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Does the format of assessment questions affect the performance of students with different learning styles?

INTRODUCTION

Investigations into the performance of higher education in recent years have highlighted grave areas for concern especially in relation to student success and throughput rates (CHE report, 2013). The CHE Report (2013) further emphasizes that higher education institutions can no longer justify their failures by blaming the schooling system but rather need to make concerted efforts to create a teaching and learning environment that would promote maximum student success.

Most of the research investigating the link between student learning styles and teaching styles, have resorted to assessing student performance using the traditional methods of assessment. Osborn & Plunkett (2003) have observed that while innovative teaching methods appear to be positively correlated with students' performance, such results become questionable when traditional summative assessments are employed. Ndebele and Maphosa (2013) believe that assessment practices in higher education need to be improved so that they take cognizance of student needs.

While a positive relationship between student performance and student learning styles was reported by Baykan and Naçar (2007), Dobson (2010), Urval *et al.*, (2014), Wilkinson *et al.*, (2014), and Almigbal (2015), reported no significant link between student academic performance and their preferred learning styles. Nuzhat *et al.* (2013) and Peyman *et al.* (2014) reported a positive relationship between student performance and multimodal learning styles. However these studies compared the students' learning styles to their final course mark with no change to the assessment methods used. Martinez and Tuesca (2018) found no significant link between

student learning styles and their performance in two types of assessment (electronic multiple choice questions and laboratory-based practical test) in an anatomy course. Only Wang *et al.* (2006) and Hsieh *et al.*, (2012) focused on the assessment format and how it impacted on students with different learning styles. Hsieh *et al.* (2012) found no significant difference between the performance of students with different learning styles. Wang *et al.* (2006) reported a positive link between student learning styles and their performance in a web-based course.

It appears that while many academics have taken cognizance of students learning styles and introduced innovative teaching practices, their modes of assessment have remained the traditional written examination (Osborn and Plunkett, 2003). However, if assessment is seen primarily as a means of determining students' true understanding, then academics need to employ assessment tools that offer students a chance to demonstrate their learning in their preferred learning style (Osborn and Plunkett, 2003; Hsieh et al., 2012).

Questioning is considered an important means by which academics can stimulate involvement in the teaching and learning process, and to gauge student understanding of the course content (Maphosa and Wadesango, 2016). It is therefore necessary to examine the effectiveness of the use of questions in enhancing learning and demonstrating student understanding. Hence it raises the question: would student performance improve if they were given the opportunity to answer questions in their preferred sensory modality?

This study aims to determine the learning styles of a group of first year Anatomy students and to investigate the impact on student performance when the assessment task is matched with their learning styles.

METHODS

Seventy two first year anatomy students completed a hardcopy of the VARK questionnaire. Students were also asked to describe their self-perceived learning style(s) by selecting whether they liked to learn from: 1) diagrams, graphs, demonstrations and flow diagrams – this implies

visually; 2) lectures, discussions and debates – this implies aurally; 3) reading and writing notes – this implies read/write; and 4) dissection, performing activities, carrying out experiments – implies kinaesthetically. Demographic data eg. age, gender, language of instruction, home language, type of school attended, and previous qualifications, were also collected. The students' names were replaced by a study number. The VARK questionnaires were inputted onto the VARK site and the results were recorded on an Excel spreadsheet, together with the results of the students' self- perceived learning style and students' demographic data.

To investigate student performance when the assessment task is matched with their learning styles, two separate sections of the body were selected to be assessed via the four VARK modalities. The assessments were conducted over a six month period.

The sections to be assessed were 1) blood supply of the heart and, 2) blood supply of the stomach. The students had to describe the blood supply of each organ via i) a paragraph (R), ii) a diagram (V), iii) a flow diagram (V), and iv) labelling of a model (K). Student performance was then evaluated in terms of their learning styles and compared across each modality.

RESULTS

Seventy of the total sample of 71 students (98.6%) reported their learning styles that were assessed via the VARK questionnaires. Approximately a third (36%) (n = 10) of the students reported a unimodal learning style while 64% reported a multimodal learning style ($p < 0.001$). This pattern was consistent with the assessed learning styles where the unimodal and multimodal learning styles were recorded as 35% and 65% respectively (Fig.1 - Results - Tables and Graphs.docx). Figure 1 illustrates the distribution and comparison between the self-reported and assessed learning styles. Cross tabulation of self-reported and assessed learning styles indicated no significant relationship ($p = 0.122$) between the students' self-reported learning styles and their learning styles as assessed by the VARK questionnaire.

ANOVA tests indicated no significant difference in the student test scores in the individual assessments between the VARK profiles (self-reported and assessed). However, t-tests indicated

a significant difference ($p < 0.05$) in student scores between the individual tests. Differences in student scores were recorded for the following assessments: i) the paragraph (R) and flow diagram (V), ii) paragraph (R) and diagram (V), iii) flow diagram (V) and diagram (V), iv) diagram (V) and model (K) of the heart and for all assessments of the stomach except for diagram (V) and model (K) (Table 1 - Results - Tables and Graphs.docx). Further analysis of the mean scores obtained in each test (Table 2), revealed a (significant) disparity in student test scores in the following pairs; 2, 4, 6, 8, 9, 10 and 11 (Table 2 - Results - Tables and Graphs.docx).

DISCUSSION

The majority of the students in this study recorded a multimodal learning style in the self-reported and assessed categories (64% and 65% respectively). Similar results have been reported by Horton, Wiederman and Saint (2012) , Nuzhat *et al.* (2013), Urval *et al.* (2014), Almigbal (2015), Meyer *et al.* (2016), Aldasori *et al.* (2018), and Husmann and O'Loughlin (2019). However, the results of this study contradict the findings of O'Mahony *et al.* (2016), who reported a higher incidence of unimodal learning styles than multimodal learning styles. The results of this study revealed no significant relationship ($p = 0.122$) between the students' self-reported learning styles and their learning styles as assessed by the VARK questionnaire. This is consistent with the study by Hsieh *et al.* (2012).

This study explored the association between student test scores in assessments that were based on the VARK learning styles. While no significant differences were noted in the student test scores in the individual assessments between the VARK profiles (self-reported and assessed), a significant difference in student performance ($p < 0.05$) was recorded between individual tests. Overall student performance was particularly poor when asked to provide answers in the diagrammatic format i.e. by means of a diagram, describe the blood supply of the heart. The results of this study however cannot be compared to Hsieh et al. (2012) as the latter study required students to choose options in multiple choice questions with words and diagrams,

whereas this study required students to produce the answers in different formats, viz. paragraph, diagram, flow diagram and labelling of models. Further investigation is warranted to investigate student performance in different formats of questioning.

Study limitations

The results reported are limited to this sample and to the participating institution and does not represent the entire student population. This study had several limitations, including a small sample size and the loss of data on the aural tests. Future studies are recommended with larger sample sizes and in different subjects at different levels.

CONCLUSION

In summary, this study revealed a discrepancy in student performance when students were tested with different question formats. Awareness of this discrepancy highlights the need for academics to interrogate their tests and examinations for question formats that may potentially disadvantage groups of students and to reconsider whether the format that is being utilized is essential for the display of mastery in the subject content under consideration. For example instead of using words like; by means of a paragraph/ short notes, by means of a diagram, or by means of a flow diagram describe the blood supply of the heart; rather asked the student to describe the blood supply of the heart and leave them to decide how they construct the answer.

REFERENCES - REFERENCES.docx