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Sheila N. Matoti

To cite this article: Sheila N. Matoti (2014) Approaches to learning by pre-service science students of an institution of higher learning: an exploratory study, *Journal of Psychology in Africa*, 24:4, 385-387, DOI: [10.1080/14330237.2014.980627](https://doi.org/10.1080/14330237.2014.980627)

To link to this article: <https://doi.org/10.1080/14330237.2014.980627>



Published online: 25 Nov 2014.



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BRIEF REPORT

Approaches to learning by pre-service science students of an institution of higher learning: an exploratory study

Sheila N. Matoti

Department of Educational and Professional Studies, Central University of Technology, Free State, South Africa
Email: smatoti@cut.ac.za

This case study explored pre-service science students' approaches to studying and learning. The participants were 65 undergraduate students (females = 47%; age range 18 to 25 years) at a university of technology in South Africa. Students' preferences for deep or surface learning were evaluated using the Revised Two-Factor Study Process Questionnaire (Biggs, Kember & Leung, 2001). Data were analysed to contrast learning motive and strategy by year of university placement. The difference in the use of deep as compared to surface motives was higher among students with senior level placement (third years) than their peers with junior placement (second years). Deep motives may be more serviceable with the more rigorous learning expected with senior level education placement.

Keywords: pre-service students, learning, deep, surface, South Africa

Deep learning approaches yield better learning outcomes with complex learning tasks (Biggs, 2003; Marton & Säljö, 1976; 1984). In the deep approach, there is a personal commitment to learning, which means that the student relates the content to personally meaningful contexts or to existing prior knowledge. Deep processing involves processes of a higher cognitive level than rote learning; searching for analogies, relating to previous knowledge, and theorising about what is learned (Snelgrove & Slater, 2003). Thus, a deep learning approach is, in general, associated with higher quality learning outcomes and a surface approach with lower quality learning outcomes (Snelgrove & Slater, 2003; Zeegers, 2001). Students using the surface approach to learning do not see the interconnections between the meanings and implications of what is learned (Snelgrove & Slater, 2003). With use of the surface approach, students' intentions emphasise memorising and reproducing the factual contents of the study materials.

In choosing their learning approach and motive, students are concerned with both the academic content and the requirements of the assessment system and they use whatever strategy to maximise their chances of academic success (Watkins, 2000). In some instances students do not employ purely deep or surface learning, but a combination of the two depending on the situation. Such "individual combinations of approaches or orientations may be called orchestrations" (Lindblom-Ylänne & Lonka, 2001). These contextualised patterns of engagement in learning are sensitive to students' perceptions of their learning context as well as to their learning conceptions, and can display 'conceptual consonance' or 'conceptual dissonance' (Meyer, 2000). Large-scale research undertaken by Watkins (2001), which involved 55 independent samples making up 27 078 respondents from 15 countries, found average correlations of 0.11 and 0.16 for surface and deep approaches, respectively. However, Watkins recognised that "these relationships assume that higher quality learning

outcomes are rewarded by the assessment system" (2001, p. 174). The correlations are low, suggesting other factors to explain the observed results.

Learning approach and motive also depends on the interplay of many factors such as the curriculum, teaching and assessment methods. Hence, Biggs (2003, p. 6) cautions that effective teaching requires more than "applying general principles of teaching according to rule; those principles need adapting to your own personal strengths and to your teaching context". In the context of higher education, students may select desirable approaches to match new institutional demands such as the overloaded curriculum, work pressures, and assessment procedures (Kember, 2000).

This exploratory study investigated motives and approaches to learning by science students at a university of technology. The science curriculum presents with increasing complexity as students progress through the years of study. This means students should experience greater learning challenges and hence a need for deep motive and learning at the more senior years of placement. This prediction has not been put to the test in the context of science education at a South African university of technology. The study sought to answer the following research question: how are study motives and approaches by pre-service university science students influenced by seniority of placement in the academic program?

Method

Participants

Participants were a convenience sample of 65 science students at a university of technology in South Africa (see Table 1 for demographics). The ages of the participants ranged from 18 to 24 years.

Table 1. Sample profile of respondents ($N = 65$)

	Male $n = 34$	Female $n = 31$	Total
Second year	19 (29.2%)	15 (23.1%)	34 (52.3%)
Third year	15 (23.1%)	16 (24.6%)	31 (47.7%)
Total	34 (52.3%)	31 (47.7%)	65 (100%)

Instruments

Students completed the Revised Two Factor Study Process Questionnaire (R-SPQ-2F) (Biggs, Kember, & Leung, 2001). The R-SPQ-2F consists of 20 items which are scored on a 5 point Likert scale ranging from 1 = rarely true of me to 5 = always true of me, and categorises students into two different types of approaches to learning, namely surface learning and deep learning approaches, each containing two subscales, namely motive and strategy. Biggs et al. (2001) reported Cronbach alpha values of 0.73 for the deep approach scale and 0.64 for the surface approach scale which are considered as acceptable (Biggs et al., 2001).

Procedure

The students individually consented to participate in the study. They were assured of the anonymity of their responses. Data were collected by an assistant researcher during normal class time.

Data analysis

Data were analysed using t-test comparisons of differences in motive and strategy use both between and within years of placement. Microsoft Excel was used to generate descriptive statistics, while GraphPad QuickCalcs was used to generate inferential statistics.

Results

Considering the motive scales, second year students reported higher use of deep to surface motives with the mean scores of 3.65 and 1.97, respectively. Similarly, third year students reported greater use of deep to surface motive for learning with mean scores of 3.66 and 2.31 respectively (See Table 2).

A t-test showed a statistically significant difference between the deep and surface motives for the second years at 95% confidence interval, $p = 0.0001$, $t = 6.5347$ and $df = 66$. Similarly a statistically significant difference was found between the deep and surface motive for the third years at 95% confidence interval, $p < 0.0001$, $t = 4.3120$ and $df = 60$.

There was no statistically significant difference in the learning strategies the students used contrasting by year of

placement at 95% confidence interval; $t = 1.6959$, $df = 60$ and $p = 0.0951$.

Discussion

Higher placed (third year students) self-reported use of deep motive to learning compared to lower placed (second year students). Third year students may be predisposed to deep approaches than second year students from having adjusted to the demands of the tertiary environment. Kember (2000) states that students probably tend to use surface approaches in tertiary studies as they are adapting to the new institutional demands such as the overloaded curriculum, work pressures, and assessment procedures. This could be the case with the second year students. Nonetheless, the students did not differ by year of placement in the learning strategies they used.

In both cases (second-year and third-year students), the surface strategies are higher than surface motives. This may reflect the demands of science curricula for deep processing for success in the course program placement. Natural Sciences curricula might wean students from being surface learners to being deep learners. In addition, it can be deduced that the students are now used to the teaching styles of lecturers and in the process have developed their own learning styles.

Science students in this study utilise deep motives and approaches to learning more than surface approaches. Higher education placement differentiated the students in their motive for learning only. This suggests that as the academic years of study progress, students get more engaged with their learning and seek real mastery of the learning goals. They are clearly more invested in their learning outcomes.

Recommendations

The transition from high school to tertiary education has been found to be problematic as the students are adjusting to the demands of the curriculum, teaching strategies, as well as assessment strategies at tertiary level. It is for this reason that lecturers at tertiary institutions should support students by assisting them to shift from being surface learners towards being deep approach learners. To be able to do this, lecturers should assess students' approaches to studying and learning and teach them accordingly. Students should be introduced gradually to activities that will force them to see the interconnections between topics that make up the curriculum and to apply what they have learned to new situations.

Table 2. Deep Motive versus Surface Motive for the two groups

Motive subscale	Second years $N = 34$		Third years $N = 31$		Between group mean difference
	Mean	SD	Mean	SD	
Deep Motive	3.65	1.06	3.66	1.15	0.01
Surface Motive	1.97	1.06	2.31	1.31	0.24
Within group mean difference	1.68		1.35		0.33
Strategy subscale	Mean	SD	Mean	SD	
Deep strategy	3.39	1.10	3.61	1.04	0.22
Surface strategy	3.02	1.18	3.11	1.27	0.09
Within group mean difference	0.37		0.5		0.32

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