English	0.161 [0.024]*	0.009 [0.024]	0.004 [0.025]	-0.021 [0.023]	-0.071 [0.021]*
Maths	0.043 [0.024]	-0.008 [0.025]	0.039 [0.026]	-0.004 [0.024]	-0.032 [0.022]
Science	0.087 [0.025]*	-0.007 [0.007]	-0.028 [0.026]	-0.004 [0.024]	0.009 [0.022]
CS/CL1				0.389 [0.023]*	0.326 [0.020]*
Random Part					
Between Tr./ Dept.	0.248 [0.095]*	0.191 [0.074]*	0.111 [0.046]*	0.156 [0.061]*	0.153 [0.059]*
Between Students	0.834 [0.028]*	0.827 [0.028]*	0.908 [0.031]*	0.750 [0.025]*	0.651 [0.022]*
Total	1.082	1.018	1.019	0.906	0.804
% Variance explained at Tr./Dept. level	17	2	9	17	27
Student	4	0	0	9	13
Total	9	0	0	11	16
%Variance attributable to Tr./Dept.	23	19	11	17	19

Note: * = Statistically significant at .050 significance level

Table 7: Model 3 Controlling Students Background and SES

	African Studies	CS1	CL1	CS2	CL2
Fixed Part (Coefficient)					
Cons/intercepts	0.055 [0.153]	0.070 [0.138]	0.237 [0.113]	0.001 [0.127]	0.234 [0.117]
Prior attainment					
English	0.161 [0.024]*	0.013 [0.024]	0.004 [0.024]	-0.019 [0.023]	-0.072 [0.021]*
Maths	0.041 [0.024]	-0.009 [0.025]	0.040 [0.026]	-0.005 [0.024]	-0.030 [0.022]
Science	0.081 [0.025]*	-0.008 [0.007]	-0.028 [0.026]	-0.006 [0.024]	0.009 [0.022]
CS/CL1				0.388 [0.023]*	0.326 [0.020]*
Background factors					
Ethnic group (ref: others): Ga-Adangbe	-0.215 [0.072]*	-0.033 [0.027]	-0.053 [0.075]	0.028 [0.069]	-0.055 [0.064]
SES					
Residence of student (ref: city) District capital	0.055 [0.077]	0.158 [0.078]*	-0.032 [0.061]	0.065 [0.075]	0.021 [0.051]
Town	-0.083 [0.840]	0.165 [0.087]	-0.054 [0.069]	-0.001 [0.083]	-0.069 [0.058]
Rural	0.096 [0.057]	0.030 [0.058]	0.008 [0.080]	-0.031 [0.055]	-0.041 [0.068]
Random Part					
Between Tr./Dept.	0.261 [0.099]*	0.192 [0.075]*	0.111 [0.046]*	0.155 [0.061]*	0.153 [0.059]*
Between Students	0.826 [0.027]*	0.823 [0.028]*	0.907 [0.031]*	0.749 [0.025]*	0.650 [0.022]*
Total	1.087	1.015	1.018	0.904	0.803
% Variance explained					
Tr./Dept. Level	12	3	1	17	27
Student	5	1	0	9	14
Total	7	0	0	11	16
% Variance attributable to Tr./Dept.	24	19	11	17	19

Note: * = Statistically significant at .050 significance level

Table 8: Model 4 Controlling for Department Context (2009 Dataset)

	African Studies	CS1	CL1	CS2	CL2
Fixed Part					
Cons/intercepts	0.196 [0.128]	0.103 [0.143]	0.172 [0.120]	0.002 [0.130]	0.118 [0.123]
Prior attainment					
English	0.161 [0.024]*	0.015 [0.024]	0.004 [0.025]	-0.017 [0.023]	-0.071 [0.021]*
Maths	0.035 [0.0250]	-0.011 [0.025]	0.041 [0.026]	-0.004 [0.024]	-0.030 [0.022]
Science	0.080 [0.025]*	-0.008 [0.007]	-0.029 [0.026]	-0.006 [0.024]	0.008 [0.022]
CS1/CL1				0.384 [0.023]*	0.323 [0.020]*
Background factors					
Language (ref: others): Ga-Adangbe	-0.222 [0.072]*	-0.031 [0.072]	-0.048 [0.075]	0.029 [0.069]	-0.054 [0.064]
SES					
Residence of student (ref: city) District capital	0.056 [0.077]	0.157 [0.078]*	-0.033 [0.061]	0.068 [0.075]	0.022 [0.051]
Town	-0.085 [0.084]	0.164 [0.087]	-0.053 [0.069]	-0.001 [0.083]	-0.068 [0.058]
Rural	0.095 [0.057]	0.030 [0.058]	0.011 [0.080]	-0.031 [0.055]	-0.040 [0.068]
Context					
Mean English	-0.487 [0.240]*	-0.514 [0.287]	0.044 [0.272]	0.017 [0.023]	-0.180 [0.287]
Mean Maths	1.422 [0.374]*	0.044 [0.416]	-0.489 [0.402]	-0.004 [0.024]	-0.017 [0.425]
Mean Science	-0.939 [0.429]*	0.411 [0.477]	0.515 [0.436]	-0.006 [0.023]	0.213 [0.462]
Mean CS1/CL1				0.384 [0.023]*	0.517 [0.266]
Random Part					
Between Dept.	0.110 [0.045]*	0.151 [0.060]*	0.097 [0.041]*	0.117 [0.047]*	0.113 [0.045]*
Between Students	0.826 [0.027]*	0.823 [0.028]*	0.907 [0.031]*	0.748 [0.025]*	0.649 [0.022]*
Total	0.936	0.974	1.004	0.865	0.762
Variance Explained					
Dept.	68	19	12	37	46
Student	5	1	0	10	14
Total	20	4	2	15	21
%Variance attributable to Dept.	12	16	10	14	15

Note: * = Statistically significant at .050 significance level

Table 9: Models 1A and 4A (Linear Models)

	Model 1A					Model 4A				
	AFS	CS1	CL1	CS2	CL2	AFS	CS1	CL1	CS2	CL2
Fixed Part										
Cons	0.114 [0.134]	0.253 [0.174]	0.195 [0.164]	0.213 [0.147]	0.375 [0.213]	0.371 [0.169]*	0.245 [0.174]	0.918 [0.200]*	0.152 [0.097]	0.274 [0.173]
Slope	-0.047 [0.069]	-0.101 [0.071]	-0.045 [0.063]	-0.083 [0.056]	-0.121 [0.091]	-0.222 [0.088]	-0.109 [0.071]*	0.045 [0.064]	-0.061 [0.046]	-0.098 [0.075]
Prior attainment										
English						0.056 [0.012]*	0.084 [0.013]*	0.073 [0.013]*	0.029 [0.013]*	-0.013 [0.011]
Maths						0.077 [0.014]*	0.009 [0.014]	0.034 [0.014]*	0.003 [0.013]	0.034 [0.012]
Science						0.057 [0.014]*	0.043 [0.014]*	0.043 [0.014]*	0.027 [0.014]*	0.010 [0.012]
CS1/CL1									0.302 [0.013]*	0.360 [0.011]
Background										
Age						-0.001 [0.005]	-0.018 [0.005]*	-0.032 [0.005]*	-0.012 [0.005]*	-0.013 [0.005]
Gender (Male)						0.114 [0.028]*	0.016 [0.029]	-0.100 [0.030]*	0.021 [0.029]	-0.042 [0.026]
Mean English						-0.262 [0.119]*	-0.325 [0.351]	-0.163 [0.306]	0.251 [0.172]	-0.321 [0.318]
Mean Science						-0.115 [0.324]	0.334 [0.209]	0.043 [0.014]*	0.193 [0.102]	0.004 [0.189]
Random Part (Variances)										
Between Tr./Dept. in their intercepts	0.251 [0.102]*	0.447 [0.171]*	0.393 [0.152]*	0.308 [0.121]*	0.689 [0.256]*	0.248 [0.100]*	0.443 [0.171]*	0.386 [0.149]*	0.114 [0.051]*	0.442 [0.167]*
Slope	0.066 [0.027]*	0.073 [0.029]*	0.055 [0.022]	0.043 [0.011]*	0.125 [0.047]*	0.069 [0.027]*	0.072 [0.028]*	0.057 [0.027]*	0.027 [0.021]	0.084 [0.032]*
Between students	0.921 [0.017]*	0.848 [0.016]*	0.881 [0.016]*	0.930 [0.017]*	0.783 [0.014]*	0.903 [0.017]*	0.836 [0.015]*	0.864 [0.016]*	0.847 [0.016]*	0.665 [0.012]*
Total	1.172	1.295	1.274	1.238	1.472	1.151	1.279	1.250	0.978	1.107
Variance explained										
Tr./Dept.						1	1	2	63	36
Student						2	1	2	9	15
Total						2	1	2	21	25
% variance attributable to Tr./dept.	21	36	31	25	47	22	35	31	12	40

Note: * = Statistically significant at .050 significance level.

Is Transition from Secondary to Tertiary Education Less Likely among Black South Africans than their Non-Black Counterparts in the Democratic Dispensation?

Nisha Sewdass and Eric O Udjo

Abstract

Education provides the building blocks for skills development for a country's labour market. Investment in education is hence an important determinant of economic growth and has been associated with various economic benefits. However, non-transition to tertiary education is a common phenomenon. This study examined the probability of a specified age cohort transiting to tertiary education in South Africa and compared Black South Africans with other population groups considering environmental and individual factors. Using cross-sectional data from the 2016 South African Community Survey, the study revealed that the difference in the probability of transition to tertiary education between Whites and Blacks was not statistically significant. The findings will be useful to policy makers in formulating strategies to improve the quality of the labour market, and thus South Africa's economic competitiveness.

Key words: Transition to tertiary education, South African education system, apartheid education, post-apartheid education, economic development

L'éducation est la base du développement des compétences pour le marché du travail d'un pays. L'investissement dans l'éducation est donc un déterminant important de la croissance économique et a été associé à divers avantages économiques. Toutefois, la difficulté de passage vers le niveau supérieur est un phénomène courant. Cette étude examine la probabilité qu'a une cohorte d'âge spécifiée de passer vers le niveau d'enseignement supérieur en Afrique du Sud et compare le niveau de passage des Sud-Africains noirs avec celui d'autres groupes de population en tenant compte de

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facteurs environnementaux et individuels. En utilisant des données transversales de l'enquête de 2016 sur les communautés sud-africaines, l'étude a révélé que la différence dans la probabilité de passage vers l'enseignement supérieur entre les blancs et les noirs n'était pas statistiquement significative. Les conclusions de l'étude seront utiles aux décideurs pour formuler des stratégies visant à améliorer la qualité du marché du travail et, partant, la compétitivité économique de l'Afrique du Sud.

Mots clés: passage vers l'enseignement supérieur, système éducatif sud-africain, éducation à l'apartheid, éducation post-apartheid, développement économique

Introduction

Background and problem statement

Labour market intelligence to guide policy in improving a country's economic competitiveness requires knowledge of transition to educational institutions as well as educational attainment in the population. This entails examining the characteristics of students who do not transit to tertiary education as well as the characteristics of those who transit but do not complete such education. This kind of analysis is generally lacking in South Africa. According to Schieferdecker and Riphahn (2012), the determinants of entry to tertiary education are of immediate policy relevance for several reasons. For example, high demand for a qualified labour force directs political attention to broadening access to tertiary education. Raborife (2017) claimed that for every six White students that transited to university, only one Black student did, with the main reasons being poverty and a lack of adequate support for Black and Coloured children at home. However, empirical evidence in support of this claim is lacking.

A country's economic competitiveness is partly dependent on the quality of its labour market which, in turn, is determined by the skills acquired through formal education at various levels as well as lifetime experiences in different levels of employment. Education is therefore a catalyst that provides the building blocks for skills development for a country's labour market. According to Nelson Mandela (posted in Patterson, 2013), education is the greatest engine of personal development, no country can really develop unless its citizens are educated, and education is the most powerful weapon which can be used to change the world. Blondal, Field and Girouard (2002) observe that investment in education is an important determinant of economic growth and that education has been found to be associated with various economic benefits. Blondal et al. (2002) add that acquired knowledge and skills tend to raise productivity and hence earning potential. Matkovic and Kogan (2012) also observe that complet-

ing tertiary education is associated with a better income, job and quality of work, as well as employment stability and prospects for promotion. Thus, the Organisation for Economic Co-operation and Development (OECD) countries aim to ensure that all young people enter working life with a minimum amount of human capital acquired during the years of compulsory education (Blondal et al., 2002).

In view of the benefits of education, governments all over the world invest in primary, secondary, and tertiary education to varying degrees. However, non-transition to tertiary education is a common phenomenon irrespective of whether it is fully or partially subsidised by the government. Matkovic and Kogan (2012) observed that about 72% of young adults in OECD countries enter tertiary education in their lifetime, while Vandenberghe (2007) estimated that 58% of individuals aged 17-24 in Belgium transited to tertiary education after completing secondary school during the period 1990-2000. The corresponding percentages in Germany, Hungary, Poland and the United Kingdom (UK) were 14%, 32%, 12% and 27%, respectively. In Hong Kong due to the highly competitive joint university programmes admissions system, less than 18% of students that had completed upper secondary education were granted places in higher education in 2001/1 (Post 2003). Citing a Global Monitoring Report, Essack (2012) noted that, in 2009, sub-Saharan Africa had the lowest proportion of the total population of the relevant age cohort enrolled in education at all levels in the world. The weighted average of people accessing tertiary education in sub-Saharan Africa in 2005 was only 5%, with more men than women participating. (Essack, 2012). Harper (2012) observed that in 2002, Black men comprised only 4.3% of students enrolled at higher education institutions in the United States (US).

Weiss and Steininger (2012) observed that decisions with regard to participation in tertiary education depend on social background such as parental occupational status or education. They also noted that social background influences the timing of entry to higher education. The authors identified four factors that influence non-participation: (a) status maintenance: families are motivated to achieve at least the same social position for their offspring as themselves. Thus, offspring whose parents do not have a high level of education will not participate in higher education; (b) Financial resources: young adults from less wealthy families might not have sufficient resources to finance higher education; (c) Perceived probability of success: Young adults whose parents are in a lower educational category feel that they are at a high risk of failing in higher education and would thus be reluctant to enrol; (d) Lower performance: failure to meet the minimum final secondary grade requirements for entry to higher education. According to Scheiferdecker and Riphann (2012), higher parental

age is known to increase secondary school attainment but should not affect subsequent transition to tertiary education. Salmi and Basset (2014) observed that while the share of the tertiary education age cohort (19-25 years) granted the opportunity to study has increased worldwide in the past two decades, disparities in terms of sex, membership of minority populations, disabilities, and academic and financial barriers are still major obstacles to participation.

Non-completion is another challenge in tertiary education. Matkovic and Kogan (2012) observed that on average, only about 69% of tertiary education entrants complete their education in OECD countries. O’Koeffe (2013) found that attrition rates in post-secondary education stood at 30-50% in the US and 20% in Australia. Shapiro et al.’s (2015) study on the outcomes for students who began post-secondary education in 2009 in the US reported that the overall national six-year completion rate was 52.9%. This represented a decline of 2.1 percentage points from the 2008 cohort, or twice the rate of decline that was observed in the 2007 cohort compared with the 2008 cohort. Radford, Wheelless and Hunt-White’s (2010) survey of a nationally representative sample of about 90 000 students in the US who enrolled for postsecondary studies for the first time in 2003/4 observed that 31% of the students received a Bachelor’s degree within six years, while 35% had not received a degree and were not enrolled at any institution. Scott (2005) estimated that 40% of domestic students starting tertiary education in New Zealand in 1998 completed after five years, while 51% left after five years without completing. Of the cohort that started tertiary education in 2001, 62% left the following year.

Scott (2005) found that in New Zealand, women were more likely to successfully complete a tertiary qualification than men, while students under the age of 25 had higher completion rates across all levels of study. Shapiro et al.’s (2015) study revealed older students and full-time students in the US experienced some of the largest decreases in completion rates. Harper (2012) noted that only 47% of Black male students graduated on time from US high schools in 2008 compared to 78% of White male students. Harper (2012) also noted that Black male college completion rates were lowest among both sexes and all racial/ethnic groups in the US.

Matkovic and Kogan (2012) compared the situations of non-completers and completers of tertiary education. They found that non-completers were worse off in terms of salary, job quality, high levels of unemployment in their early career, and less access to graduate occupations. Non-completers were also observed to experience higher rates of crime (Owens, 2004 cited in Lamb and Markussen, 2011). The literature suggests that, at the macro level, non-completion of tertiary education is a waste of national resources because students’ failure to complete programmes (Yorke, 1998)

increases welfare needs, and results in poor physical and mental health and a reduced tax base (Owens, 2004 cited in Lamb and Markussen, 2011). Non-completion can also affect the funding of tertiary education institutions (Yorke, 1998).

Several reasons have been cited for non-completion of tertiary education, including mental health, disability, socioeconomic and ethnic status, a lack of sense of belonging within higher education institutions (O’Koeffe, 2013), and family income (Vandenberghe, 2007). Harper (2012) observed that Black males’ success in higher education in the US was partly attributable to being able to pursue their Bachelor’s degree without the burden of financial stress. Harper (2012) added that these achievers reported having a good start, including bridging programmes that brought them to the institutions before the start of the first year that acquainted them with the environment and the resources available.

Longitudinal cohort data to assess completion rates are not publicly available in South Africa. The exception is Van Broekhuizen, Van Der Berg, and Hofmeyr’s (2016) study that focused on six-year outcomes for students who began post-secondary education in 2009. National Senior Certificate (NSC - Matric) examinations data from 2008 to 2013 was combined with data from all South African universities (Higher Education Management System (HEMIS) data) from 2009 to 2014 and added to the data from the HEMIS master list and the 2011 census. The study found that around a third of those who obtained matric exemption in the 2008 cohort, did not go to university. The authors noted that: “When considering only those matriculants who obtained Bachelor passes (the group considered as potential candidates for university degree programmes), overall university access is not biased against black students....” (Van Broekhuizen et al., 2016, p. i). Furthermore, there were “only small differences in the composition of the two sub-groups of students who achieved Bachelor passes, namely those who do and those who do not access university in the subsequent six years. Only 63.4% of White matriculants from 2008 who had achieved Bachelor passes went on to study at university in the next six years, as against 71.2% for Black matriculants with Bachelor passes (Table 7.5)”. However, several concerns are noted with regard to this study. We do not offer a complete review of this extensive report, but focus on those aspects relevant to the current study.

A close examination of the figures in some of the authors’ tables for sub-group comparisons indicate illogical computations and contradictions, thus casting doubt on their Black vs Whites comparisons. We reproduce parts of Tables 7.5 and 7.3 from their report below.

Part of Table 7.5. University access, completion, and dropout rate summaries for learners who achieved Bachelor passes in the 2008 NSC, by race group

	Black	Coloured	Asian	White
Share of Bachelor Passes (%)	56.4	8.2	8.0	27.4
6-year access rate	71.2	63.1	72.8	63.4
- UG degree	53.7	53.3	66.1	59.0
1 - Year access rate	51.3	47.5	62.9	48.7

Source: Van Broekhuizen et al. (2016)

Part of Table 7.3. University access, University access, completion, dropout, and retention rates (%) for black learners, from the 2008 matric cohort (2009-2014)

	1 year (2009)	2 years (2010)	3 years (2011)	4 years (2012)	5 years (2013)	6 years (2014)
Black learners						
Access rate	9.9	13.4	14.8	15.6	16.2	16.6
Completion rate	0.2	0.6	12.7	31.8	45.3	53.5
Dropout rate	9.9	15.7	21	26.2	32	-
Retention rate	84.7	78.9	61.5	38.8	22.6	-
White learners						
	(2009)	(2010)	(2011)	(2012)	(2013)	(2014)
Access rate	35.5	42.5	44.8	46	46.9	47.4
Completion rate	0	0.2	24.4	52.7	65.3	71.6
Dropout rate	6.5	10.2	13.1	15.3	18.1	-
Retention rate	90	86.9	59.9	30.6	16.6	-

Source: Van Broekhuizen et al. (2016)

In Table 7.1 of Van Broekhuizen et al.'s (2016) report, the authors showed that the percentage of Blacks candidates for the 2008 NSC examinations was 82.5% while the corresponding percentage for Whites was 7.7%. The same table showed that of the Black candidates, only 13.6% achieved a Bachelor's pass. The corresponding percentage for Whites was 70.2%. Given that around 80% of South Africa's population is Black, it is expected that the percentage of Black candidates for the 2008 NSC or any other year would be much higher than the percentage of candidates for the other population groups. This being the case, it is arithmetically illogical for Van Broekhuizen et al. (2016) to have computed the share of Bachelor's passes as between group percentages in the first row of their Table 7.5, part of which is shown above. Thus, the percentages in the first row of the table

are misleading. Secondly, in the second row of their table 7.5, the authors indicate that the six-year access rate for Blacks was 71.2% while for Whites it was 63.4%. However, Table 7.3 in their report, part of which is reproduced above, indicates that the six-year access rate for Blacks for the 2008 cohort was 16.6% while the corresponding figure for Whites was 47.4%. The rates in these two tables are contradictory. The seemingly "small differences in the composition of the two sub-groups of students who achieved Bachelor passes, namely those who do and those who do not access university in the subsequent six years" (Van Broekhuizen et al., 2016 p. ii), was based on the comparison in their Table 7.5. The question is: which table does one believe regarding Black/White university access comparisons in Van Broekhuizen et al.'s (2016) report?

Furthermore, the multivariate analysis in Van Broekhuizen et al.'s (2016) study controlled only for matric pass rate and matric average achievement in two different models; yet the authors argued "that racial differentials in university access, completion, conversion, and dropout in South Africa can be explained away almost entirely by differences in matric achievement" (Van Broekhuizen et al., 2016, p. 78). This statement is inconsistent with the Adjusted R^2 values in their multivariate results. The adjusted R^2 values for the six-year university access in each of the two multivariate models were 0.415 and 0.392. Focusing on the higher R^2 value indicates that 'race' accounted for a maximum of 41.5% of the racial differences in the six-year university access. This infers that other factors must be at play. Probable relevant factors include the matriculant's home background or individual socio-economic status. Information on these variables are not available in the Matric examinations or HEMIS data.

Indirect evidence appears to suggest that the tertiary education completion rate might be low. Our computations from the 2016 South Africa's Community Survey unweighted data (Statistics South Africa, 2016) indicate that 68% of South Africans aged 25 and over in 2016 had a secondary or higher education qualification. Of these, only about 3.4% had a Bachelor's degree or higher. When this is decomposed by population group, about 66.3% of Black South Africans aged 25 and over had a secondary or higher education qualification and of these, 2.4% had a Bachelor's degree or higher whereas 76.3% of non-Black South Africans (i.e., Coloured, Indian and White) had a secondary or higher education qualification and of these, 7.9% had a Bachelor's degree or higher. This study investigated whether transition from secondary to tertiary education is less likely among Black South Africans than their non-Black counterparts in the democratic dispensation.

Objectives of the study

The study's objective was to examine the probability of a specified age cohort transiting to tertiary education in South Africa and to compare Black people with other population groups in transition to tertiary education considering environmental and individual factors. More specifically, the study estimated:

1. The overall probability of South African-born persons aged 18-19 in 2016 (i.e., one to two years after completing secondary education) transiting to tertiary education.
2. The probability of persons classified as Black aged 18-19 in 2016 transiting to tertiary education in comparison with people classified as Coloureds, Indians/Asians, Whites in the same age group considering environmental and individual factors (confounders).

The research questions arising from the objectives were:

- A. What was the probability of a South African-born person aged 18-19 in 2016 (i.e., after completing secondary school) transiting to tertiary education?
- B. Were Black South Africans aged 18-19 in 2016 less likely to transit to tertiary education than non-Black South Africans of similar age controlling for confounders?

The racial classifications used during apartheid were White, Indian, Coloured (persons of mixed descent), and Black in that hierarchical order. Racial categories in the democratic dispensation are African Black, Coloured, Indian and White (Spaull, 2013, p. 36) in alphabetical order without hierarchy. While the latter are used in this article, some Coloureds and Indians categorise themselves as Black. This is, however, ideological rather than official statistical classification.

The OECD "follows standard international conventions in using tertiary education to refer to all programmes, regardless of the institutions in which they are offered" (Santiago, Tremblay, Basri, and Arnal, 2008, p. 26). According to the World Bank (2017), higher education is also known as tertiary education in some countries and it refers to all post-secondary education, including public and private universities, colleges, technical training institutes, and vocational schools. Tertiary education in South Africa is also sometimes referred to as higher education and includes all post-school education offered at various institutions. The mission of the Department of Higher Education and Training (DHET) "is of a South Africa in which we have a differentiated and fully-inclusive post-school system that allows South Africans to access relevant post-school education and training, in order to fulfil the economic and social goals of participation in an inclusive economy and society" (DHET, 2012-2021).

As a background to this study, we present an overview of the apartheid and post-apartheid education system in South Africa.

Overview of the apartheid and post-apartheid education system in South Africa Naicker (2000) notes that, apartheid education promoted race, class, gender and ethnic divisions and emphasised separateness rather than common citizenship and nationhood. It produced a dual system of education which included a mainstream and a special education component that were characterised by racial disparities, with many learners were excluded from the mainstream. Only a small number of Africans graduated from high school (EducationState, 2013). Chisholm (2012, p. 86) observed that by 1968, for every 100 000 students in a specific population group, 866 Whites, 322 Indians, 74 Coloureds and only 13 Africans were able to reach the final year of schooling.

Racially segregated universities were established in 1969 to cater for specific ethnic groups of Black, Indian and Coloured students. Whites had their own universities and the institutions that were established for other population groups were largely under resourced, understaffed, overcrowded and offered limited subjects and qualifications, which reinforced the racial division of labour once students completed their studies (Chisholm, 2012, p. 88).

South Africa's new Constitution (Republic of South Africa, 1996) identified basic education as a right for all citizens and the democratic government that came to power in 1994 was committed to ensuring universal education (Chisholm, 2012, p. 85). The South African Schools Act (SASA) (Department of Education, 1996) provided for compulsory education from the age of seven to 15 or ninth grade.

Since 1994, South African learners have had the choice of three different types of schools: independent or private, public or government, and Model C schools. Public schools depend on the government for funding and material. Private schools, also known as independent schools, are usually owned and operated by a trust, church or community, or by a for-profit company (Schoolguide, 2018). Model C schools were semi-private structures used to govern Whites-only government schools that were introduced by the apartheid government in 1991. After 1994, they became state-aided (or semi-private). They now admit learners of all races and since they are state-aided, they are regarded as the same as public schools. However, in public discourse, the term 'Model C' is now used to refer to the former Whites-only government schools in South Africa (Christie and McKinney, 2017).

Public schools, including former Model C schools write the NSC examinations at the end of Grade 12 (Spaull, 2013, p. 39) that are set by the Department of Basic Education, while private schools write the Independent Examination Board (IEB) exams. Both result in a matric certificate which allows learners entrance to higher education institutions. Depend-

ing on the level of pass, the learner will have access to certain programmes. For a Bachelor's pass the learner must achieve a minimum of 50% in four designated 20-credit subjects (excluding Life Orientation) and a minimum of 30% in three subjects (including Language) (Wedekind, 2013, p. 17).

Data source and study limitations

Ideally a critical assessment of transition to and completion of tertiary education requires longitudinal cohort data where by those who completed secondary education or registered in tertiary institutions in a specific year are followed over time to examine the proportion that transits to or completes tertiary education after a specified period of years taking into consideration environmental and individual factors. Such data are not publicly available in South Africa. The HEMIS data was noted in the literature review. Some individuals in higher education institutions may have privileged access to such data. The Higher Educational Data Analyser (HEDA) now provides a portal for access to HEMIS data, but these are aggregated data reports (see www.heda.co.za) without no individual student characteristics and are therefore not suitable for the kind of analysis presented in this study that called for anonymised individual unit records. Furthermore, even if available, longitudinal data have inherent limitations including "achievement of the initial sample, sample mortality and conditioning" (Moser and Kalton, 1979, p. 140) that cast doubt on the reliability of the results.

In the absence of longitudinal individual unit record data, this study utilised the 2016 South African Community Survey (2016 CS) – a cross-sectional survey. The target population for the 2016 CS was the non-institutional population residing in private dwellings (Statistics South Africa, 2016). The sampling frame was the geo-referenced dwelling frame based on the 2011 census enumeration areas (EAs). The final sample consisted of 3 328 867 persons in 984 627 households although Statistics South Africa's (2016) report noted that the final sample for weighting after all the necessary checks and validation consisted of 1 422 928 households. It should be noted that these data are anonymised unit records and not aggregated data.

The 2016 CS questionnaire included a section on education which consisted of nine questions. Those relevant to this study included the following:

1. Is (this person) currently attending an educational institution?
2. Which of the following educational institutions does (this person) attend?
3. What is the highest level of education that (this person) has successfully completed?

The answers to these questions combined with the characteristics of the

person available from other parts of the questionnaire were used to achieve the study's objectives. The major limitation is the lack of data on students' performance in the final secondary school examinations. As noted previously, minimum grade levels for subjects in these examinations collectively classified as matric or NSC are required for university admission. Those without matric can pursue other tertiary education such as technical and vocational education and training, or a nursing college, agricultural college, or police college should they wish. In the absence of information in the 2016 CS on the matric pass, it was not possible to determine whether non-transition to university was due to not meeting university admission requirements. Therefore, all post-secondary institutions were combined and labelled tertiary education institutions since a student can pursue tertiary education in a non-university environment without a NSC.

Another limitation of the data relates to employment and income. Although this information was collected in the 2016 CS, Statistics South Africa did not release it in the data files available to the public. Thus, a lack of money to buy food in the household in the past 12 months was used as a proxy for insufficient household income. Finally, due to flaws in the weighting of the data (see Udjo, 2017), the unweighted data were used.

Methods

The standard age for completing secondary school in South Africa is 17 or 18. It is therefore expected that, in the absence of social and economic constraints, a secondary school graduate would transit to some form of tertiary education within one to two years of secondary school graduation, i.e., when they are aged 18-19 irrespective of whether or not they obtained a NSC or matric. Thus, the probability of transiting to tertiary education for a certificate, diploma, or a Bachelor's degree in 2016 can be computed for persons aged 18-19 as at 2016 whose highest level of education was Grade 12. The study focused on South African-born persons living in the country disaggregated by population group to avoid external 'contamination' of environmental and individual factors. The circumstances of foreign-born persons who migrated to South Africa may be different from those of South African-born persons living in the country. The advantage of focusing on one to two years after secondary school graduation for persons aged 18-19, is that it is unlikely that the environmental and individual factors may have changed much. It should be noted that students that started school later or those that took longer to complete matric were not included in this study.

The analysis involved univariate and bi-variate descriptive statistical methods followed by logistic multivariate analysis. The logistic regression involved several models. In terms of the first objective, the overall probability of a South African-born person aged 18-19 in 2016 transiting to

tertiary education was estimated. Thereafter, each factor associated with the probability of a South African-born person aged 18-19 in 2016 transiting to tertiary education (dependent variable) was examined in a bi-variate logistic regression. The statistically significant factors resulting from this model were noted. In the next stage, the probability of a Black South African-born person aged 18-19 in 2016 transiting to tertiary education (dependent variable) compared with each of the other population groups of similar age (independent variable) was estimated without controlling for confounders. Finally, the probability of a specified population group transiting to tertiary education was estimated controlling for confounders. Because the circumstances of each of the population groups are not necessarily the same, non-Black South Africans were not lumped together as a single category; instead, Black South Africans were used as reference group for comparison with each of the other population groups.

The selection of the confounders was based on the literature review presented earlier. The review revealed that some of the factors associated with university non-completion are similar to those associated with transition to tertiary education. Temporal effects may sometimes be at play. In view of this and due to data limitations, the dependent, independent and confounders examined in this study were as follows. To avoid repetition, the citations are indicated after each variable without repeating the link between the variable and transition to tertiary education since the link was provided in the literature review.

Dependent variable

Transition to tertiary education.

Independent variable

Population group: Black South Africans compared with each of the other non-Black South African population groups (see Harper (2012) above).

Confounders

Household/Environmental factors: Ran out of money to buy food in the household in the past 12 months (as a proxy for insufficient income in the household); educational level of house head (household head as a proxy for parent) (see Weiss and Steininger (2012) above); age of household head (household head as a proxy for parent) (see Schieferdecker and Riphahn (2012) above).

Individual factors: sex of student (see Salmi and Basset (2014) above), parental survival (father/mother alive). A parent’s death has an effect on a child’s enrolment and reduces the probability of acquiring higher education (Gertler et al., 2004; Gimenez et al., 2013).

The general form of the logistic regression equation is:

$$Prob(Tt) = \frac{1}{1 + e^{-(\beta_0 + \beta_1 X_1)}} \dots\dots\dots(1)$$

$$Prob(Tt) = \frac{1}{1 + e^{-(\beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 \dots + \beta_n X_n)}} \dots\dots\dots(2)$$

Hosmer and Lemeshaw (2000).

Equation (1) is a bi-variate logistic regression. It assessed the relationship between transition to tertiary education (dependent variable) and belonging to a specific population group (independent variable). Equation (2) assessed the same relationship as equation (1), but included confounders. The variables in the equations were defined as follows:

Dependent variable

Prob (Tt) is the probability of a South African-born person living in South Africa aged 18-19 in 2016 that had at least Grade 12 transiting to tertiary education (Tt).

Tt = 1 if a South African-born person living in South Africa aged 18-19 in 2016 had at least Grade 12 and was attending tertiary education in 2016;
Tt = 0 if a South African-born person living in South Africa aged 18-19 in 2016 had at least Grade 12 and was not attending tertiary education in 2016;

e = base of the natural logarithm;

β_0 = constant;

$\beta_1 \dots n$ = estimated coefficients corresponding to the covariates $X_1 \dots X_n$

Independent Variable

X_1 = Population group (Indicator variable): 1= Black (reference group), 0 for each of the other population groups.

Confounders

Household/Environmental factors

X_2 = Ran out of money to buy food in the household in the past twelve months: 1 = Ran out of money.

0 = Did not run out of money (reference group).

X_3 = Educational level of household head (Indicator variable): 1 = Lower than tertiary level or no education (reference group), 0 for each of the other educational levels (tertiary, higher than tertiary).

X_4 = Age of household head (Indicator variable): 1 = 20-34 years (reference group) 0 for each of the other age groups (10-19 years, 35 years and over).

Individual factors

- X_5 = Sex: 1 = male, 0 = female (reference group).
- X_6 = Mother alive: 1 = Yes, 0 = No (reference group).
- X_7 = Father alive: 1 = Yes, 0 = No (reference group).
- X_8 = Mother and father alive: 1 = Yes, 0 = No (reference group).

Results

Background Characteristics

Table 1 shows that of the South African-born persons living in South Africa aged 18-19 in 2016 who had at least Grade 12, 36% were in tertiary education institutions, about 82% were Black, 41% were female and 87% had a surviving mother. As a proxy for income, about 79% of this group indicated that they did not run out of money in their household to buy food in the past 12 months.

Table 1: Characteristics of South African-born persons living in South Africa aged 18-19 in 2016 with at least a Matric (n = 32 904)

Variable	Percent
1. Current Type of Educational Institution	
Non-tertiary	2.0
Tertiary	36.
Unknown/Not applicable	62.0
2. Population Group	
Black	81.6
Coloured	10.0
Indian/Asian	3.0
White	5.4
3. Sex	
Male	41.4
Female	58.6
4. Age of Household Head (yrs)	
10-19	9.0
20-34	10.0
35+	81.0
5. Highest Educational Level of Household Head	
Grade 12	7.3
Higher than Grade 12	0.7
Unknown	92.0
6. Ran Out of Money to Buy Food in past 12 Months	
Yes	20.4
No	79.2
Unknown	0.4
7. Biological Mother Alive	
Yes	87.6

Variable	Percent
No	11.6
Unknown	0.7
8. Biological Father Alive	
Yes	75.3
No	19.0
Unknown	5.8

Source: Authors' computation from 2016 CS

Uni-variate and Bi-variate Results: Independent Effects of Household, Environmental and Individual Factors on Transition to Tertiary Education

The results indicate that the overall probability of South African-born persons aged 18-19 in 2016 transiting to any tertiary education institution in 2016 was 0.36. However, among this group the probability of transiting to a higher education institution including university was only 0.08 in 2016. The bi-variate logistic regression analysis regressed each household/environmental and individual factor with tertiary education transition, i.e., without controlling for confounders. The results that are summarised in Table 2 indicate that poverty (measured by a proxy variable - ran out of money to buy food in the past 12 months) had a significant negative effect on transition to tertiary education among persons aged 18-19 in 2016 who had at least Grade 12 ($p < 0.008$). Furthermore, among this group, the mother being alive had a significant positive effect on transition to higher education ($p < 0.001$). There was no statistically significant difference between males and females as well as in the age of the head of the household among this group in terms of transition to tertiary education ($p > 0.05$).

Table 2: Bi-variate Logistic Regression Showing the Relationship of Household/Environmental and Individual Factors with Transition to Tertiary Education among South African-Born Persons Aged 18-19 with at least Grade 12 in 2016 (n = 32 904)

Transition to tertiary education			
Household/Environmental	Coefficient	Standard Error	Significance
Ran out of money for food in the past 12 months	-0.269	0.101	0.008
Household head's education level	-0.010	0.418	0.981
Household Head's age group 10 – 19	0.257	0.187	0.170
Household Head's age group 35 and over	-0.223	0.138	0.106
Individual Factors			
Sex	0.054	0.081	0.504
Mother alive	0.390	0.120	0.001
Father alive	0.053	0.108	0.625
Mother and father alive	0.141	0.096	0.143

Source: Authors' computation from 2016 CS

Multivariate Results

The significant variables noted in the bi-variate results were included in a multivariate analysis that examined the relationship between transition to higher education and belonging to a specific population group controlling for household, environmental and individual factors. The overall results of the multivariate analysis are summarised in Table 3.

Table 3: Logistic Regression of Transition to Tertiary Education by Population Group and Confounders among South African-Born Persons Aged 18-19 who had at least Grade 12 in 2016 (n = 32 904)

Probability of transition to tertiary education				
	Model 1		Model 2	
Variables	Coefficient	Odds ratio	Coefficient	Odds ratio
Independent variable: Population group				
Coloured	-0.402 (0.138)**	0.669	-0.458 (0.139)**	0.633
Indian/Asian	0.643 (0.275)*	1.901	0.564 (0.276)*	1.848
White	0.071 (0.156)	1.074	0.004 (0.159)	1.004
Black (RF)				
Confounders				
Household/Environmental Factors: Ran out of money for food in the past 12 months Yes No (RF)			-0.242 (0.102)*	0.785
Individual Factor: Mother alive Yes No (RF)			0.397 (0.121)**	1.487
Constant	2.875(0.044)**		2.578 (0.115)***	
Nagelkerke R ²	0.004		0.007	

RF = Reference category, standard errors in parenthesis.

*Statistically significant $p < 0.05$.

**Statistically significant $p < 0.001$.

*** Statistically significant $p < 0.000$

Source: Authors' computation from 2016 CS

Model 1 in the table does not control for confounders.

After controlling for confounders (household, environmental and individual factors) in Model 2, the results indicate that the odds of transiting to tertiary education among Whites aged 18-19 who had at least Grade 12 were similar to that of Blacks of similar age and educational level in 2016. The difference between the two groups after controlling for the above-mentioned confounders was only 0.004 and was not statistically significant ($p > 0.05$). Comparing Blacks with Coloureds and controlling for the above-mentioned confounders, Model 2 shows that the odds of transiting to tertiary education among those aged 18-19 with at least Grade 12 in 2016 were less for Coloureds by about 37%. This difference is statistically significant ($p < 0.001$). Model 2 further shows that comparing Indians/Asians with Blacks in the specified age group and controlling for the above-mentioned confounders Indians/Asians were about 1.8 times more likely than Blacks to transit to tertiary education in 2016. The difference is statistically significant ($p < 0.001$).

Other aspects of the results in Model 2 in Table 3 indicate that controlling for population group and other variables, persons aged 18-19 with at least Grade 12 who lived in poor households were significantly less likely to transit to tertiary education than persons aged 18-19 with at least a Grade 12 who did not live in poor households in 2016 ($p < 0.018$). Furthermore, controlling for the above-mentioned confounders, persons aged 18-19 who had at least a Grade 12 in 2016 and whose mothers were alive were significantly more likely to transit to tertiary education than persons of similar age and education level whose mothers were dead ($p < 0.001$).

Discussion and conclusion

An ideal comparison of population groups' tertiary education completion rates in South Africa would involve the use of longitudinal (panel) data in which a cohort of students of different population groups are followed over time and which include the household, environmental and individual characteristics of the cohort of students that enrolled at the start of the follow up. The analysis would normally involve the use of life table methods (in a demographic sense). Such data are currently not publicly available in South Africa. In its absence, this study utilised cross-sectional data on persons in different population groups aged 18-19 in 2016 who had a matric transiting to tertiary education considering environmental and individual factors. We noted that even if longitudinal data were available, such data suffer from inherent problems.

The weaknesses in our analysis primarily arise from the limitations of the data utilised. The data did not include information on whether the persons of interest in the analysis obtained a matric pass. This is an important factor in transition to university education. To address this limitation, this study focused on the probability of transiting to a tertiary institution and not neces-

sarily transition to university. All persons with Grade 12 are qualified to transit to at least the lowest level (i.e., certificate) of tertiary education. Household or individual income – an important factor in pursuing tertiary education – was not available in the data. We therefore used a proxy measure – ran out of money in the household to buy food in the past 12 months.

Despite these limitations, our results indicate that the overall probability of South African-born persons aged 18-19 in 2016 transiting to any tertiary education was low (36%). This suggests that certain factors inhibited them from doing so.

Controlling for confounders, the study did not find evidence that transition from secondary to tertiary education among persons aged 18-19 in 2016 who had at least Grade 12 was significantly less likely among South African-born Black people than among South African-born Whites of similar age. However, controlling for confounders, Indians/Asians aged 18-19 who had at least Grade 12 were significantly more likely to transit to tertiary education in 2016 than Black people of similar age and level of education. These findings are relevant to guide policy formulation to improve the quality of the labour market and thus the country's economic competitiveness. We recommend that the HEMIS individual level anonymised data be made publicly available to enrich future research on transition to tertiary education.

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Continuous Workplace-based Assessment as an Indication of Clinical Competence in Paediatric Dentistry

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Abstract

An authentic workplace setting provides the ideal opportunity for assessment of students' clinical competence at the 'does' level of performance. Final-year dental students in the Department of Paediatric Dentistry at the University of the Western Cape are evaluated in the clinical environment on a daily basis through multiple clinical evaluations which assess clinical and diagnostic skills over a year. An additional end-of-module clinical assessment in the form of a single blinded patient case (BPC) determines if students have reached the expected level of clinical competence in terms of patient evaluation and diagnosis. However, the reliability and feasibility of this single end-of-module clinical case have been questioned in this setting. This study aimed to determine if the current continuous workplace-based assessment (WPBA) results could be used as an indication of final-year students' clinical competence at the end of the module. A retrospective, quantitative, cross-sectional study was conducted of all complete assessment records. The correlation between the continuous WPBA components was analysed together with an evaluation of the reliability and validity of the assessment results. The continuous formative WPBA practices were found to be both valid and reliable when using Kane's (2013) and Royal's (2017) frameworks for analysis. However, the BPC should be reconsidered due to feasibility and reliability concerns.

Key words: Dental education, Paediatric Dentistry, clinical skills, workplace, summative, formative, continuous assessment

Un milieu de travail authentique offre l'occasion idéale d'évaluer les compétences cliniques des étudiants. Les étudiants de dernière année en médecine

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dentaire du Département de dentisterie pédiatrique de l'Université du Cap-Occidental sont évalués quotidiennement dans l'environnement clinique grâce à de multiples évaluations cliniques qui évaluent les compétences cliniques et diagnostiques sur une année. Une évaluation clinique supplémentaire en fin de module sous la forme d'un seul cas de patient à l'insu (BPC) détermine si les étudiants ont atteint le niveau attendu de compétence clinique. Cependant, la fiabilité et la faisabilité de ce cas clinique simple de fin-de-module ont été remises en question dans cet arrangement. Cette étude vise à déterminer si les résultats actuels de l'évaluation continue en milieu de travail (EBA) pouvaient être utilisés comme une indication des compétences cliniques des étudiants de dernière année à la fin du module. Une étude rétrospective, quantitative et transversale a été menée sur tous les dossiers d'évaluation complets. La corrélation entre les composantes continues de l'EBA a été analysée en même temps qu'une évaluation de la fiabilité et de la validité des résultats de l'évaluation. Les pratiques formatives continues de l'EBA se sont avérées à la fois valides et fiables lors de l'utilisation des cadres d'analyse de Kane (2013) et de Royal (2017). Toutefois, le BPC devrait être réexaminé en raison de préoccupations liées à la faisabilité et à la fiabilité.

Mots clés: éducation dentaire, dentisterie pédiatrique, compétences cliniques, milieu de travail, évaluation sommative, formative, continue

Introduction

Regardless of the discipline, the end result of training health professionals is to ensure that graduates are clinically competent and can treat patients safely. Workplace-based assessment (WPBA) is thought to be the most authentic way to assess clinical competence as students are evaluated in the work environment and have to solve real life clinical problems as they present. Workplace-based assessment practices are characterised by feedback and include reflection and skills development to encourage lifelong learning (Harris et al., 2017). Students are assessed at the 'does' level of Miller's pyramid (Beard, 2011; Harris et al., 2017). This uppermost tier of Miller's pyramid is synonymous with integration and higher-order thinking (Downing and Yudkowsky, 2009; Miller, 1990) which requires that students are also able to incorporate the lower tiers of the pyramid, which include knowledge and application. Such integration of theory and clinical practice is essential to be able to treat a patient holistically (Wimmers, 2006).

The Health Professions Council of South Africa (HPCSA, 2014) has incorporated an adapted version of the 2005 CanMEDS competency framework (The Royal College of Physicians and Surgeons of Canada, 2015) into its guidelines; where competencies are defined as observable and measur-

able abilities that, when actively integrated in practice, constitute health professional competence (Frank et al., 2010). Teaching, learning and assessment strategies should therefore enable students to develop clinical competence and ensure that competencies have been achieved and can be applied at the end of a course (Hays, Hamlin and Crane, 2015; South African Qualifications Authority, 2001).

The overall undergraduate dentistry curriculum at the University of the Western Cape in Cape Town, South Africa comprises six disciplines or modules of which Paediatric Dentistry is one. In order for students to sit the final examination, which will enable them to graduate from the dental programme, they are expected to pass each of the six modules individually during the fifth/final year of study. The final integrated examination is in a written, case-based format and includes contributions from all the disciplines within Dentistry. The need for sound assessment of the paediatric clinical competence of final-year students is thus critical during the course.

Assessment in the workplace can provide an ideal opportunity for assessment of clinical competencies in the context of professional practice (Beard, 2011; Epstein and Hundert, 2002) as students are evaluated on actual procedures that they will encounter in their working environment. In clinical disciplines, WPBA methods include Clinical Encounter Cards (CEC), Blinded Patient Encounters (BPE), Direct Observation of Procedural Skills (DOPS), Case-based Discussions (CbD), and the Mini-Clinical Evaluation Exercise (mini-CEX) (Norcini and Burch, 2007). All these methods have a feedback component based on specified criteria and are considered formative in nature (Norcini and Burch, 2007).

The mini-CEX has been widely used in the workplace-based environment (Pelgrim et al., 2011) and can be applied to a variety of settings (Norcini and Burch, 2007) including Dentistry. It is an abbreviated version of the traditional clinical examination (CEX) and consists of single patient encounters (Pelgrim et al., 2011) which are conducted over a period of time (Norcini, Blank, Duffy and Fortna, 2003).

Final year dental students in Paediatric Dentistry at the University of the Western Cape are assessed through continuous WPBA practices. These include daily direct observation assessments of student-patient interactions in the workplace over the course of a year (mini-CEX), completion of a minimum clinical quota of procedures, and two case presentations.

Due to the disruptions caused by student protests (#FeesMustFall) in October/ November 2015, final examinations for that year were cancelled. This forced the department to promote students based on their continuous assessment results. The question therefore arose as to whether these results were an accurate reflection of clinical competence.

There is a paucity of research on the application of WPBA tools in the

dentistry setting. This study therefore aimed to determine if the current continuous WPBA results in the Department of Paediatric Dentistry could be used as an indication of the clinical competence of final-year students at the end of the module and whether they could be used to make pass/fail decisions.

Methods

Paediatric Dentistry assessment

Assessment in the discipline of Paediatric Dentistry takes place in the clinical setting as well as in tutorials and traditional test and examination environments. In the final year, greater emphasis is placed on continuous assessment which includes a clinical component comprising of various WPBA tasks, as well as written tests on theoretical content. The clinical component carries a higher overall weighting of 60%, with 40% for the theoretical component (Figure 1). As this article focuses on clinical competence, the theoretical component will not be discussed further.

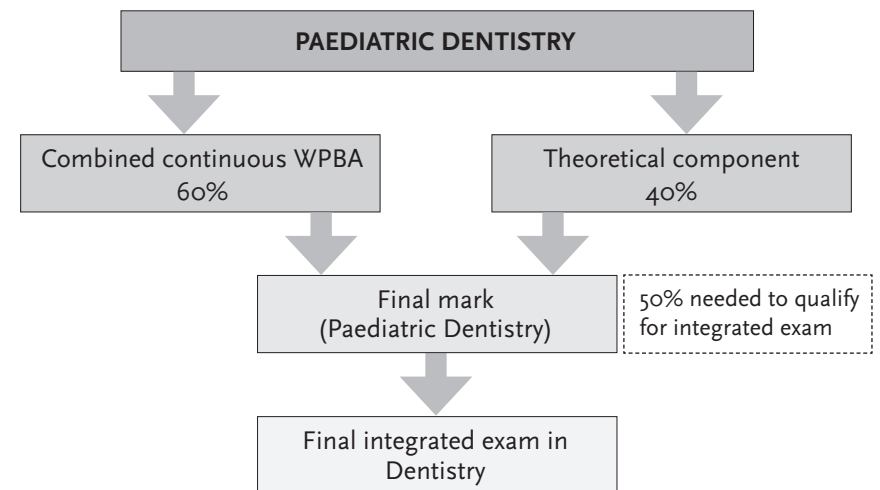


Figure 1: Overall assessment plan

A variety of assessment methods are used to determine whether a student can be considered clinically competent (Figure 2). Students are evaluated and receive feedback on all clinical aspects of Paediatric Dentistry, including their ability to formulate a diagnosis based on history taking, integration of knowledge, ability to address the patient's main complaint and actual treatment procedures. An end-of-module paediatric clinical assessment is also required to assist pass/fail decisions in the discipline. This assessment task

comprises a single blinded patient case (BPC)' however, the reliability of the single clinical case has been questioned (Harris et al., 2017).

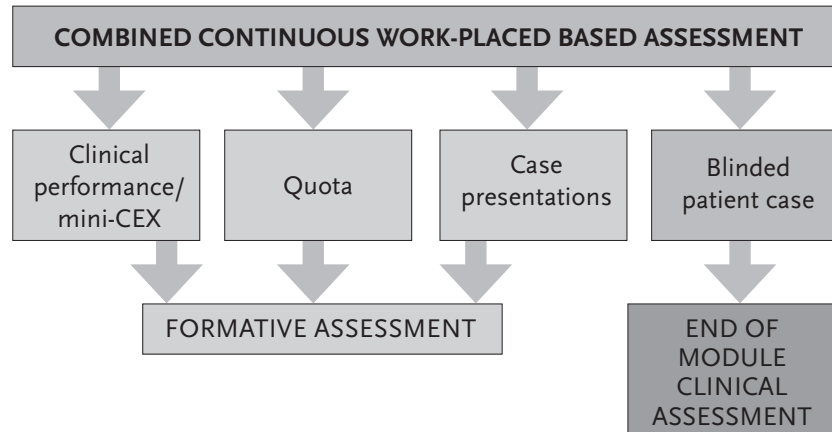


Figure 2: Clinical assessment components

Mini-CEX evaluations and logbook quotas

The department accommodates approximately 80 to 85 final-year students in the clinics every year over a period of roughly 30 weeks. Each student sees an average of ten patients during this time. These patients return for numerous visits so that all the treatment they require is completed. The initial visit is a diagnostic one where a treatment plan is drawn up. Subsequent appointments are dedicated to executing the treatment plan and completing all the treatment the patient requires. Students are supervised when treating these patients under local anaesthesia, general anaesthesia or sedation. This provides the ideal opportunity to assess students performing varied professional tasks in a range of workplace-based environments.

For the purposes of this article, the direct observation assessments of student-patient interactions are referred to as mini-CEX encounters although a rubric relevant to the Paediatric Dentistry context is used in place of the original mini-CEX scoring sheet published by Norcini and Burch (2007). This holistic clinical rubric with specific criteria (See appendix) is used to assess clinical ability, knowledge and application of knowledge as well as diagnostic and problem-solving skills.

Similar to the implementation of the mini-CEX in other clinical settings (Al Ansari, Kauser and Donnon, 2013; Norcini et al., 2003; Norcini and Burch, 2007), a student's performance is assessed by various staff members through direct observation whilst treating a range of patients.

All staff members are rotated through the clinics and students are thus exposed to a number of different staff during the year.

Based on staff and student feedback, the implementation of the clinical rubric in its current format has been shown to be feasible. The evaluation criteria are explicit and staff are required to provide feedback (in keeping with the principles of formative assessment) after each clinical session. Staff members discuss each student's performance with them. However, in order to be beneficial, students should understand why certain standards were not met and how to improve (Hays et al., 2015; Yorke, 2003). Specific verbal feedback relevant to the clinical session is provided. Students are required to reflect on their performance and highlight what they did well and where they feel they can improve. This approach is in line with recommendations in the literature that emphasise the need to develop an "action plan" which provides specific information on how students need to proceed to achieve the learning outcomes (Norcini and Burch, 2007, p. 866).

Staff are also required to record comments on the rubric to provide more detail regarding student performance. This is in line with other authors who encourage an additional narrative as opposed to merely recording a grade (Harris et al., 2017; Govaerts, Van de Wiel, Schuwirth, van der Vleuten and Muijtjens, 2013). These narratives allow scores to be interpreted more meaningfully (Govaerts et al., 2013). The grade allocated by the clinical supervisor is discussed with the student and both parties are required to sign the rubric as acknowledgement that this discussion has taken place. This improves accountability of the supervisor as well as the student and is the department's way of ensuring "sustainable assessment and feedback strategies" as recommended in the literature (Norcini and Burch, 2007, p. 869).

As most of the module credits are devoted to clinical time in the clinical workplace-based setting, the average of the mini-CEX encounters is calculated to reflect student performance throughout the year. Clinical practice is evaluated in conjunction with logbook experience (Beard, 2011) in order to calculate the final clinical mark. The mini-CEX episodes are therefore directly linked to procedures which form part of an expected clinical quota. Student protests have also forced management to question the value of logbook quotas and how they correlate with actual clinical competence.

Case presentations

Students are required to present patients seen in the workplace as part of a case for discussion. They motivate their treatment choices and receive feedback from their peers and supervisors. This is regarded as a continuation of WPBA as real patient cases are discussed (Norcini and Burch, 2007). The assessment focusses on clinical reasoning and the rationale for the clini-

cal choices (Norcini and Burch, 2007), thus honing critical thinking skills (Popil, 2011). Through presentations of their peers' patient cases, students are also exposed to a range of real-world patient cases that they would normally not have had access to (Popil, 2011).

Blinded Patient Case (BPC)

At the end of the module, students are assessed using a single BPC that is unknown to them. This is similar to the BPE reported on in the literature (Norcini and Burch, 2007). This assessment evaluates the student's ability to formulate a diagnosis based on history taking, integration of knowledge and ability to address the patient's main complaint.

The patients used for the BPC are not standardised, are unpredictable and have to be rescheduled if they fail to attend their appointments. In addition, as children younger than 12 are used in these assessments, expecting them to sit for more than one student examination is not feasible as they tire easily and have a limited attention span. Different patients are therefore booked, calling into question the fairness of this assessment. Students are also assessed by different examiners. These challenges raise questions regarding the reliability of this assessment.

Target and study population

The target population consisted of final-year students from the Paediatric Dentistry Department at the University of the Western Cape over a two-year period (2016-2017).

Data collection and management

The study participants were identified from routine university records. A retrospective, quantitative, cross-sectional study was conducted of all complete clinical assessment records. This included the completed mini-CEX rubrics (hard copies) as well as the routine annual departmental spreadsheets containing all clinical components of students' assessment marks. All final-year students were included, irrespective of final fail/pass/repeat assessment results. Incomplete records were excluded from the study. The theoretical component of the assessment was not included.

Data analysis

The data was analysed using STATA version 15. Descriptive statistics were used to assess the characteristics of the continuous WPBA components, i.e., means, proportions, standard deviation, median and maximum and minimum scores. Workplace-based assessment scores for each clinical encounter were plotted to track student progress. A Spearman's rank-order correlation was run to assess the relationship between the various

assessment components. This was illustrated using correlation matrices. The closer the correlation coefficient is to the value of 1, the better the correlation. One-sample t-tests were used to determine whether there was a statistically significant mean difference between various scores, i.e., when the p-value was less than or equal to 0.05.

In addition to statistical analysis, two qualitative approaches were used to assess the reliability and validity of the WPBA practices. Driessen et al.'s (2005) principles of credibility and dependability were applied to assess the reliability of the assessment, and validity was evaluated using a combined framework based on Kane (2013) and Royal (2017).

The characteristics of, and correlation between the continuous WPBA components were analysed together with an evaluation of the reliability and validity of the assessment results to ascertain whether inferences drawn from these results could assist the department to make decisions regarding the assessment practices currently employed.

Qualitative approach

Clinical supervisors evaluate and judge critical thinking and the quality of student responses when students motivate treatment choices and apply theory to the clinical context as part of the mini-CEX evaluations and case presentations. This is a subjective interpretation of the student's abilities, with assessment information presented as qualitative data.

An alternative qualitative approach to evaluate the reliability of assessment tasks was suggested where markers for credibility and dependability are included based on the supervisor's judgement (Driessen, van der Vleuten, Schuwirth, van Tartwijk, and Vermunt, 2005). Credibility or trustworthiness of an assessment must be supported by evidence and this can be achieved through three strategies, namely, triangulation (i.e., combining information from different sources), prolonged engagement over time and member checking which includes student discussion and feedback. Dependability refers to the quality assurance processes in place (Driessen et al., 2005). Using this qualitative analysis strategy (Driessen et al., 2005), the principles of credibility and dependability were applied to the assessment practices based on assessment records.

Ethical considerations

All data (including rubrics and spreadsheets) were handled and managed according to Good Clinical Practice (GCP) requirements and ethical standards. Students whose assessment scores were included in the study were assigned a unique student identifier number. This data was entered into an electronic database (an Excel spreadsheet). Student numbers and names were not entered into the electronic database, thereby ensuring confiden-

tiality. A request was made for a waiver of individual informed consent as this was a retrospective review of routinely collected data with minimal risk. Ethical clearance was obtained from the Health Research Ethics Committee at Stellenbosch University (X18/02/002) as well as the University of the Western Cape (UWCCRP070318NM).

Results

The study population consisted of 57 and 58 students in the 2016 and 2017 cohorts, respectively, i.e., a total of 115 complete records. Sixty students whose full complement of records was not available were excluded from the study. This included 36 records for 2016 and 24 for 2017.

A summary of the study cohort assessment data is presented in Table 1 with mean (%) and minimum and maximum scores for each assessment component (with standard deviations).

Table 1: Summary of assessment data for the cohort (n=115)

Assessment component	Average mini-CEX scores (%) [with SD]	Average case presentations (%) [with SD]	Logbook quota (%) [with SD]	Blinded patient case (%) [with SD]	Combined Continuous WPBA score (%) [with SD]
Mean	58.9 [4.3]	65.3 [6.4]	63.2 [11.6]	67.8 [8.2]	61.9 [4.9]
Minimum score	50	36.5	35	45	49.3
Maximum score	67.5	81.2	90	83	74.9

As depicted in Table 2, positive correlations were found between most of the assessment components.

Table 2: Spearman correlation coefficients between various assessment components (correlation row 1, p-value row 2)

	Average mini-clinical evaluation	Cases average	Logbook Quota	Blinded patient case	Combined continuous WPBA
Average mini-clinical evaluation	1.000				
Case presentation average	0.4114 0.0000	1.0000	0.3710 0.0000	0.4848 0.0000	
Logbook quota (procedures)	0.2550 0.0060		1.0000	0.0973 0.3011	
Combined continuous WPBA	0.7218 0.0000	0.7229 0.0000	0.7192 0.0000	0.5289 0.0000	1.0000
Blinded patient case	0.4704 0.0000			1.0000	

Moderate positive correlation was found between the average mini-CEX and the BPC ($r_s = 0.47, p < 0.0001$) which was statistically significant. The participants performed better in the scores for BPC (Table 1), 67.8% (8.2) than those for their average mini-clinical evaluation, 58.9% (4.3), a statistically significant difference of -8.82% (95% CI, -10.16 to -7.48), $p < 0.0001$.

The combined continuous WPBA moderately correlated with the BPC ($r_s = 0.52, p < 0.001$) which was statistically significant (Table 2). The participants performed better in the single clinical assessment, 67.8 (8.2) (Table 1) than in their combined continuous WPBA, 61.9 (4.9). A statistically significant difference was noted, -5.74 (95% CI, -7.03 to -4.45), $t(114) = -8.79, p < 0.0001$.

The combined continuous WPBA scores were also strongly correlated with the average mini-CEX score ($r_s = 0.72, p < 0.001$) as well as quota and cases ($r_s = 0.72, p < 0.001$). All of these findings were statistically significant (Table 2).

The principles of credibility and dependability (Driessen et al., 2005) were applied to the assessment practices based on the assessment records. A summary of the evaluation is presented in Table 3.

Table 3: Evaluation of reliability of the assessment approach using qualitative strategies (Driessen et al., 2005)

	Strategies	Application to Paediatric Dentistry
Credibility of assessment Dependability	Triangulation (combining information from different sources)	✓ Varied assessment used (mini-CEX, logbook quota, cases for discussion, blinded patient case)
	Prolonged engagement over time	✓ Multiple assessments over time ✓ Multiple examiners ✓ Multiple and varied patient cases
	Member checking	✓ Student feedback ✓ Student involvement in assessment process
	Quality assurance	✓ Rubrics with explicit criteria ✓ All staff attended training ✓ Rubrics are completed with detailed notes ✓ Regular evaluation and adaptation of assessment practices based on staff and student feedback

This qualitative analysis suggests that the continuous formative WPBA results are reliable.

Validity of WPBA

In order to structure an argument for validity, a combination of two frameworks was used that most accurately represented the department's WPBA practices, i.e., Kane's four inferences (2013) and Royal's four tenets (2017). The findings of the application of these frameworks are summarised in Table 4.

Table 4: Validity argument for WPBA

Tenets/ inferences	Application to Paediatric Dentistry
Scoring	Use of a detailed clinical rubric Staff trained to use rubric Evaluates both clinical and theoretical aspects of each patient case
Generalisation/ validity evidence	Multiple assessments Multiple examiners Varied patient cases
Implications	Correlation of scores between WPBA components WPBA as an indicator of clinical competence Value of end-of-module clinical assessment

** Adapted from Royal (2017) and Kane (2013)

This analysis suggests that the continuous formative WPBA results are valid.

Discussion

No previous studies could be directly compared with the combination of assessment practices employed by the Department of Paediatric Dentistry. Where applicable, the individual components are thus discussed in relation to the literature.

Formative results as predictors of summative performance

The mean scores obtained for the end-of-module BPC were statistically significantly higher than the average scores obtained in all the other assessment components during the module (Table 1). This is similar to the findings reported in a 2009 study where success in formative assessment tests was associated with better summative marks (Carrillo-de-la-Peña, Baillès, Caseras, Martínez, Ortet and Pérez, 2009). Two other studies support formative assessment's positive contribution to summative results (Anziani, Durham and Moore, 2008; Riaz, Yasmin S and Yasmin R, 2015).

It should be noted that the end-of-module assessment comprises of a single patient case. These clinical cases are not standardised and vary in terms of presentation of problems and complexity. The reliability of these results therefore has to be questioned. This score may thus not be a true reflection of competence when compared to the other assessments that take place over a period of time. However, the fact that the scores obtained for the end-of-module BPC were better even though a more structured, detailed assessment process was used, can also be regarded as evidence of improved performance as students were more thoroughly interrogated.

The continuous assessment results could be a better indication of student performance and could be considered when making a judgement call on whether or not a student should pass in this setting. Harris et al. (2017) concur that multiple assessments are a more accurate indicator of whether or not a student is fit to progress to the next level.

The value of multiple and varied assessments

Clinical practice requires a range of characteristics, as no single method of assessment is likely to provide sufficient data to make a valid and reliable judgement of competency (Norcini and Burch, 2007). Assessment methods should therefore be fit for purpose; with an understanding of the information they can provide. Individual assessment methods have strengths and weaknesses and issues of reliability, validity and feasibility should be considered. Furthermore, multiple and varied assessment tasks offer students the opportunity to showcase different competencies and strengths, making the assessment fairer (Downing and Yudkowsky, 2009; UWC Assessment Policy, 2018).

While most WPBA methods can be used for formative assessment on their own, multimodal assessment across a time period is recommended

for summative decisions (Schuwirth and van der Vleuten, 2010). Clinical competence assessment in the Paediatric Dentistry programme is pitched at the 'does' level of Miller's pyramid (Miller, 1990; Wass, van der Vleuten, Shatzer and Jones, 2001) and various WPBA methods are used over time to assess performance.

Because clinical skills are essential for a dentist, it is important that competence in performing clinical procedures is assessed. A logbook is used to monitor the number and type of clinical procedures students have completed. Whilst Dahllöf, Tsilingaridis and Hindbeck (2004) reported on the use of logbooks for reflection purposes and Anziani et al. (2008) used logbooks to compare formative and summative assessment scores, no studies have examined the correlation between clinical performance and the number of procedures completed. The average mini-CEX score in this study showed only a weak positive correlation with the logbook quota (Table 2). The results show that the number of procedures does not equate to clinical competence and that a more holistic view of student performance should be considered.

Presentation of patient cases seen in the clinical area enables students to appraise their chosen treatment options and defend their decisions with appropriate motivation from the literature. This helps to hone critical thinking and problem-solving skills as well as improve understanding of complex issues through integration of concepts (Popil, 2011; McDade, 1995).

The findings of this study suggest that the combined WPBA components provide a more accurate reflection of student competence than a single assessment task. This is in line with the principles of programmatic assessment which state that more than one component should be evaluated to obtain a more holistic view of student competence (van der Vleuten, Schuwirth, Driessen, Govaerts, and Heeneman, 2015). The combined continuous WPBA score includes all clinical work and a quota of procedures. It is therefore a true representation of the workplace as integration of theoretical knowledge and application thereof to the clinical context is assessed. This integrated assessment is important to determine clinical competence.

The case for reliability

Jonsson and Svingby (2007) suggest that multiple examiners and rubrics with explicit criteria strengthen reliability, especially if the criteria are strictly adhered to. In Paediatric Dentistry, all departmental staff have been trained to use the rubrics and emphasis was placed on identifying specific criteria to substantiate the mark that is allocated. Regular reinforcement is nonetheless essential to ensure that staff remain focussed on the purpose of the assessment. This helps to improve accuracy when completing the rubric.

The learning outcomes and the purpose of the assessment were used in

designing the rubric. As recommended by Gibson and Shaw (2010), specific aspects/characteristics that are linked to the learning outcomes and that need to be evaluated were identified and incorporated. Rubrics that are specifically designed for a particular clinical context also enhance reliability (Jonsson and Svingby, 2007). In this case, the clinical rubric was specifically designed for the Paediatric Dentistry context.

With the once-off clinical assessment, students can perform very well or very poorly depending on the type of patient case on that particular day. This could either be attributed to the complexity of the patient case or the student's inability to handle high-pressure situations. This was confirmed by Wass et al. (2001), who highlighted that these conditions could influence the reliability of the assessment.

The criteria delineated in the clinical rubric portray more than one description for each level (see appendix). It has been shown to be reproducible and the fact that staff and students often agree on the same score, attests to the clarity of the assessment criteria stipulated on the rubric. Overt performance where actual skills are assessed is easier to measure (Andreatta and Gruppen, 2009). However, the theoretical component that underpins the clinical practice is more open to subjective interpretation because covert performance like clinical reasoning is assessed (Andreatta and Gruppen, 2009). Examiner subjectivity comes into play with the mini-CEX evaluation, making it vulnerable to bias. On the other hand, as posited by Pelgrim et al. (2011), multiple assessors counter the effect of assessor subjectivity.

It should be borne in mind that factors like inherent personality traits, and staff's beliefs and opinions can also influence how students are scored (Tziner, Murphy and Cleveland, 2005). Scoring can therefore never really be "objective" as there is "no single true score"; however, all perspectives are valid (Govaerts and van der Vleuten, 2013, p. 1170). The fact that the average mini-CEX marks are recorded levels the playing field to some extent as any discrepancies resulting from subjective interpretation on the part of the clinical supervisor are somewhat mitigated.

Strong correlation between the combined continuous WPBA score and the individual WPBA components indicates good reliability of the assessment. Students are assessed by multiple supervisors who rotate through the clinic at different times and treat a broad spectrum of patients with varied needs. Reliability and validity are thus improved as students are assessed by more than one supervisor on multiple occasions over a period of time. This is in line with arguments presented in the literature (van der Vleuten and Schuwirth, 2005; Downing, 2004). Pelgrim et al. (2011) found that an acceptable level of reliability can be achieved using a minimum of ten encounters. The number of encounters included in the present study exceeds this as students have two encounters per week over a roughly 30-week period. As

noted by van der Vleuten and Schuwirth (2005), a larger sample accounts for variance and minimises errors, thereby improving reliability. The outcome of the assessment can therefore be considered reliable.

Based on Driessen et al.'s (2005) qualitative approach to reliability, the continuous formative WPBA practices in Paediatric Dentistry can be regarded as credible and dependable, and therefore reliable (Table 3).

The case for validity

According to Downing (2004), the reliability of an assessment is the main indication of its validity. The proven reliability of the WPBA in Paediatric Dentistry is therefore the first source of evidence in favour of validity of the departmental assessment practices. Content validity suggests that the entire course content should be covered (Schuwirth and van der Vleuten, 2010) and that competencies should be aligned with the learning objectives (Coderre, Woloschuk and McLaughlin, 2009). The importance of constructive alignment was also highlighted by Biggs (1999). In the module being evaluated, constructive alignment exists between the assessment methods employed and the learning outcomes as evidenced in the module descriptors and study guides. The latter sources were used when compiling the clinical rubric. Content is specific to the discipline and content validity is therefore enhanced. This is supported by Durning, Cation, Markert and Pangaro (2002).

Construct validity implies that an assessment tool should be able to discriminate between the high and low scorers (Schuwirth and van der Vleuten, 2010). It would seem that the clinical rubric does not discriminate between very good and very poor students. The tendency for departmental staff (part-time and permanent) to cluster their scores around a '4' does, however, suggest that supervisors find students to be competent. This score correlates well with the average mini-CEX scores over the entire year (Table 1). The latter all lie in the vicinity of 60%.

In terms of the BPC, each student is examined on a different patient case and it is therefore not standardised. This negatively affects the fairness and validity of the BPC component and is the motivation to consider removing the once-off BPC from the assessment.

According to Andreatta and Gruppen (2009), validity refers to whether decisions based on assessment data within a particular context can be trusted. Based on the combined framework of Kane (2013) and Royal (2017), evidence of validity in the departmental WPBA has been highlighted (Table 4). All individual assessment components are taken into consideration when making a decision on whether or not a student is competent, i.e., programmatic assessment practices are followed. This information richness adds to the credibility of pass/fail decisions (van der Vleuten et al.,

2015). Validity is thus enhanced as a more complete representation of a student's abilities can be obtained (Schuwirth and van der Vleuten, 2010).

The construct assessed, skills, knowledge and application of knowledge to a particular patient case, are clearly defined in Paediatric Dentistry with the measurement tool, i.e., the detailed clinical rubric, measuring what it is supposed to measure in an actual clinical setting. The overall WPBA practices can therefore be considered valid within this context.

Multiple mini-CEX assessments conducted over a period of time improve reliability and validity as student performance across a range of patients can be observed by different examiners (Al Ansari et al., 2013; Norcini et al., 2003). Interaction with different patients and assessors provides multiple opportunities for feedback (Norcini et al., 2003) and is therefore a valuable formative assessment exercise. Different supervisors are able to observe a range of skills over a period of time, thereby gaining a reasonable idea of the student's abilities (Norcini et al., 2003). This is essential when evaluating the level of clinical competence (Wass et al., 2001) as inferences made from multiple observations over time give a more accurate picture of competence to the point where a summative decision can perhaps be supported (Harris et al., 2017).

Limitations

The study is a single-centre review and its findings may not be transferable to other settings, although other resource-poor settings may share similar challenges. A further limitation was that roughly a third of the available records were excluded due to the fact that they were incomplete. However, the remaining records are sufficient to draw reasonable conclusions regarding the WPBA scores as an indication of clinical competence.

Conclusion

The continuous formative WPBA practices were found to be both valid and reliable when using Kane's (2013) and Royal's (2017) frameworks for analysis. They were shown to be feasible as they are integrated in the daily routine patient care provided in the paediatric dental clinics. The findings of this study suggest that the continuous formative WPBA scores are an indication of the clinical competence of final-year dental students and that they could be used to decide if students have reached the expected level of clinical competence in this module. However, the value of the single BPC should be reassessed.

Where the workplace provides an opportunity to assess students on all aspects of patient management in an authentic clinical environment, the complexity of the workplace-based setting poses a challenge where assessment practices are concerned. This is especially true when a judgement

call has to be made regarding a student's clinical competence. This study suggests that holistic evaluation of student performance is essential when making such a judgement call. A balance must be struck between retaining good clinical practice and ensuring that assessment practices are feasible, fair and more importantly, reliable and valid. The final decision on a student's competence should be made on the basis of professional judgements that are supported by evidence that is both defensible and credible.

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Appendix: paedo/ortho clinical evaluation

Student name		Year:	Student code				
Staff name		Staff code					
Date:							

Rating	%
1	20
2	40
3	50
4	60
5	75+

	Pt codes
1	Child (Prim. Tooth)
2	Child (Perm Tooth)
3	Adult
Type codes	
1	Observed/ Grp discussion
2	Assisted
3	Treated

Patient Folder Number										Tooth No.	Pt	Type	Procedure Code					

Final mark (rubric)	Pt 1	Pt 2	Pt 3	Additional comments:	Procedures assisted
Clinical					
Theory					
Supervisor's signature: Student's signature:					

Mark	Clinical (includes professionalism)	Theory
1	<p><i>Patient bookings/professionalism</i></p> <ul style="list-style-type: none"> • Student absent/ Cancels patients without permission • No patient booked by student at least a week in advance <p><i>Clinical</i></p> <ul style="list-style-type: none"> • Detrimental to patient—mistake not rectifiable • Missed important information e.g. History of pain • Missed obvious pathology • Treatment plan unacceptable • Wrong procedure performed • Starting procedure without permission or signed treatment plan • Restorations clinically unacceptable 	<p>Complete lack of core knowledge—could not answer any of the questions posed</p> <ul style="list-style-type: none"> • Not able to justify material selection despite prompting • Cannot integrate theory with clinical practice • Complete lack of critical thinking • Cannot motivate treatment chosen

Mark	Clinical (includes professionalism)	Theory
2	<p><i>Patient bookings/professionalism</i></p> <ul style="list-style-type: none"> • Double-booking patients without permission • Arriving/starting late • Lack of time management/poor planning • Leaving without permission (if patient doesn't arrive) • Dismissing patient without supervisor's permission • Non-compliance with dress code <p><i>Clinical</i></p> <ul style="list-style-type: none"> • Instrument seal broken before patient arrives • Poor infection control, untidy cubicle, gloves not in biohazard container • Could not correlate history and clinical picture • Took radiographs before doing a clinical charting • Starting tooth preparation without radiographs where indicated • Missed no pathology clinically but treatment plan unacceptable • Quality of procedure unacceptable but mistake rectifiable • Restorations need major adjustment 	<ul style="list-style-type: none"> • Needs prompting to justify material selection/procedures <p>Could answer less than half of questions posed</p> <ul style="list-style-type: none"> • Has some idea of rationale for treatment • Some core knowledge • Critical thinking skills/reasoning not sound
3	<ul style="list-style-type: none"> • Incomplete History/Diagnosis • OH and Fluoride only • Reasonable history taking-- missed some things but could not answer when prompted • Treatment plan acceptable but needs major revision • Clinical work acceptable but guidance required with procedure • Clinically acceptable restorations but needs minor adjustment 	<p>Core knowledge acceptable/average</p> <ul style="list-style-type: none"> • Reasonable insight regarding procedures/materials • Fair idea for choosing treatment option • Theoretical knowledge and critical thinking skills sound
4	<ul style="list-style-type: none"> • Missed some things regarding history but could answer when prompted • Treatment plan acceptable. Needs only minor revision. • Very limited guidance needed with procedure • Good quality restoration (good contacts/ marginal adaptation)-- minor adjustment needed 	<p>Sound knowledge (better than average)</p> <ul style="list-style-type: none"> • Good motivation but doesn't cover all the possible treatment options • Competent • Able to justify material selection • Good insight demonstrated but can improve • Theoretical knowledge good
5	<ul style="list-style-type: none"> • Missed nothing. Covered all the bases without prompting • Diagnosis and treatment plan spot-on • No guidance needed with procedure • Exceptional patient management • Perfect restoration (good contacts/ marginal adaptation/ no overhangs)—no adjustment needed • All restorations polished—no rough spots 	<p>Substantial knowledge (more than expected)</p> <ul style="list-style-type: none"> • Good motivation— aware of all the treatment possibilities/ options • Displays in-depth understanding • Able to justify material selection/ choice of procedures critically • Excellent insight demonstrated • Theoretical knowledge excellent

NB! Lowest mark achieved gets recorded

COVID-19's Impact on the Student Learning Process in Rwandan Higher Education Institutions

Daniel Twesige, Faustin Gasheja, Kadhafi Isae Misago and Eugen Muvunyi

Abstract

The coronavirus pandemic has not only challenged health systems, but has also had a significant impact on education systems across the globe. This study analysed COVID-19's impact on the student learning process in higher education institutions in Rwanda. A quantitative research design was adopted and pragmatism was selected as the research philosophy. Primary data was collected from 1 170 students in 30 institutions using a closed-ended questionnaire. The data was analysed using descriptive and inferential statistical tools. The results indicate that the pandemic has led to changes in the academic calendar, suspension of examinations, and final-year students being unable to conduct research and serve internships. It has also affected the quality of learning and learning from peers due to social distancing. Students in rural areas and those from vulnerable families have been worst affected.

Key words: COVID-19, learning, higher education institutions, online learning, students

La pandémie de coronavirus a non seulement mis à l'épreuve les systèmes de santé, mais a également eu un impact significatif sur les systèmes éducatifs à travers le monde. Cette étude analyse l'impact du COVID-19 sur le processus d'apprentissage des étudiants dans les établissements d'enseignement supérieur au Rwanda. Un plan de recherche quantitatif a été adopté et le pragmatisme a été choisi comme philosophie de recher-

che. Des données primaires ont été recueillies auprès de 1,170 étudiants de 30 établissements à l'aide d'un questionnaire fermé. Les données ont été analysées à l'aide d'outils statistiques descriptifs et inférentiels. Les résultats indiquent que la pandémie a entraîné des changements dans le calendrier scolaire, la suspension des examens et l'incapacité des étudiants de dernière année de mener des recherches et de faire des stages. Elle a également diminué la qualité de l'apprentissage et réduit la fréquence de l'apprentissage des pairs en raison du besoin de la distanciation sociale. Les élèves des zones rurales et ceux en provenance de familles vulnérables ont été les plus touchés.

Mots clés: COVID-19, apprentissage, établissements d'enseignement supérieur, apprentissage en ligne, étudiants

Introduction

School closures are one of the non-pharmaceutical measures that were introduced to control the spread of COVID-19. Following the identification of the first case of COVID-19 in Rwanda on 14 March 2020, the government took immediate steps to control its spread. Among the first measures that were announced on 15 March were the closure of schools and churches. These were followed by other measures such as social distancing, a total lockdown and the wearing of face masks.

These measures led to many higher education institutions (HEIs) shifting the teaching and learning process (teaching, learning and assessment) from normal classrooms (face-to-face) to virtual classrooms (online teaching) through the use of various technologies. Although online learning is a common trend in this new technological era, scholars such as Naciri et al. (2020), Bao (2020), Reimer and Schleicher (2020), and Sintama (2020) observe that it confronts a number of challenges such as a lack of infrastructure to support online learning, and poor network connections.

The COVID-19 pandemic has created a number of challenges in the learning process of students in HEIs. Huston et al. (2020) and Peters et al. (2020) note that COVID-19 interrupted the learning process of students in hard sciences subjects due to a lack of virtual laboratories, cadavers, dissection rooms, specimens, skeletons, and practical learning material. Ogunode et al. (2020), Wargadinata et al. (2020) and Daniel (2020) highlight that it disrupted the academic calendar, with students unable to complete their studies on time. Wargadinata et al. (2020), Owusu et al. (2020), Drane et al. (2020), Calhoun (2020) and Cao et al. (2020) observe that many students lack skills to study and practice online. Furthermore, many live in homes that do not offer a conducive study environment. Finally, COVID-19 has meant that students are missing out on learning from others through group discussions.

Reimers and Schleicher (2020) and Toquero (2020) point out that the

lockdowns imposed as a result of COVID-19 prevented final-year students from gathering data for their research projects. The pandemic also disrupted assessment, which is one of the key activities in the teaching and learning process, as it evaluates whether students have acquired the relevant knowledge and skills. As noted by Reimers and Schleicher (2020) and Joseph et al. (2020) many HEIs did not develop online curricula to facilitate the online learning process. This severely affected many HEIs' internal assessment processes.

While there is a rich body of emerging literature on COVID-19's impact on education in different countries (Zhanga et al., 2020; Radwan and Radwan, 2020; Connorchick et al., 2020; Karalis, 2020; Brown et al., 2020; Reimers and Schleicher, 2020), limited research has been conducted in Rwanda. Moreover, most studies that have analysed this phenomenon have relied on secondary data (Connorchick et al., 2020; Zhanga et al., 2020; Ozer, 2020; Ogunode et al., 2020; Peters et al., 2020; Karalis, 2020). This study contributes to the existing literature in two important ways; firstly, by focusing on the impact of the COVID-19 pandemic on the learning process in Rwanda and secondly, by adding to the methodological approach by adopting the research philosophy of pragmatism.

Literature review

The coronavirus pandemic which started in Wuhan, China in December 2019 has not only challenged health systems, but has had a significant impact on education systems across the globe (Owusu et al., 2020, Daniel, 2020; Chan, 2020; Peters et al., 2020; Karalis, 2020). The measures adopted to combat COVID-19 such as lockdowns, social distancing and quarantine have disrupted the operations of education institutions (Daniel, 2020; Ognodi et al., 2020; Reimers and Schleicher, 2020). Teaching shifted from physical to virtual classrooms and from schools to homes (Zhanga et al., 2020). This has not only affected teaching and learning processes, but also threatened the survival of private education institutions that rely solely on fees from students (Karalis, 2020).

While online learning appears to be a solution in situations where the normal learning process cannot take place (Wargadinata et al., 2020), it has raised numerous challenges. Daniel's (2020) survey of different education institutions in the United Kingdom used a questionnaire which was emailed to the respondents. The findings show that COVID-19 has impacted on students in different ways, including delays in final-year students completing their studies, employment challenges, and inability to complete the school curriculum and conduct rigorous assessment. Zhanga et al.'s (2020) study examined the suspension of classes while continuing learning and China's education management policy during the pandemic. The qualitative study

which relied on secondary sources revealed that the learning process has been affected by poor online teaching infrastructure, inexperienced teachers, unequal learning outcomes due to inexperienced teachers, a complex home environment and ineffective use of online teaching resources. It also noted that, both teachers and students confront problems in teaching and learning online due to unclear teaching modes and pedagogy.

Chan's (2020) research on COVID-19 and global higher education adopted a qualitative approach, with the data comprising 123 abstracts. It found that the pandemic negatively impacted the academic calendar. Murphy (2020) focused on eLearning and the implications of the securitisation of higher education for post-pandemic pedagogy. The qualitative study that relied on a literature review showed that securitisation theory is an important tool for educators in relation to emergency eLearning and the author advocated for the de-securitisation of schools after COVID-19.

Naciri (2020) examined the role of mobile learning as a remote teaching strategy in sustaining student-centred learning. Mobile learning enables learning at any time and place. The author notes that the COVID-19 pandemic has highlighted the potential of teaching innovations. However, there are also significant challenges in terms of developing students' technological skills to use e-Learning. Doyle (2020) analysed COVID-19's impact on education inequality in Ireland. A systematic qualitative review was conducted of 45 studies modeling the effect of COVID-19 on schools. The findings revealed that the pandemic has widened education inequality.

Abidah et al. (2020) analysed COVID-19's impact on the Indonesian education sector through a conceptual analysis of various research articles. The findings point to a lack of learning resources, digital classes, and virtual laboratories during the pandemic. Aziz and Ojcius' (2020) literature review investigated COVID-19's impact on dental education in the United States (US). The study found that the pandemic has impacted the teaching and learning process, with graduations delayed or moved online and parents having to assist their children with online learning.

Wargadinata et al. (2020) analysed the learning experiences of 225 students at HEIs in Malang, Indonesia during COVID-19 using an online questionnaire. The study found that students preferred WhatsApp groups as the App does not require much data and is simple to use. Education institutions adopted different learning models to ensure continuous learning, including WhatsApp groups, e-learning platforms, Zoom, Google classrooms, Microsoft teams, WebEx and others. Huston et al. (2020) examined the impact of the COVID-19 pandemic on medical students in the US. The qualitative study found that the fact that students were sent home and removed from hospital and clinic settings, and shifted from live groups to virtual teaching affected their acquisition of practical skills.

Owusu et al.'s (2020) research on COVID-19's impact on learning in Ghana surveyed 214 students at tertiary institutions using a questionnaire. The challenges identified included not being able to study effectively, parents' lack of skills to assist their children with online learning, limited access to the Internet, and a lack of technological knowhow. Drane et al. (2020) analysed the impact of online learning on the educational outcomes of vulnerable children in Australia during the COVID-19 pandemic. The qualitative study pointed to limited skills in the use of technology during the learning process, limited Internet coverage and a lack of data, and less learning from others through group discussions. The researchers concluded that offsite learning and the loss of school connectedness may negatively impact students' emotional wellbeing and heighten anxiety.

Calhoun (2020) focused on medical students' surgical education during the pandemic in the US and found that it limited their ability to acquire practical skills. Cao et al.'s (2020) research on COVID-19's psychological impact on the college students in China administered a questionnaire to 7143 students. The findings revealed that living with one's parents, a stable family income, and residing in an urban area reduced students' levels of anxiety during the pandemic.

Kapasiasa et al.'s (2020) online survey of the learning status of undergraduate and postgraduate students during the COVID-19 pandemic in India covered 232 students. It concluded that students from remote areas and those that were marginalised faced the most severe challenges. Daroedono et al. (2020) analysed the impact of COVID-19 on medical education based on students' perceptions and practice of long distance learning in Indonesia. The study used a cross-sectional design and covered 545 students from medical schools. The findings revealed that a lack of virtual laboratories negatively affected the learning process.

This brief literature review highlights the efforts made by researchers to analyse COVID-19's impact on students' learning process across the globe. While these studies yield valuable insights, they may not apply to the Rwandan context. It is against this background that our study focused on the COVID-19 pandemic's impact on Rwandan students' learning process.

Secondly, the existing literature provides little evidence on the inequality created by COVID-19 among students based on their location, in particular, the differences between rural and urban areas. Previous studies have noted that a lack of Internet connections, electricity and infrastructure that supports online learning hamper virtual learning (Drane et al., 2020; Owusu et al., 2020). However, comparisons have not been made to show which countries have been most affected by these challenges. Learning inequality arises when some areas of a country and sections of the population has greater access to education than others (Cao et al., 2020). This

study contributes to the existing literature by establishing the impact of the COVID-19 pandemic based on students' location.

Methodology

This study analysed how the COVID-19 pandemic affected the learning process of students in Rwandan HEIs. The following methods and techniques were employed to collect and analyse the data.

Research approach and design

This research was guided by the pragmatism research philosophy and a quantitative research design. A quantitative research design has been adopted by many studies on COVID-19's impact on education (Daroedono et al., 2020; Kapasiasa et al., 2020; Cao et al., 2020). Twesige et al. (2020) point out that if a study requires the use of questionnaires, a quantitative research design is the best technique.

Study population and sampling

The study population was drawn from Rwandan HEIs. According to the Higher Education Council (HEC) (2020), there are 30 such institutions in the country, including two public and 28 private institutions. The target population was students from different programmes offered by HEIs on different campuses. However, it is important to note that the University of Rwanda has nine campuses across the country. Therefore, each campus was considered as an independent university. The number of universities surveyed was thus 29 plus these nine campuses, bringing the total to 38. Thirty students were selected from each campus to form the sample. Therefore, the target sample was (38 x 30) = 1178 students selected from both towns and rural areas. A purposive sampling technique was used to select the students from three clusters, namely, Kigali city, towns and rural areas.

Data collection

Data was collected from primary sources using questionnaires. A closed-ended questionnaire using a Likert scale was emailed to students through their head of department and class representatives. A questionnaire was deemed appropriate due to the advantages it offers over other instruments (Kasomo, 2006; Grafton et al., 2011; Twesige et al., 2020). Given restricted movement and social distancing during COVID-19, an online questionnaire was particularly appropriate. A pilot study was conducted with students from the Department of Accounting at the University of Rwanda to ensure the reliability of the instrument. The reliability was tested using a Cronbach alpha test, which indicated an alpha of 87%, showing that the instrument was reliable and could be used to achieve the study's objectives.

Data analysis

A total of 1 178 questionnaires were distributed to the respondents and 1 100 were returned, representing a return rate of 93.4%. These included 479 students from rural areas, 334 from towns and 287 from Kigali city. After receiving the completed questionnaires, a template was designed in the Statistical Package for the Social Sciences (SPSS) which was used for data entry. After data entry and cleaning, descriptive and inferential statistical tools were used to analyse the data. Descriptive data analysis was conducted using frequency tables, mean and standard deviation. The inferential data analysis was conducted using ANOVA and the Kruskal Wallis Test. ANOVA was used to test the significance of the impact of the COVID-19 pandemic on students' learning process in Rwandan HEIs. The Kruskal Wallis test was used to determine the areas that were most affected by the pandemic and to test the significance of the challenges it posed to students' online learning.

Operationalisation of variables

The independent variable was the learning process. As per the HEC academic guidelines, the learning process includes teaching and learning, and assessment strategies. Before the COVID-19 pandemic the learning process was through normal classrooms (face-to-face). However, due to COVID-19 restrictions, it was shifted to virtual classrooms (online). In this study, the learning process was measured by whether students accessed online learning, whether they were able to learn effectively using online platforms, and whether they had devices to help them online. The impact of COVID-19 was measured by the challenges caused by the shift from face-to-face to online learning.

Results and discussion

This section presents and discusses the results from the survey.

Table 1: Mode of Learning during the COVID-19 pandemic

Tools used in online learning	Strongly Disagree &	Disagree %	Neutral %	Agree %	Strongly Agree %
Moodle online platform				22	78
Video conferencing	57	15.2	9.6	8	10.3
Moodle and video conferencing	46.6	22.7	11.5	18.2	1
WhatsApp groups			30	65	5
WhatsApp and Moodle			35.6	50.4	14

Source: Survey Data, 202

Table 1 shows that all the respondents studied using an online Moodle platform; while 72.2% of the students did not use video conferencing, with 18.3% using this tool; and 9.6% of the respondents remaining neutral on this question. Furthermore, 69.3% of the students disagreed, 11.5% were neutral and 19.2% agreed that they used both the Moodle platform and video conferencing during their learning process. The results further revealed that 70% of the respondents used WhatsApp to support their learning process, whereas 30% were neutral. Finally, 64.4% of the students used both Moodle and WhatsApp to support their learning process.

These findings thus show that learning shifted from face-to-face to online classrooms during the COVID-19 pandemic using different learning platforms. This concurs with the findings of previous studies (see, for example, Zhanga et al., 2020; Wargadinata et al., 2020 and Daniel, 2020). The results also illustrate that the Moodle e-learning platform was the most used by students, followed by WhatsApp. The findings reveal limited use of video conferencing to support the learning process by students. The use of WhatsApp has been fundamental in supporting group discussions and interactive learning by students. Owusu et al. (2020) also found that WhatsApp was used in Ghana to support online learning through interactive learning and group discussions.

Table 2: Student attendance

		Frequency	Percent	Cumulative Percent
Valid	Every day	309	28.1	28.1
	Once a week	348	31.6	59.7
	Twice a week	96	8.7	68.4
	Three times a week	25	2.3	70.6
	Never attended	322	29.4	100
	Total	1 100	100	

Source: Survey Data, 2020

Table 2 shows how often the students attended online classes. It reveals that 28.1% attended online classes every day; 31.6% once a week; 8.7% twice a week; 2.3% three times a week and 29.4% of the respondents never attended online classes. The findings clearly illustrate COVID-19's impact on student attendance of classes as only 28.1% of the surveyed students attended their classes on a daily basis. They concur with those of previous studies that point to students' poor attendance of online classes (see Daroedono et al., 2020; Caoa et al., 2020 and Kapasiaa et al., 2020). This

not only results in low skills acquisition, but also leads to learning inequality among students.

Table 3: Devices used by students during the online process

		Frequency	Percent	Cumulative Percent
Valid	Smart phone	646	58.7	58.7
	Laptop	263	23.9	82.6
	Laptop and smartphone	149	13.5	96.1
	IPad	39	3.5	99.7
	Internet café	3	.3	100
	Total	1 100	100	

Source: Survey Data, 2020

Table 3 shows that 58.7% of the respondents used smartphones during online learning; 23.9% laptops; 13.5% laptops and smartphones; and 3.5% iPads, while 0.3% visited an Internet café in order to access online learning. They thus show that the majority of the students used smartphones to access learning platforms. While the fact that the majority of these students could at least access learning platforms using smartphones might be regarded as good news, smartphones are somewhat complicated for students to use to complete assignments, especially those that are quantitative. This further impacts the quality of the learning process. Furthermore, Huston et al. (2020) assert that a lack of technological tools impinges on students' learning process.

Table 4: Challenges faced by students during Online Learning

		% within Location		
		Rural Areas	Towns	City of Kigali
Challenges faced during online learning	Lack of computers	75.6	18	6.4
	Lack of sufficient skills to learn online	75	65	70
	Lack of electricity	60	25	15
	Home environment was not conducive	65	70.2	65.8
	Lack of data	50.9	36.8	12.3
	Poor Internet connection	79.6	41.1	39.3
	Studying without doing exams	78	62	80
	Learning platform not sufficient	82.9	69.4	57.6

Source: Survey Data, 2020

Table 4 sets out the challenges that students confronted while studying online. It shows that 75.6% of the respondents in rural areas had no access to computers, compared to 18% and 6.4% of those in towns and Kigali city, respectively. The results also reveal that 75%, 65% and 70% of the respondents from rural areas, towns and the city of Kigali, respectively, lacked sufficient skills to study online. Furthermore, 60% of the respondents in rural areas reported a lack of electricity, compared to 25% and 15% of those in towns and Kigali city, respectively. Turning to the conduciveness of the home environment, the results show that 65% of the respondents from rural areas indicated that their home environment was not conducive to studying, compared to 65% and 70% of those in towns and the city of Kigali, respectively. The table reveals that 50.9% of the students lacked data to engage in online learning, while the figures for towns and the city of Kigali were 36.8% and 12.3%, respectively.

Another challenge that confronted these students in studying online was poor Internet connections. The findings illustrate that 79.6% of the respondents in rural areas experienced this problem, compared to 41.1% and 39.3% in towns and the city of Kigali. Both summative and formative examinations are used to assess students' learning status. In order to combat the spread of COVID-19, social distancing measures were introduced. This led to the closure of schools and students were thus unable to sit for their exams. Table 4 above shows that 78% of the respondents from the rural areas were concerned about studying without sitting for exams compared with 62% from towns and 80% from the city of Kigali. Finally, 82.2%, 69.4% and 57.6% of the respondents from rural areas, towns and the city of Kigali, respectively, agreed that learning infrastructure was insufficient to support effective learning.

In summary, the challenges confronted by the respondents in studying online during the COVID-19 pandemic included a lack of computers, insufficient skills, poor Internet connections, a lack of data, lack of learning from peers through group discussions, lack of face-to-face clarification, insufficient learning infrastructure like virtual laboratories and a poor home learning environment. These findings concur with those of previous studies (Kapasiasa et al., 2020; Drane et al., 2020; Owusu et al., 2020; Abidah et al., 2020).

Table 5: Ranking of the most affected students

	Location	N	Mean Rank
Challenges faced during online learning	Rural Areas	479	189.44
	Towns	334	158.03
	City of Kigali	287	131.38
	Total	1 100	

Source: Survey Data, 2020

Table 5 ranks the most affected areas during online learning using the mean. The results show that the respondents in rural areas faced more challenges in online learning than those in towns and the city of Kigali. This was mainly due to poor Internet connections, lack of data and an unstable electricity supply. These results concur with those of previous studies. For example, Caoa et al. (2020) demonstrate that students in rural areas are more marginalised when it comes to online learning than their counterparts in towns and cities. Daroedono et al. (2020) produced similar results. It is thus clear that COVID-19 has led to learning inequality between students in rural and urban areas (also see Doyle, 2020).

Table 6: Test Statistics^{a,b}

	Challenges faced during online learning
Chi-Square	21.049
Df	2
Asymp. Sig.	.000

a. Kruskal Wallis Test

b. Grouping Variable: Location

Source: Survey Data, 2020

Table 6 shows the Kruskal Will's test of the significance of the challenges faced by students during online learning due to the COVID-19 pandemic. The results reveal that a lack of computers, lack of sufficient skills to study online, lack of data, poor Internet connections, an uncondusive home learning environment, lack of electricity, and changes to the academic calendar have a statistically significant impact on the effective learning process of students based on their location.

Table 7: Significance test of the Impact of COVID-19 on students' Learning Process using ANOVA

		Sum of Squares	Df	Mean Square	F	Sig.
Reduction in the maintenance costs of students during learning	Between Groups	66.726	2	33.363	27.740	.000
	Within Groups	369.223	1097	1.203		
	Total	435.948	1099			
Affected the quality of learning	Between Groups	6.500	2	3.250	3.591	.029
	Within Groups	277.836	1097	.905		
	Total	284.335	1099			
Lack of face-to-face clarification	Between Groups	22.301	2	11.150	9.310	.000
	Within Groups	367.686	1097	1.198		
	Total	389.987	1099			
Studying without examinations	Between Groups	3.700	2	1.850	1.292	.276
	Within Groups	439.771	1097	1.432		
	Total	443.471	1099			
Promoted independent learning	Between Groups	18.185	2	9.092	6.437	.002
	Within Groups	433.635	1097	1.412		
	Total	451.819	1099			
Lack of group discussions	Between Groups	4.257	2	2.128	1.973	.141
	Within Groups	331.192	1097	1.079		
	Total	335.448	1099			
Unable to do research	Between Groups	5.181	2	9.012	8.891	.003
	Within Groups	379.224	1077	1.723		
	Total	384.405	1099			
Unable to do internship	Between Groups	6.349	2	12.010	11.992	.000
	Within Groups	831.920	1097	1.123		
	Total	838.269	1099			
COVID-19 affected the academic calendar	Between Groups	39.667	2	19.833	22.496	.000
	Within Groups	270.669	307	.882		
	Total	310.335	309			

Source: Survey Data 2020

Table 7 shows the impact of COVID-19 on the students' learning process. As evidenced by P-values of less than 5%, it illustrates that COVID-19 has had a significant impact on maintenance costs for the students, face-to-face clarification, the quality of learning, independent learning, students' internships,

students' research and the academic calendar. These results concur with those of previous studies. Zhanga et al. (2020) and Daniel (2020) show that the shift from face-to-face to online learning has affected the students' learning process, while Daroedono et al. (2020); Kapasiaa et al. (2020); Caoa et al. (2020); Calhoun (2020); Drane et al. (2020); and Owusu et al. (2020) note that COVID-19 led to changes in the academic calendar, especially for final-year students. Naciri (2020), Chan (2020) and Abidah et al. (2020) observe that students doing science courses' quality of learning has been particularly hard hit due to the lack of virtual laboratories, library, cadavers, etc. Our study also shows that COVID-19 negatively impacted group discussions and examinations. Drane et al. (2020) Owusu et al. (2020); Karalis (2020) and Brown et al. (2020) note that learning from peers through group discussions is fundamental to students' learning process. Moreover, formative and summative assessment are critical to this process.

Conclusion and recommendations

Conclusion

This study analysed the impact of the COVID-19 pandemic on the learning process of students in Rwandan HEIs. The findings revealed that the pandemic has had numerous impacts on the learning process. While both positive and negative impacts were identified, the latter outweigh the former. The negative impacts include learning inequality among students, poor attendance of classes, lack of face-to-face clarification, studying without examinations, lack of group discussions, and inability to conduct research and undertake internships among final-year students.

Furthermore, the findings revealed that students in rural areas were more affected by poor Internet connections, a lack of data and a poor electricity supply than students in towns and the city of Kigali. This raises the worrying challenge of learning inequality between students from rural areas and those from towns.

The pandemic's positive impacts on the learning process of students in HEIs include promotion of independent learning; reduced maintenance costs of students during learning and improved technological skills.

Recommendations

The government should make concerted efforts to close the learning gap between students from towns, the city of Kigali and those from rural areas. This can be achieved by establishing learning centres in rural areas with full Internet connections. Furthermore, the government should improve Internet connectivity in rural areas and assist students from disadvantaged families with learning tools such as laptops and data.

For their part, HEIs should train students on online learning. A module

should be introduced in first year to introduce students to online learning. Moreover, online learning should be part and parcel of all higher education offerings and modules should be delivered partly online and partly face-to-face.

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