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Project management learning: A comparative study between engineering students' experiences in South Africa and the United Kingdom

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Abstract

This study explores how engineering students studying project management perceive their learning experiences. To facilitate an understanding of the constituent components of engineering students' experiences, and to understand how these experiences influence preferred learning styles, a comparative study of university students studying engineering in South Africa and the United Kingdom is conducted. The study finds no significant demographic differences in learning experiences across the two student cohorts. However, the South African cohort reports higher levels of *overall experiences. They also report higher usage of online learning materials* but lower levels of *blended learning* and *individual critical evaluation skills* experiences.

Keywords

Learning; Project Management; Engineering; South Africa

INTRODUCTION

This paper explores how students on engineering programmes perceive their project management learning experiences and expectations, and how these perceptions influence their preferred learning approaches. Pedagogical issues spanning both teaching and learning remain core to the project management discipline. Pedagogy has been highlighted as a critical area of interest within the re-thinking project management agenda (Cicmil et al., 2006; Winter et al., 2006). As one of six overarching categories within that agenda (Svejvig & Andersen, 2015) pedagogy now cannot be neglected by project management literatures concerned with rethinking project management practice. Furthermore, within the context of project management literature, teaching and learning remains a core constituent of 'rethinking practice' which has also been identified as one of the six categories comprising the rethinking project management agenda (Svejvig & Andersen, 2015). Taking stock, clearly the teaching and learning of project management has attracted the attention of numerous scholars within project management (see for example Ashleigh et al., 2012; Bredillet et al., 2013; Chipulu et al., 2011; Ojiako et al., 2011, 2014; Ramazani & Jergeas, 2014; Walker, 2008). Our choice of project management as a learning comparator was driven by earlier studies suggesting that: (i) common dimensions of pedagogy in the teaching and learning of project management ascribe their independence to specific discipline peculiarities (see Ashleigh et al., 2012; Chipulu et al., 2011; Hamilton, 2006; Ojiako et al., 2011, 2013, 2014), and that (ii) project management skills are core to the leadership attributes of engineers as articulated by both scholarship (Hamilton, 2006; Wearne, 2004; Ojiako et al. 2013) and professional engineering bodies (ICE, 2011; IMechE, 2012). Table 1 shows the various managerial and leadership competencies required for professional registration and chartered status by the Institution of Civil Engineers, the Institution of Mechanical Engineers, and the Engineering Council of South Africa. Although in a number of cases, they do not refer specifically to 'project management', these competencies nonetheless largely emphasise project management skills as articulated in the normative literature of professional project management associations such as the Association for Project Management (APM) in its Body of Knowledge (see APM, 2012), the Project Management Institute (PMI) in its Guide to the Project Management Body of Knowledge (see PMI, 2013), and the Chartered Institute of Building (CIOB) in its Code of Practice for Project Management for Construction and Development.

Table 1: Professional engineering project management competency requirements.

Professional body	Objective	Competency requirement	Emphasised project management skills.
Engineering Council of South Africa (ECSA)	Register as a Professional Engineer through ECSA and to become a Member of South African Institution of Civil Engineers	Candidates have developed the ability to exercise [engineering] judgement, to make responsible decisions, to communicate lucidly and accurately, to identify and find solutions to problems and to implement these solutions.	Judgement Responsible decision-making Effective communication Problem identification Problem solving
Institution of Civil Engineers (UK)	Attributes required to become a Chartered Member of the Institution of Civil Engineers (UK)	Ability to plan direct and control tasks, people and resources. Ability to lead teams and develop staff to meet changing technical and managerial needs. Commitment to continuous improvement through quality management.	Planning Direction People management Resource management Team leadership Quality management
Institution of Mechanical Engineers (UK)	Chartered Engineer: competence statements to become a Chartered Member of the Institution of Mechanical Engineers (UK)	Identify the factors affecting the project implementation / Lead on preparing and agreeing implementation plans and method statements / Ensure that the necessary resources are secured and brief the project team / Negotiate the necessary contractual arrangements with other stakeholders.	Leadership Stakeholder management Negotiation Resource management

An examination of relevant literature suggests that a number of interrelated research streams are available to facilitate an understanding of current challenges facing teaching and learning in both engineering (see, for example, Kember et al., 1996; Zhou, 2012) and project management education (Chipulu et al., 2011; Ojiako et al., 2011, 2013, 2014; Ashleigh et al., 2012; Louw & Rwelamila, 2012). In the case of engineering education, there are five such interrelated research streams. These are: (i) studies focused on the expansion of pedagogical imperatives, particularly those related to teaching and learning approaches and outcomes (for example, Marton et al. (1984) conceptualise learning approaches as descriptions of courses of action available when tackling specific learning tasks); (ii) studies focused on improving teaching skills and increasing employer engagement, (iii) studies focused on developing students' 'transferable' as opposed to 'inductive' and 'intrinsic' understanding skills (see Bruneel et al., 2010), (iv) studies focussed on how to balance student workload, study time and learning approaches against academic outcomes (e.g. Kember et al.'s [1996] study that found perceived workload and academic outcomes to be dependent on student motivation), and (v) studies addressing questions of relevance for all the foregoing streams of research. Related to this, Jesiek et al. (2010) urge researchers to adhere very closely to empirical findings and studies when theorising best educational practice.

In the case of project management, a number of research streams exist in teaching and learning. These include: (i) studies focused on exploring the softer skills of project management practitioners' parameters (Pant & Baroudi, 2008; Clarke, 2010), (ii) studies focused on enhancing more reflective and creative dimensions of project management practice through education and training (Sewchurran, 2008; Louw & Rwelamila, 2012), (iii) studies focused on enhancing project management learning through university-industry collaboration (Collofello, 2000; Baldock & Chanson, 2006) and (iv) studies focused on understanding not only the critical dimensions of students' experiences of learning project management (Ojiako et al., 2011; Ashleigh et al., 2012), but also the relative salience of these dimensions (Chipulu et al., 2011; Ojiako et al., 2013, 2014). This study focuses on two of these research streams: critical dimensions of students' learning experiences and the relative salience of these dimensions. However, this study's contribution to literature is that while prior studies on critical dimensions of learning experiences and their saliences (i) significantly contribute to the development of a theoretically rigorous discourse on project management pedagogy and also (ii) attribute significant student "voice" to learning experiences and expectations in project management, the majority - if not all - of prior studies exploring critical dimensions of learning experiences and their saliences have been restricted to single-country cases (Ashleigh et al., 2012; Bredillet et al., 2013; Chipulu et al., 2011; Ojiako et al., 2011, 2014). This forms the major point of departure of this study in that, as an *across-*

country rather than a *within*-country comparative exercise, this study is likely to produce much larger variance in level of perceived salience, thus providing researchers with a much stronger statistical imperative to identify how specific factors impact upon students' learning experiences. Comparative data also allow for the identification of systematic heterogeneity in factors impacting upon learning experiences across different countries, thus providing much deeper insight into the relationship between, for example, national culture and student learning experience. The study outcomes will therefore be of interest to project management educators and practitioners around the world, particularly those interested in the growth of project management in emerging countries.

A point to note, however, is that critical to any South Africa/UK comparison of learning experiences is broad appreciation of differences between both countries in terms of underlying educational circumstances. This is especially important in the light of earlier studies by Louw and Rwelamila (2012) which sought to explore project management curriculum development in South Africa, with reference to the rethinking project management agenda (see Winter et al., 2006a, b; Berggren & Söderlund, 2008; Svejvig & Andersen, 2015). For example, while education in South Africa is compulsory from ages seven to 15 (Government of South Africa, 2014), in the United Kingdom it is compulsory for all children within this age range (set to extend from ages five to 18 in 2015, see HM Government, 2012). South Africa's higher education policy emphasises the need to "promote equity of access and fair chances of success to all who are seeking to realise their potential through higher education, while eradicating all forms of unfair discrimination and advancing redress for past inequalities" (Ministry of Education, 2001; p. 6). To limit fragmentation of higher education through class and racial division, policy makers in South Africa have remained committed to limiting the roles of the private sector within higher education (Ellis & Steyn, 2014).

Language also remains a key differential factor in learning experiences (see De Witt et al., 1998). In South Africa, only 9.6% of the country's population speak English as a mother tongue (South Africa.info, 2013), although English remains the principal medium of academic instruction. However, taking note of increases in both the internationalisation of higher education (Teichler, 2004), and the fact that engineering is itself a global enterprise with its most common principles crossing national, cultural and political boundaries, the call for international comparative studies exploring learning imperatives in project management cannot be over-emphasised. Drawing upon recent work by Hanushek and Woessmann (2014), this study posits that international comparative studies on learning experiences are likely to focus on two different strands: (i) what determines cross-national learning differences and (ii) understanding the impacts of such differences. This study considers both.

Taking the above factors into consideration, we utilise data obtained from students on engineering programmes in both South Africa and the United Kingdom to undertake a comparative analysis of: (i) the constituent components of engineering students' experiences and expectations, and (ii) how these influence preferred learning styles. We draw conclusions for South Africa in particular, in light of its recent experiments with outcome-based education and its broader historical experience.

The next section explains the rationale and context for our study by providing an overview of engineering education. In the third section we present the research methodology. This is followed by a presentation of data analysis results in the fourth section. In the fifth section we discuss the findings, while in the penultimate section we discuss the limitations of the study. The paper concludes in the seventh section with discussion of directions for future research.

ENGINEERING EDUCATION

Overview

The statutory body for the engineering profession in South Africa is the Engineering Council of South Africa (ECSA, 2007; 2012) which confers Professional Engineer (PE) status on candidates demonstrating professional competence arising from: (i) achievement of minimum educational requirements, (ii) being employed and completing training contracts, and (iii) professional registration augmented with evidence of continued professional development. To achieve minimum PE status, engineering students in South African universities are expected to possess either a four-year bachelor's degree which focuses on problem-solving skills, or a national diploma which focuses more on practical skills. Historically, a non-honours Bachelor of Technology (B.Tech) degree was offered from 1995. However this was phased out under the 2008 National Qualifications Framework Bill, which shifted educational emphasis over to career-focused knowledge development beyond the National Diploma level. While the four-year bachelor's degree is currently offered mainly at 'traditional' and 'comprehensive' universities, most national diplomas are offered by technology universities (former *Technikons*, i.e. Polytechnics).

Competency and achievement levels in South Africa

The competency of engineering students in South Africa has received academic attention (see Case, 2006; McLean & Walker, 2012). Project management remains at the core of engineering education in that country; however, although competency requirements of the Engineering Council of South Africa (ECSA) do not specifically mention 'project management', they nonetheless cover important project management skillsets under the heading of 'professional attributes' (see ECSA, 2014) expected of Professional Engineers (see below 1, taken from ECSA) which show considerable project management emphasis. These include being able to: (i) keep an accurate daily record of events and instructions, (ii) participate in the dimensional control and accuracy of work being implemented or controlled, (iii) plan and programme section of work and be involved in progress monitoring and reporting, and (iv) measure and record, or independently check, work undertaken for payment purposes.

Achievement levels of South African engineering students appear poor, arguably driven by a "downward trend in the number of learners [students] who pass matric with mathematics" (Government of South Africa, 2012; p. 317). Even with pass marks set at 30%, only 46.3% of matric students passed mathematics in 2011 (SAICA, 2012). Hence the South African government is now questioning whether the country has adequate numbers of "…good quality engineers" (Government of South Africa, 2012; p. 55) to "…deliver the massive infrastructure programme announced in the 2012 State of the Nation address" (Government of South Africa, 2012; p. 297). Such achievement levels are of course influenced by the country's history. For a long time, educational ideology sought to institutionalise racial and social privilege through exclusion (Marshall & Case, 2010). One of the more subtle instruments of power and exclusion within educational systems is of course language (see Miller, 2007). Requirements to write well in the preferred languages of educational institutions and other civil society actors profoundly disadvantaged South Africa's many linguistic minorities under apartheid. Relatedly, the value to be placed on subtle 'social' skillsets is problematic in a country whose cultural legacy is shaped by social inequality and the many, sometimes invisible, psychological and cultural obstacles to participation in social networks that this entails (McLean & Walker, 2012). Case (2006) points to continued racial disparity in numbers of students enrolling on, and successfully graduating from, engineering programmes. Most worrying is Scott et al.'s (2007) observation that dropout rates from engineering programmes still hover around 25%. More recently, the Engineering Council of South Africa reported that only approximately 10% of engineering graduates registered on candidate status for longer than three years eventually achieve professional engineers status (ECSA, 2007; 2012; Government of South Africa, 2012). Hence there are clearly serious issues of disengagement and anomie which educational institutions must consider if they are to stimulate social and professional engagement within the profession.

Overview of the UK context

Arguably, compared to South Africa, the United Kingdom has had a much longer and richer history of engineering education. While the majority of the professional engineering bodies had been formed between 1717 and 1871 (Army Engineers formed 1717; Institution of Civil Engineers formed 1818; Institution of Mechanical Engineers formed 1847; Institution of Electrical Engineers formed 1871), it was not until 1964 that a central body, the Joint Council of Engineering Institutions (now known as the later the Engineering Council), was formed. Its primary objective was and remains that of agreeing a uniform and standard set of expectations for education, training and qualification of professional engineers in the UK (Severn, 2009). A further key role is to articulate uniformly applied Standards and Routes to Registration for potential Chartered Engineers in the UK.

In the UK, although professional engineering bodies such as the Institution of Mechanical Engineers (IMechE) and the Institution of Civil Engineers (ICE) expect candidates seeking chartered status (CEng) to demonstrate key competencies in project management (see ICE, 2011; IMechE, 2012), concerns voiced over competence have grown following a decision by the Joint Board of Moderators (JBM, 2004) to permit UK universities to enrol students not possessing 'A' level mathematics onto engineering degree programmes. A more detailed overview of various historical developments associated with engineering education in the UK is covered in existing literature (see Evans, 1957; Baker, 1960; Etherington, 1977; Campbell et al., 1984; Cranston, 1984; Finniston et al., 1989; Haksever & Manisali, 2000; Barr, 2008; Severn, 2009; Ojiako et al., 2013), and is therefore unnecessary in this paper.

In summary, there is currently world-wide debate within the engineering profession on how teaching and learning may be enhanced to increase professional competence (EC, 2000; Barr, 2008; Schexnayder & Anderson, 2011; ICE, 2013); a debate which is also ongoing in South Africa (see ECSA, 2007, 2012; SAICE, 2012). A common concern is that current engineering education may have too narrow a focus. Scholars such as Owens and Fortenberry (2007) and Barr (2008) observe that most engineering programme curricula address only small subsets of the competency areas articulated in the annual competency reports issued by the American Society of Civil Engineers[1]. In addition, the quality of candidates gaining entry to undergraduate engineering programmes is increasingly being questioned (EC, 2000). Thus this comparative study of student experience across two continents comes as a timely reminder that a more holistic approach to learning and pedagogy in engineering needs to be seriously considered if effective practice is going to flourish within the industry. Having presented the rationale and context of this study, the research methodology is next explained.

THE RESEARCH METHODOLOGY

[1] See www.asce.org. The ASCE's effort to improve professional competence is strongly influenced by the US regulatory "raise the bar for engineering" initiative which aims to ensure that US-licenced professionals in engineering are educated to beyond Bachelors level to safeguard public health, safety and welfare.

Overview of the sample and collection (South Africa)

The study sample in South Africa was drawn from data obtained from two residential universities (*UnivA* and *UnivB*).

The focus of the study was established based on the following similarities and differences between the two institutions. In terms of similarities, both institutions are full-contact residential universities and emphasise research. For example, as of 2013, *UnivA* employed a total of 255 National Research Foundation (NRF)-rated researchers of which 16 held 'A' status[2]. On the other hand, *UnivB* employed a total of 113 National Research Foundation (NRF)-rated researchers of which six held 'A' status. In terms of differences, *UnivA* is a medium-sized contact university offering a range of undergraduate and postgraduate courses. Approximately 32% of its students are postgraduates. The language of instruction is English. Conversely, *UnivB* is a comprehensive university dedicated to providing a range of vocational and professional courses at undergraduate and postgraduate levels. Approximately 13% of its students are enrolled on postgraduate courses. The university is a dual-medium institution offering courses in both English and Afrikaans. Although coming from different cultural traditions (one English and the other Afrikaans) the two Universities sampled reside in the same region and city.

Data collection involved the sampling of engineering students at both *UnivA* and *UnivB* taking project management modules across both undergraduate and postgraduate levels. Data collection commenced in February 2012 and was completed in March 2013. In total, 407 questionnaires were distributed across the two institutions (267 questionnaires were distributed at *UnivA* and 140 questionnaires at *UnivB*). In line with recommendations from earlier studies on survey response rates (Kaplowitz et al., 2004), respondents to the study had been informed earlier (orally) of the proposed study. The total number of questionnaires collected in South Africa (across the two institutions) was 295. This comprised of 208 questionnaires from *SAUnivA* and 87 questionnaires from *SAUnivB*. One hundred and forty *SAUnivA* and 53 *SAUnivB* were discarded for a number of reasons including where questionnaires were uncompleted or had

[2] Researchers who are unequivocally recognised by their peers as leading international scholars in their field for the high quality and impact of their recent research outputs.

missing values. Of the respondents, 41% were female while 59% were male; and 85% of the respondents were enrolled on undergraduate programmes of study while 15% were enrolled on postgraduate programmes.

Overview of the sample and collection (UK)

The UK study sample was drawn from data obtained from four universities in England (*UKUnivC, UKUnivD, UKUnivE* and *UKUnivF*). While *UKUnivC* and *UKUnivD* are members of the research-intensive group of universities called the Russell Group, comprising the 24 leading British universities recognised for their commitment to research excellence, *UKUnivE* and *UKUnivF* are members of the 'University Alliance', representing 23 UK universities focused mainly on business. *UKUnivE* and *UKUnivF* are both former polytechnics with a strong history in teaching vocational and professional subjects (including engineering). Both gained status as independent degree-awarding institutions in 1992 following enactment of the UK Further and Higher Education Act 1992.

Data collection in the UK (comprising the sampling of engineering students taking both undergraduate and postgraduate project management modules) had commenced earlier in October 2010, and was completed in August 2012. In total over 500 students were sampled and 409 returned questionnaires were later deemed usable. Of the respondents, 33% were female and 67% were male. 53% were enrolled on undergraduate programmes while 47% were enrolled on postgraduate programmes. Neither the South African nor the UK study sought to gather regional, racial nor ethnic demographical data of students as this was deemed to be out with their scope.

The survey instrument

A questionnaire survey was employed. The questionnaire framework was developed from earlier studies (Chipulu et al., 2011; Ojiako et al., 2011)[3], and the questionnaire was structured against questions arranged sequentially which the respondents were required to assign ratings to. The questions were as follows.

Question 1 dealt with information on consent and awareness of the survey. Question 2 focused on general demographics such as gender, institution of learning and degree programme currently enrolled on. Contents were influenced by earlier work of Ainley (2001) and extant literature on absorptive capacity and learning (see Zahra & George, 2002; Easterby-Smith et al., 2008). In Question 2, we also gathered information on prior experience of respondents in terms of both academic work at university level and work experience. Question 3 focused on critical thinking (largely drawn from earlier work by Siller (2001) and Moore and Voltmer (2003). It also examined other key professional competencies as gleaned from a number of professional engineering bodies (see ECSA, 2007, 2012; ICE, 2011; IME, 2012). Further, by drawing upon earlier works of Law et al. (1990) and Cox et al. (2012), other questions which followed in question 3 sought to examine key components of students' experiences and expectations based on levels of engagement within the engineering profession and the students' experiences with e-learning. Responses to question 3 were structured against a seven-point Likert scale (Likert, 1932), with response categories of '*1*'- Strongly Disagree; '*2*'- Disagree; '*3*'- Slightly Disagree; '*4*' - Neither disagree nor agree; '*5*'- Slightly Agree; '*6*'- Agree; and '*7'*- Strongly Agree. Altogether the questionnaire comprised 42 measures of student experiences (see Table 2).

Data analysis and results

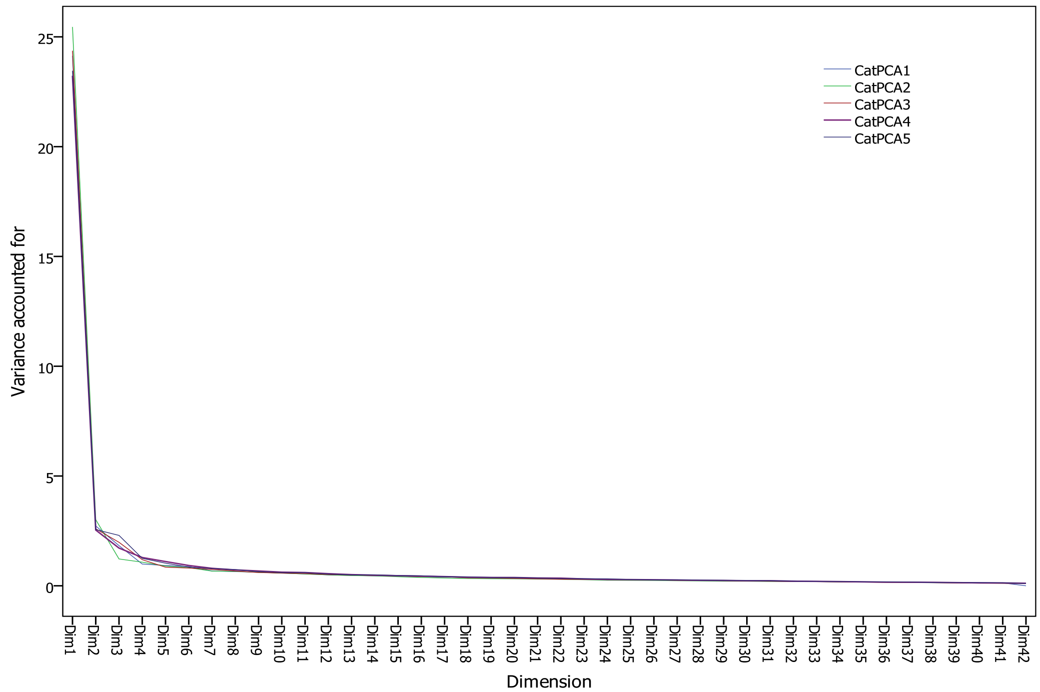
Data was analysed using Multidimensional Scaling (MDS). In common with techniques such as Exploratory Factor Analysis (EFA) and Principal Components Analysis (PCA), MDS seeks to reduce large amounts of data to the smallest possible number of dimensions that capture its variations. The advantage of MDS over these other techniques is that its data need not be strictly

[3] The questionnaire is available on request.

quantitative; variables can be metric or non-metric (Kruskal, 1964; Kruskal & Wish, 1978). MDS is consequently a good choice for this research because measures of students' experiences adapted in this study were strictly speaking of an ordinal nature.

As with other data reduction techniques, researchers must decide how many dimensions to retain in the MDS solution. This requires a trade-off between variance-accounted-for and interpretability. The amount of variance accounted for increases with the number of dimensions retained, but higher dimensions often capture residual variance and are difficult to interpret. One approach (see Chipulu et al., 2013), which we adopted, was to determine dimensionality *a priori,* using a separate model. We took five samples of the data using bootstrapping; each sample was of equal size (*N* = 705) to the original data set. Using each sample in turn, we conducted categorical principal components analysis (CATPCA) of the 42 measures of students' experiences. In each CATPCA model, we extracted 42 components, the maximum possible with 42 variables. We then examined the variance accounted for by each component in each of the five models. Figure 1 (below) shows the equivalent of Cattel's scree plot for the CATPCA models. This is a plot of the variance accounted for per dimension from the CATPCA models.

Figure 1: Variance accounted for per dimensions retained.



From Figure 1, we can see that the solutions from the five models are convergent. In each case the curve turns or has an 'elbow' at four dimensions. We should be able to explain most of the patterns in student experiences in the two countries using four dimensions. Nevertheless, the plots indicate visible improvement in model fit between Dimensions 4 and 6. After Dimension 6, the curves have little or no slope, indicating that very little variance remains unexplained after Dimension 6 and each additional increment provides very little improvement. Therefore, adopting a conservative strategy traditionally used in PCA (see for example, Neophytou & Mar Molinero, 2004), we extracted a six-dimensional MDS solution; but we only attempted to interpret the first four.

We began the MDS modelling by calculating proximities (similarities) among the students based on the 42 students' experiences measures. We used the Euclidean distance metric to calculate proximities. We then used the *Proxscal* algorithm (see, for example, van Eck et al., 2005) to conduct the MDS. The six-dimensional configuration fit the data well: the Normalized Raw Stress was .00316, Stress-I was .05619 and Dispersion Accounted For (D.A.F.) was .99684.

Table 2 shows the descriptive statistics of the coordinate values of the students on the six dimensions in the two countries. We comment further on these means below.

Table 2: Summary statistics of MDS dimension by country.

MDS Dimension	*South Africa*			*United Kingdom*		
	N	*Mean*	*Std Dev*	*N*	*Mean*	*Std Dev*
DIM_1	295	0.6866406	0.3779654	410	-0.4940463	0.2103020
DIM_2	295	0.0339871	0.2568055	410	-0.0244541	0.0899849
DIM_3	295	-0.0130475	0.1706624	410	0.0093878	0.0591446
DIM_4	295	-0.0056161	0.1574993	410	0.0040408	0.0471896
DIM_5	295	-0.0012695	0.0874031	410	0.0009134	0.0880028
DIM_6	295	0.0026931	0.1094893	410	-0.0019377	0.0501007

The next step was to analyse patterns in dimensional coordinates in order to interpret the dimensions. We used *Property fitting* or *Pro-fit*; a method which attempts to fit properties to the MDS dimensions post-optimally. This is achieved typically by correlation or regression analysis (see for example, Schiffman et al., 1981, Mar-Molinero & Mingers, 2006). We calculated the correlation of each MDS dimension with each of the 42 measures of student experiences using Kendall's Tau-b correlation coefficient. We chose Kendall's Tau-b because it is non-parametric and therefore suitable for the students' experiences data which are ordinal. Table 3 shows the correlation coefficients. Similar to how components or factors in principal components analysis might be interpreted by looking at large loadings, we interpreted each dimension by looking at the variables significantly and substantively correlated with it. Key correlations are highlighted in Table 3.

Table 3: Correlations of MDS dimensions with students' experiences measures.

Measure	*Description*	*DIM_1*	*DIM_2*	*DIM_3*	*DIM_4*
critical_1	I have developed my ability to make judgements about alternative perspectives	**.670****	.071**	-.087**	**.135****
critical_2	I have become more willing to consider different points of view	**.688****	.097**	-.085**	**.152****

critical_3	I have been encouraged to use my own initiative	**.654****	.087**	-.077**	**.131****
critical_4	I have been challenged to come up with new ideas	**.668****	.082**	-0.028	.113**
self_manage_1	I feel that I can take responsibility for my own learning	**.691****	.102**	-.092**	.067*
self_manage_2	I have become more confident of my ability to pursue further learning	**.689****	.101**	-.093**	0.025
adapt_more	During my time at university, I have learnt how to be more adaptable	**.702****	.109**	-.079**	.074**
adapt_views	I have become more willing to change my views and accept new ideas	**.687****	.109**	-.089**	0.022
prob_solve_subject	I have improved my ability to use knowledge to solve problems in my field of study.	**.706****	.094**	-.068*	0.043
prob_solve_general	I am able to bring information and different ideas together to solve problems	**.693****	.101**	-0.042	0.044
communi_with_others	I have developed my ability to communicate effectively with others	**.678****	.087**	-.068*	0.012
communi_ideas	In my time at university studying project management I have improved my ability to convey ideas	**.694****	.056*	-0.038	-0.021
Interperson_1	I have learnt to become an effective team or group member	**.704****	.111**	-0.05	-0.039
Interperson_2	I feel confident in dealing with a wide range of people	**.671****	.113**	-0.006	-0.035
Interperson_6	I feel a strong sense of belonging to my class group	**.687****	0.022	-0.01	**-.132****
Interperson_7	I frequently work together with others in my classes	**.653****	.065*	.094**	**-.131****
ICT_confidence	I feel confident in using computer applications when necessary	**.642****	0.004	.053*	-0.05
ICT_info_communi	I have learnt more about using computers for presenting information	**.641****	-0.01	.093**	-.099**
active_mtd_variety	My academic instructor/s use a variety of teaching methods	**.677****	-.118**	-.089**	-0.037
active_participate	Students are given the chance to participate in classes	**.711****	-0.037	-.101**	-0.026
teaching_1	The teaching staff try hard to help us understand the course material	**.681****	-.101**	-.082**	-.118**
teaching_2	The course design helps students understand the course content	**.708****	-.069*	-.124**	-.085**
fback_formative	When I have difficulty with learning materials, I find the explanations provided by the teaching staff useful	**.678****	-.096**	**-.161****	-.118**
fback_summative	There is sufficient feedback on activities and assignments to ensure that we learn from the work we do	**.657****	-.139**	-.130**	-.124**
relation_2	I find teaching staff helpful when asked questions	**.696****	-0.051	-.134**	-0.053
workload_1	I manage to complete the requirements of the programme without feeling unduly stressed	**.643****	-0.025	-.101**	-0.035
workload_2	The amount of work we are expected to do is quite reasonable	**.592****	-.127**	-.077**	-.065*
workload_3	I generally had enough time to understand the things I had to learn	**.540****	-.108**	-0.027	-.054*
cooperative_1	I have frequently discussed ideas from courses with other students out-of-class	**.646****	-.077**	0.047	-.094**
cooperative_2	I have found that discussing course material with other students outside classes has helped me to reach a better understanding of the material	**.587****	-0.035	.074**	-.057*

coherence_1	Information needed to understand the purpose and content of the programme was easily accessible	**.644****	-0.033	-.083**	-.092**
coherence_2	The study guidelines were clear to me	**.652****	-.065*	-.106**	-.085**
coherence_3	Information needed for assignments was integrated in the one place online	**.628****	-.144**	-.119**	-0.051
coherence_4	I can see how courses fitted together to make a coherent programme of study for my major	**.682****	-.096**	-.121**	-0.036
coherence_5	The programme of study for my major was well integrated	**.678****	-.118**	-.107**	-0.046
eresource_1	The online teaching materials in this unit of study are extremely good at explaining things	**.636****	**-.243****	**-.165****	-0.012
eresource_2	The online activities are designed to get the best out of students	**.653****	**-.197****	**-.161****	-0.04
eresource_3	The online teaching materials are designed to really try to make topics interesting to students	**.635****	**-.273****	**-.144****	0.031
eresource_4	The online learning materials helped me to learn during the face-to-face situations in this unit of study	**.650****	**-.255****	**-.144****	0.027
VLE_1	The tutor used the online environment when appropriate to keep students informed about results	**.648****	**-.254****	-.075**	0.02
VLE_2	The tutor used the online environment to regularly update students about relevant unit of study information	**.660****	**-.210****	-.058*	0.043
VLE_3	The tutor ensured continuous access to the relevant online materials throughout the semester.	**.642****	-.183**	-.062*	.065*

** Correlation is significant at the 0.01 level (2-tailed);
* Correlation is significant at the 0.05 level (2-tailed).

THE FINDINGS

Like Principal component analysis, MDS dimensions are extracted hierarchically. The first dimension explains the most variance; successive dimensions capture incrementally less variance. As a result, because it tends to be related to the greatest variety of elements in the data, it is not unusual for the first dimension to be indistinct. For example, in their MDS analysis, Chipulu *et al* (2013) found the first dimension 'generic'. Our results were similar: all measures of student experiences were significantly and positively correlated with Dimension 1. This dimension is therefore generic. It does not represent particular experiences and so we interpreted it as *overall students' experiences* – in other words, as tapping the saliences of overall student experiences.

The measures which are most strongly correlated to Dimension 2 are either indicators of usage of online learning materials (*eresource_1, eresource_2, eresource_3* and *eresource_4*) or how tutors use virtual platforms (*VLE_1* and *VLE_2*). Based on literature (see Garrison & Kanuka, 2004; Osguthorpe & Graham, 2003), this finding suggests that Dimension 2 represents students' experiences of *blended learning*. All the strong correlations are negative: large negative values on Dimension 2 indicate stronger experiences of blended learning experience; large positive values indicate weaker experiences. Similar to Dimension 2, Dimension 3 has significant, negative relationships with indicators of usage of online learning materials (*eresource_1, eresource_2, eresource_3* and *eresource_4*) but it is not as strongly related to how tutors use virtual platforms (*VLE_1* and *VLE_2*). Dimension 3 appears to be more specific than Dimension 2; it is indicative of students' experience of *usage of online learning materials. Similar to* Dimension 2, large negative values on Dimension 3 represent stronger experiences; large positive values represent weaker experiences.

Dimension 4 has significant positive relationships with indicators of development of critical evaluation skills (*critical_1, critical_2* and *critical_3*) and yet is also negatively related to *Interperson_6* and *Interperson_7,* which are indicative of collaborative learning experiences. Dimension 4, thus, appears to indicate *individual critical evaluation skills* experiences.

Finally, we conducted Analysis of Variance (ANOVA) to test whether students' experiences represented by the MDS dimensions differ significantly between students in South Africa and those in the United Kingdom. We conducted four models, one for each dimension, each time entering the students' dimensional coordinate values as dependent and country as a factor. We also entered gender and programme of study (undergraduate or postgraduate) as factors to control for differences due to these factors. The ANOVA results shown in Table 4 suggest significant differences only on Dimensions 1, 2 and 3 and only country as the source of significant variance; there are no significant differences due to gender or programme of study. Based on these ANOVA results and the means in Table 2, we can conclude that, on average, engineering students in South Africa report higher levels of *overall experiences* and *usage of online learning materials* than those in the United Kingdom. In addition, engineering students in South Africa report lower levels of *blended learning* and *individual critical evaluation skills* experiences than those in the United Kingdom although the differences in the latter are not statistically significant.

Table 4: Results of ANOVA of MDS dimensions.

Dependent Variable: DIM_1 (overall students' experiences)

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Country	1	212.1804	212.1804	2485.15	<.0001
Gender	1	5.84E-05	5.84E-05	0	0.9791
Programme	1	0.009158	0.009158	0.11	0.7434

Dependent Variable: DIM_2 (blended learning)

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Country	1	0.539535	0.539535	16.65	<.0001
Gender	1	0.002329	0.002329	0.07	0.7887
Programme	1	0.00029	0.00029	0.01	0.9247

Dependent Variable: DIM_3 (usage of online learning materials)

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Country	1	0.065303	0.065303	4.58	0.0328
Gender	1	0.000313	0.000313	0.02	0.8822
Programme	1	0.003716	0.003716	0.26	0.61

Dependent Variable: DIM_4 (individual critical evaluation skills)

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Country	1	0.022926	0.022926	1.96	0.1617
Gender	1	0.020988	0.020988	1.8	0.1805
Programme	1	0.004252	0.004252	0.36	0.5465

DISCUSSIONS

Although inconclusive, scholarship exploring core teaching and learning challenges and imperatives continues to expand, to now include cross-national comparative studies. Various studies (e.g. Bennett et al., 2007; Byrne et al., 2012) suggest that preferred learning approaches elicit higher overall student satisfaction levels, which can improve academic performance (Bennett, 2003), as well being pathway-dependent and demographically dependent on factors such as age, gender and nationality (see Cassidy, 2012).

Here, it is important to consider that learning has different meanings within different countries and nationalities. Sometimes learning is seen as an adolescent rite of passage, or perhaps elevation to an elite, or maybe simply an inevitable corollary to modern capitalism and its frequent retraining needs (see van Egmond et al., 2013). Specific dimensions of national culture also seem to influence learning. Hofstede (1986) found these to be significant determinants of preferred learning styles. In summary, scholarship on cross-national learning experiences appears inconclusive. For example, Chiu et al. (2007) found individual country characteristics to have an impact not only on students' preferred learning approaches, but also in the relationship between learning approaches and academic achievement. Zhu et al. (2008) and Arevalo et al. (2012) compared Flemish and Chinese, and Brazilian, Chinese and Finnish students' learning experiences, respectively, and found both similarities and differences in learning styles, thereby concluding that learning approaches were probably more dependent on context-specific factors than on national culture differences in general. Byrne et al. (2012) found country differences in student learning styles and expectations. Conversely, Tekinarslan's (2008) and Viberg & Gronlund's (2013) comparisons of Dutch and Turkish, and Chinese and Swedish students, respectively, did not find country differences impacting significantly on learning styles.

So what is the implication of such cultural salience on project management learning? The authors suggest that although project management learning (and teaching) is seen to be independent of the peculiarities of specific disciplines (see Ojiako et al., 2011, 2014), learning should be framed contextually (see Chipulu et al., 2011; Ashleigh et al., 2012; Ojiako et al., 2013). Specific to South Africa and UK comparative studies, an earlier study by Case and Marshall (2004) found preferred learning approaches of engineering students in South Africa and the UK to be adaptable, depending on course context. Visser et al. (2006) conducted a similar UK-South Africa comparison (for accounting students) and found learning preferences similar for both countries.

In terms of this specific study, findings suggested that engineering students in South Africa, compared to those in the UK, reported higher levels of *overall experiences* and *usage of online learning materials,* and lower levels of *blended learning* and *individual critical evaluation skill* experiences. A possible reason for the finding that engineering students in South Africa, compared to those in the UK, reported higher levels of *overall experiences* (which we interpret in terms of overall salience for these experiences) relates to students recognising their professional relevance within the new political dispensation of South Africa. Such recognition is also mandated by the ECSA (2014, Chapter 6; Section 6), which stipulates that candidates seeking to register as a Professional Engineer (PE), must be able to show evidence that "they have acquired an understanding of the professional environment in which they work…". Engineering plays a critical role in socio-economic development (McLean & Walker, 2012), and as a profession, engineering has been identified by the South African government as a "critical skill" to support national development (Government of South Africa, 2012). Davison and Porritt (1999) found that the ability of tutors to articulate the relevance of subjects being taught to the wider profession had a positive impact on student learning experiences.

Taking stock of literature (Wawrzynski et al., 2012) which articulates the relationship between learning experiences and student engagement (see Carini et al., 2006; Rodriguez-Largacha et al., 2014), this study upholds the relationship by suggesting that perceived strategic importance of the engineering profession to South African students seems to have a positive and encouraging impact upon overall learning experiences.

The finding that engineering students in South Africa reported higher levels of *usage of online (virtual) learning materials* (in comparison to those in the UK) admits multiple explanations. One reason may be the emergence of what Prensky (2001a, b) describes as the digital native. In the context of this study, this expression can refer to an emergent group of project management learners, born into an age where technology is not only a crucial constituent of their learning fabric, but is also taken as a given (Ojiako et al., 2011). Another more specific reason is suggested by studies (see Friedman & Deek, 2003; Barham et al., 2014), which discuss 'appeals to novelty', suggesting that in developing countries such as South Africa (as against more developed countries such as the UK), the novelty associated with 'new' technology used in teaching and learning (in this case online/virtual learning materials) may lead to such technology increasingly being adopted and used. Thus while there also appears to be a relationship between access and *online learning materials* usage for learning (Oliver & McLoughlin, 1999; Friedman & Deek, 2003), in South Africa, Brown and Czerniewicz (2007, 2010) and Chuma (2014) consider such relationships are dependent on a number of factors which include, for example, availability of appropriate technology infrastructure (Wilson, 2008) and the socio-economic background of the student and the group to which the student belongs. There are also students with low access to online learning materials who nevertheless still exercise their agency in constraining conditions, and make frequent use of ICTs for learning, particularly in the business and engineering disciplines. In their 2007 study, Brown and Czerniewicz found that in South Africa, there was a higher use of *online learning materials* by engineering students compared to the case with students from the science and humanities. This contrasted to a later UK-based comparative study of engineering and management students which found that management students allocated more criticality to *online learning materials* usage (compared to engineering students).

LIMITATIONS

As expected, our study was not without some limitations. Five main limitations are highlighted. Firstly, it is acknowledged that a richer dataset may well have arisen if comparative survey data had been derived from more than two countries. Secondly, the study did not explore how best to address possible curriculum changes in light of the findings. Thirdly, there was inequality in both the number of respondents in the study (295 in South Africa vs 409 in the UK) and the number of universities sampled (two in South Africa vs four in the UK). Fourthly, although the literature on blended learning articulates that (i) it includes online (e-), learning (Garrison & Kanuka, 2004; Lopez-Perez et al., 2011; Ashleigh et al., 2012), and (ii) what constitutes blended learning in South Africa is in line with the mainstream literature (De Beer & Mason, 2009), a distinction was made in the study between the terms 'blended learning' and 'online learning'. This decision was particularly driven by literature (see Jaffer et al., 2007) who points out that in developing countries (such as South Africa), there has always been a tendency to conceptualise blended learning based on the possibilities provided by technology as against pedagogical needs. Thus making a distinction between the two terms served as an opportunity for the study to draw out student responses to their own learning experiences (a key component of blended learning).

Finally, the comparison on project management learning experience relates more to implied rather than explicit project management skills gleaned from professional engineering bodies. This could have been improved by employing a more rigorous model comprising specific project management skillsets that might have enabled us to explore the deficit of critical skill within South Africa which our study merely outlined. Similarly, it would have been useful to recognise, and to employ some model to quantify, different pedagogical philosophies within the countries of interest, in order to explore how these influence how students rate - and rate themselves on - a broad range of specific project management skills.

CONCLUSIONS

This study explored how engineering students in South Africa studying project management perceive their learning experiences and expectations. Consistent with earlier studies (Chipulu et al., 2011; Ojiako et al., 2011, 2013, 2014; Ashleigh et al., 2012), we place this study within the nexus of calls for re-thinking project management (see Winter et al., 2006a, b; Berggren & Söderlund, 2008; Svejvig & Andersen, 2014) and engineering education (see Miller, 2010), which we regard as vitally important within the context of studying the ongoing transformation of both engineer and project manager roles (see Miller, 2010). Thus, in the case of engineers, we see a role transformation from 'technician' to manager responsible for articulating and managing the integration between various engineering components. In such a role, engineers are expected to fully grasp the complexity and fluidity associated with the range of interconnected social, technical, political and economic factors that commonly matter within work packages and projects. The pedagogic corollary to this shift in professional competence is of course one that must place increasing emphasis on holistic knowledge and understanding.

In light of South Africa's history, the findings of this study, in particular the fact that engineering students in South Africa reported low levels of *blended learning* and *individual critical evaluation skills* experiences in comparison to those reported by the UK students, serve to underscore the need for Project Management teaching and learning in South Africa to focus more on holism and its benefits.

These findings are, however, quite unsurprising. Curriculum reforms which followed the country's first national democratic elections in 1994 were sensitive to the challenges facing higher education, following the country's previous history of institutionalised exclusion based on race. These reforms for example sought to breakdown a teaching and learning philosophy which positioned tutors and lecturers as sole sources of directional guidance. Arguably such a teaching philosophy had not only impeded the ability of students' to participate in their own learning experiences, but also limited their ability to develop core engineering *critical evaluation skills* (Siller, 2001; Daly et al., 2014). It is also likely that such a teaching and learning philosophy may specify project management pedagogical outcomes too narrowly and without sufficient regard for how the learning context itself may shape learners as future professionals.

Introducing engineering students to the complexities associated with projects depends in part on providing rich learning experiences (Ojiako et al., 2013) which is hard to achieve when educational delivery takes place through narrowly compartmentalised study modules matched rigidly to learning outcomes. Thus, this study supports recent assertions by McLean and Walker (2012) that South Africa will continue struggling to produce sufficient engineers who are both technically and socio-technically proficient. The latter refers to what can loosely be called the social aspect in complex problem-solving expected in engineering challenges. To be socio-technically proficient is to appreciate that managerial actions and judgements are often political in the sense that they combine elements of adversarial and co-operative co-working; correspondingly, socio-technical proficiency must negotiate issues of power, as well as frailties of perception and social construction that impede co-ordination and collaboration. Thinking from this standpoint, professionals do not just need to be taught how to use tools and processes. They also need to take great care to negotiate broader social issues of trust, cultural sensitivity, transparency, blame, ownership and accountability each time they deal with what *prima facie* appears as a narrow technical process or problem requiring attention. There is no reason why current teaching philosophy in the country cannot specify socio-technical aspects of professional competence as required learning outcomes; yet the reality is that these usually do not extend beyond checklists of technical competencies that are relatively easy to assess by traditional forms of assessment.

Critical skillsets can of course be emphasised to improve teaching and learning within South African engineering and project management education; however we need to take great care when interpreting data such as ours suggesting a deficit of them in South Africa relative to the UK. The present study relied on self-report data revealing the perceived importance of critical skills to students. Although this may serve as a proxy indicator for critical skill itself, we need to bear in mind that how students perceive the desirability of critical thought is likely to vary considerably with national and other cultural contexts because such perceptions have profound implications for how individuals interact and orient themselves towards rules and other social regulators of behaviour. For this reason, further studies may usefully focus on understanding systematic heterogeneity in factors that impact upon learning experiences across different countries. Such studies will provide much deeper insights into the relationship between, for example, national culture and student learning experiences. There are however challenges with proposals for such studies. For one, the main theoretical propositions behind such studies (see Hofstede, 1986), assume single *in*-house cultural instances, in effect, they assume the existence of single national cultures which of course in countries such as South Africa and to a large extent, the United Kingdom, do not necessarily reflect the multicultural complexity that often exists.

More research is also required to ascertain what students perceive critical skills to consist of, and perhaps more importantly, to ascertain within what pedagogical and project management contexts displays of these skills are perceived to be both helpful and socially acceptable.

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