

Learning styles

by Benita Olivier

FILE	261_BENITA_OLIVIER_LEARNING_STYLES_300_2112563070.DOCX (209.21K)		
TIME SUBMITTED	24-MAR-2020 06:24AM (UTC+0200)	WORD COUNT	6804
SUBMISSION ID	1280928831	CHARACTER COUNT	39485

Learning styles in physiotherapy and occupational therapy students: an exploratory study

Abstract

Background: Learning styles of health care professionals are unique and tend to be profession specific. The aims of the study were to compare the learning styles of undergraduate occupational therapy and physiotherapy students and to determine the relationship between preferred learning styles, demographic factors and academic performance.

Method: The study design was a cross-sectional, descriptive study. Undergraduate students, at the occupational therapy and physiotherapy departments, University (*information removed to allow for anonymous peer-review*) were invited to complete a self-developed questionnaire as well as the Grasha-Reichmann Learning Style Inventory. The independent t-test, Mann Whitney U and a linear regression was conducted.

Results: A total of 313 students with a mean age of 19.6±1.58 years participated in this study. The results showed that students preferred the collaborative (75%) learning style, with the first-year students scoring significantly higher in the collaborative style (3.97±0.48; $p < 0.001$, Partial Eta Squared=0.053). The male students (2.67±0.65) scored higher in the competitive learning style than female students (2.20±0.62; $p = 0.001$, $d = 0.757$). The competitive learning style when adjusted for sociodemographic variables, is a significant predictor of an increase in academic performance in English language (B=2.28, 95%CI=0.60-3.96), physics (B=3.62, 95%CI=0.22-7.02) and overall academic performance (B=2.12, 95%CI=0.34-3.90).

Conclusion: The application in the teaching space should be carefully considered for the selection of teaching approaches and activities. The predominant preferred learning style as shown by the result is the collaborative and participant styles and this would be of interest to both the students and academics involved in the physiotherapy and occupational therapy programmes.

Keywords: Grasha-Reichmann Learning Style Inventory, learning styles, occupational therapy, physiotherapy, undergraduate students

Introduction

The South African higher education landscape is heavily burdened with the pressures of massification while striving to compete in the global knowledge economy ¹. In the past two decades the enrolment rate in the occupational therapy and physiotherapy degrees at (*our institution*) have increased drastically, resulting in much higher lecturer: student ratios. In the strive to maintain the standard of education and continue to produce highly skilled occupational therapy and physiotherapy graduates, this study seeks to increase our understanding of how our student body prefers to learn.

Since the 1950's many theories related to learning style and learning preferences have emerged, yielding over 70 different scales attempting to measure the identified constructs ²⁻⁴. Rice et al. ⁴ suggest that there are three primary categories of learning style measures: consitutional, ability and instructional preference measures. Critics of the value of learning style theories have sought to debunk the notions of a relationship between learning style, actual learning behaviours and academic performance ^{5, 6}, but focus largely on the consitutional and ability measures which tend to categorise a learner as a single type that remains stable, such as being a kinaesthetic learner. Rice et al. ⁴ suggest that the instructional preference measures contextualise learning behaviour and approaches to study, offering the position that learning preference is flexible, with the best learners having the ability to adapt their learning preference and behaviour with changing contexts and demands. The Grasha-Riechmann Student Learning Style Survey (GRSLSS) is an instructional preference scale.

The learning styles of students in health professions have been studied using the GRSLSS internationally ⁷⁻¹⁰ and locally, focused on the relationship of physiotherapy students learning style preferences and their performance in gross anatomy ³. The Grasha-Reichmann Learning Style Scales Inventory identifies six learning style preferences, and it is believed students make use of a combination of these learning styles to a greater or lesser extent ¹¹. This system of classification prevents learning style stereotyping and provides an incentive for growth in under-used learning style areas. The six learning styles are described as Independent, Avoidant, Collaborative, Dependent, Competitive and Participant (Table I).

<Table I approximately here>

1
Table I: Grasha-Reichmann Learning Style Inventory ¹¹

Learning style	Description
Independent	Students prefer to work alone and require a little direction from the teacher
Avoidant	Students tend to be at the lower end of the grade distribution. They tend to have high absenteeism, they organise their work poorly and take little responsibility for their learning
Collaborative	Students enjoy working harmoniously with their peers.
Dependent	Students typically become frustrated when facing new challenges not directly addressed in the classroom
Competitive	Students are described as suspicious of their peers leading to competition for rewards and recognition
Participant	Students are characterised as willing to accept responsibility for self-learning and relate well to their peers

Learning styles are unique for health care disciplines and tend to be profession-specific ^{12, 13}. Medical students generally favour competitive, collaborative or participative learning styles ^{14, 15} while students studying pharmacy are more inclined to the converger learning style (similar to the independent learning style of the GRSLS) ^{7, 12}. Studies comparing learning style preferences amongst physiotherapy and occupational therapy students are scarce ^{16, 17}, although various individual studies have been conducted on the respective disciplines' learning styles ^{3, 18, 19}. Furthermore, the majority of studies focusing on learners in these fields have made use of other learning style inventories, particularly ³⁴ Kolb's Learning Style Inventory (LSI) ¹⁶⁻¹⁸. ³⁴ In a review of different learning-styles instruments, Ferrell ²⁰ found that while small overlap does exist between constructs, "the instruments were clearly not measuring the same thing" (p. 1). Thus, different models of learning styles may provide novel insights.

In a Turkish study, the dominant learning style for physiotherapy students ¹⁹ was the 'collaborative' learning style ⁷. Additionally, it was found that the academic performance of the sample was negatively correlated with 'avoidant' learning styles and positively correlated with 'participant' learning styles ⁷. Most of the learning style studies in physiotherapy and occupational therapy disciplines used Kolb's model ²⁰. In an Australian study, the dominant learning style for physiotherapy students was identified as the assimilator while the two dominant learning styles for occupational therapy students were identified as converger and diverger learning styles ¹⁶. Other studies reported the majority of physiotherapy students as reflective observers ^{21, 22}.

Students entering higher education in South Africa hail from highly diverse schooling contexts, with stark disparity in access to resources, quality education, cultural experiences and rural to

urban divide. ⁴⁴ It is therefore important to consider the potential impact of demographic factors on these students learning strategies. Factors influencing learning styles may include gender ²³, year of study ²⁴, culture ²⁵ and academic performance ⁷.

It has been reported that up to 30% of students prefer multiple learning styles when measured using a constitutional measure such as the VARK (Visual, Aural, Read/write, Kinaesthetic) scale; however, the majority of the medical students preferred a single learning style ¹⁵. A student preferring a single learning style may need an appropriate teaching style aligning with their preferred learning style, in turn, maximising efficiency. ¹⁷ It is important to expose the single style learner to a variety of learning styles to produce a more balanced learner ²⁶. Exposing students to various learning styles may optimise the student's learning experience and throughput. Awareness of the preferred learning styles among occupational therapy and physiotherapy students, as well as the factors associated with the preferred learning style, are therefore crucial. ¹ The primary aim of this study was to establish and compare the learning styles of undergraduate occupational therapy and physiotherapy students and to determine the relationship between demographic factors and students' learning styles. A secondary aim was to establish the relationship between learning styles and academic performance. ¹² ⁵

Methods

³³ Study design

The study design was a cross-sectional, descriptive study. Quantitative analysis was used to analyse the demographic information and GRSLSS. ²⁸ The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines were adhered to ²⁷.

Study setting and participants

Total population sampling was used for the 2017 undergraduate students, specifically first, second- and third-year students at the Occupational Therapy and Physiotherapy Department, University... (*Information removed to allow for anonymous peer-review*). No exclusion criteria were set and all first to third-year students within the respective departments were invited to participate. ¹⁴ Ethical clearance was obtained from the Human Research Ethics Committee of the associated tertiary institution in the spirit of the Helsinki Declaration (M140540). ¹⁰

Assessment tools

A self-developed questionnaire was administered which consisted of questions about age, gender, career field of interest, year of study, physical activity participation and previous year's marks in the main subjects as well as an open-ended question related to teaching philosophy. Content validity was established by a panel of experts consisting of four occupational therapists and four physiotherapists. Panel members had between 10 and 40 years of professional experience. The outcome of the open-ended question of the study will be presented in another publication.

Learning style was evaluated by using the GRSLSS, which is a 60-item standardised, self-administered questionnaire that determines an individual's preferred learning style. Six learning styles are described: independent, avoidant, collaborative, dependent, competitive and participant²⁸. Cronbach alpha coefficient for internal consistency was found 0.89 for the GRSLSS²⁹. The learning styles were calculated according to the guidelines by Grasha²⁸ and the sum of the scores for each of the learning styles was divided by 10. The learning styles were further categorised into low, moderate and high (Table II).

<Table II approximately here>

Table II: Categorisation of the Grasha-Reichmann Learning Style Scales Inventory subscales ¹¹

³ Learning Style	Independent	Avoidant	Collaborative	Dependent	Competitive	Participant
Low	1.0 - 2.7	1.0 – 1.8	1.0 - 2.7	1.0 - 2.9	1.0 - 1.7	1.0 - 3.0
Moderate	2.8 - 3.8	1.9 - 3.1	2.8 – 3.4	3.0 - 4.0	1.8 - 2.8	3.1 - 4.1
High	3.9 - 5.0	3.2 - 5.0	3.5 - 5.0	4.1 - 5.0	2.9 - 5.0	4.2 - 5.0

Procedure

Data were gathered by the use of a self-administered questionnaire as described under assessment tools. A pilot study was performed and included 26 participants from the Department of Nursing Education. Following the pilot study, no changes were made to the questionnaire. Instructions were adapted to include more detail. The time taken to complete the two questionnaires was twenty minutes; hence, this was the amount of time asked for when appointments with the sample groups were made.

For the main study, researchers made appointments with the sample groups via the student class representatives of the first, second and third year of study. Verbal, as well as written information about the study was provided to both groups. Participation was voluntary, and completion of the questionnaires implied consent. Students could return the completed questionnaires to the class representatives or the departmental secretaries. Researchers collected the completed questionnaires from the student class representative and the departmental secretaries.

Data analysis

Quantitative data were analysed using IBM SPSS (v25) and JASP (v0.9.2) software programmes. Frequencies and descriptive statistics were produced for all variables. The Fisher 2-tail exact test was used to compare the following demographic information: Field of study, year of study, gender and ethnicity. Comparisons of the preferred learning styles identified amongst (1) occupational therapy and physiotherapy students, and (2) the gender of the participants, were made using the independent t-test, except where Levene's test was significant ($p < 0.05$), suggesting a violation of the equal variance assumption, wherein such cases Mann Whitney U test was used. For the independent t-test, the effect size is given by Cohen's d while for the Mann-Whitney test, the effect size is given by the rank bi-serial correlation. Cohen's d can generally be interpreted as 0.2 is

'small' effect size, 0.5 is a 'medium' effect size, and everything over 0.8 is 'large' (Cohen, 1988 as cited by Pautz et al., 2018).

The rank bi-serial correlation (r) can be interpreted as 0.1 is small, 0.3 is medium, and 0.5 is large Cohen, 1988: cited in ³⁰. MANOVA tests were run comparing differences in learning styles based on (1) ethnicity, (2) home province, and (3) year of study. Partial eta-squared statistics were used as measures of effect size: here an effect size of 0.01 is small, 0.06 is medium and 0.14 is Cohen, 1988: cited in ³⁰. Where significant differences were found, Bonferonni posthoc tests were run to investigate these differences further. Linear regression models (enter method) were used to determine if learning styles predicted academic performance (Matric English, First Year Physics, Second Year Anatomy, and the average of these scores) while controlling for age, department and gender. All tests were performed using an alpha of 0.05. $P < 0.05$ was considered statistically significant. Missing data points were excluded on a list-wise basis.

Results

Study participants

A total of 313 students with a mean age of 19.6 ± 1.58 years participated in the study (Table III). The group consisted of 48.6% (n=152) occupational therapy students and 51.4% (n=161) physiotherapy students. The majority of students were female (n=267; 85.3%), and 82.5% (n=259) of the students participated in at least one sport (Table III).

<Table III approximately here>

Table III: Demographics of Occupational Therapy and Physiotherapy Students (n=313)

Item	Occupational Therapy (n=152)	Physiotherapy (n=161)	Total (N=313)
Age, Mean (SD)	19.54 (1.51)	19.6 (1.65)	19.6 (1.58)
Year of study, n (%)			
First	54 (35.5)	63 (39.1)	117 (37.4)
Second	48 (31.6)	55 (34.2)	103 (32.9)
Third	50 (32.9)	43 (26.7)	93 (29.7)
Gender, n (%)			
Male	2 (1.3)	44 (27.3)	46 (14.7)
Female	150 (98.7)	117 (72.7)	267 (85.3)
Ethnicity, n (%)			
African	29 (19.1)	50 (31.1)	79 (25.2)
White	94 (61.8)	77 (47.8)	171 (54.6)
Indian	15 (9.9)	26 (16.1)	41 (13.1)
Coloured	4 (2.6)	7 (4.3)	11 (3.5)
Other	10 (6.6)	1 (0.6)	11 (3.5)
Home Province, n (%)			
Gauteng	134 (88.2)	127 (78.9)	261 (84.5)
KwaZulu-Natal	6 (3.9)	13 (8.1)	19 (6.1)
Limpopo	3 (2.0)	10 (6.2)	13 (4.2)
Other ^x	7 (4.6)	9 (5.9)	16 (5.3)
Play a sport, n (%)			
Yes	123 (80.9)	136 (84.5)	259 (82.5)
No	29 (19.1)	25 (15.5)	54 (17.5)

^x = Mpumalanga (n=3), North West (n=2), Eastern Cape (n=2), Free State (n=2), Western Cape (n=2), Unspecified (n=5)

Low, moderate and high ranking of learning style preference

Using the classification of the learning style preference into low, moderate and high as defined by Grasha ¹¹ (Table I), the majority (n=234; 75.0% of 308) of students scored in the high preference range for the collaborative learning style, followed by the participant learning style with 36.8% (n=113 of 307) of the students scoring in the high preference range. The competitive learning style was least preferred with 21.7% (n=67 of 309) of the students scoring in the low preference range (Figure 1).

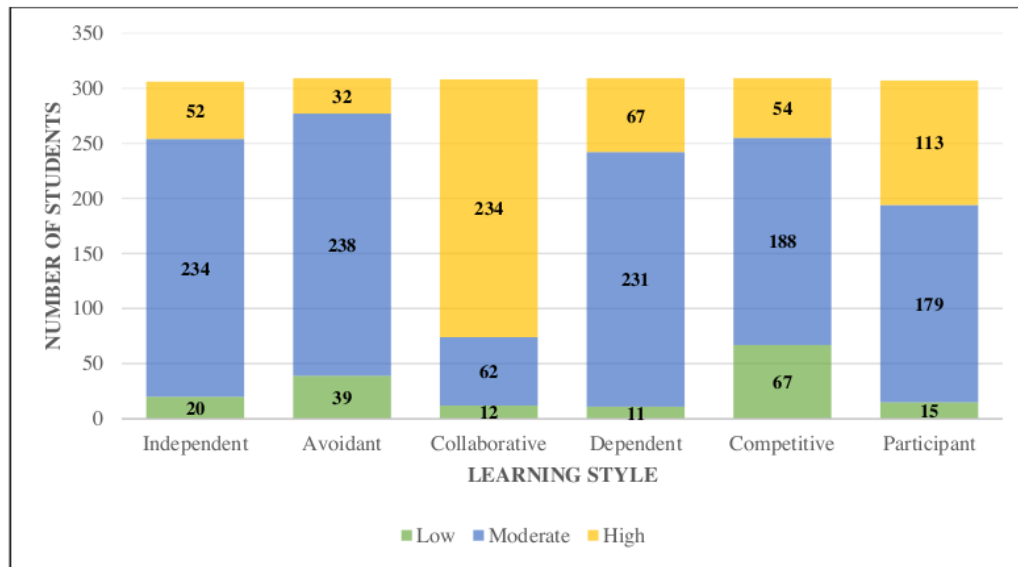


Figure 1: Student Learning Styles (n=313)
 *Totals in each category may differ due to missing data.

<Figure 1 approximately here>

The majority of students, 58.4% (n=180) scored in the high preference range for two or more learning styles, while 9.7% (n=30) showed no learning style scoring high enough to indicate a preference for any of the six learning styles.

Learning style preferences between physiotherapy and occupational therapy students

Table IV compares the learning style preferences between physiotherapy students and occupational therapy students.

<Table IV approximately here>

Table IV: Learning styles related to physiotherapy and occupational therapy students

Learning Style	Overall Means Mean (SD)	Department		p-value	Effect Size
		Occupational Therapy (n=145) Mean (SD)	Physiotherapy (n=160) Mean (SD)		
Independent	3.40 (0.44)	3.35 (0.45)	3.45 (0.41)	0.037	0.241
Avoidant	2.44 (0.56)	2.43 (0.52)	2.46 (0.58)	0.641	0.053
Collaborative	3.81 (0.54)	3.77 (0.52)	3.84 (0.56)	0.245	0.133
Dependent	3.72 (0.45)	3.72 (0.46)	3.73 (0.45)	0.730	0.039
Competitive	2.27 (0.64)	2.18 (0.57)	2.35 (0.69)	0.034 ^a	0.140
Participant	3.95 (0.50)	3.93 (0.5)	3.98 (0.51)	0.38	0.101

^aMann Whitney U tests were performed; Effect size for non-parametric tests = biserial *r* correlation; Effect size for parametric tests = Cohen's *d*

There was a significant difference between the two professions in the independent ⁵ learning style (p=0.037) and the competitive learning style (p=0.034). However, the effect size for both these findings was small (*d*=0.241 and *d*=0.140, respectively). This is further illustrated by the categorical data presented in Figure 2, where more occupational therapy students scored in the low preference range for the independent (occupational therapy n=13, 9.0%; physiotherapy n=7, 4.4%) and competitive learning styles (occupational therapy n=35, 23.8%; physiotherapy n=32, 19.9%) and more physiotherapy students scored in the high preference range for both styles (Independent: occupational therapy n=19, 13.1%; physiotherapy n=33, 20.6% Competitive: occupational therapy n=16, 10.9%; physiotherapy n=38, 23.6%), indicating that should a student show preference for either of these styles they are more likely to be a physiotherapy student.

<Figure 2 approximately here>

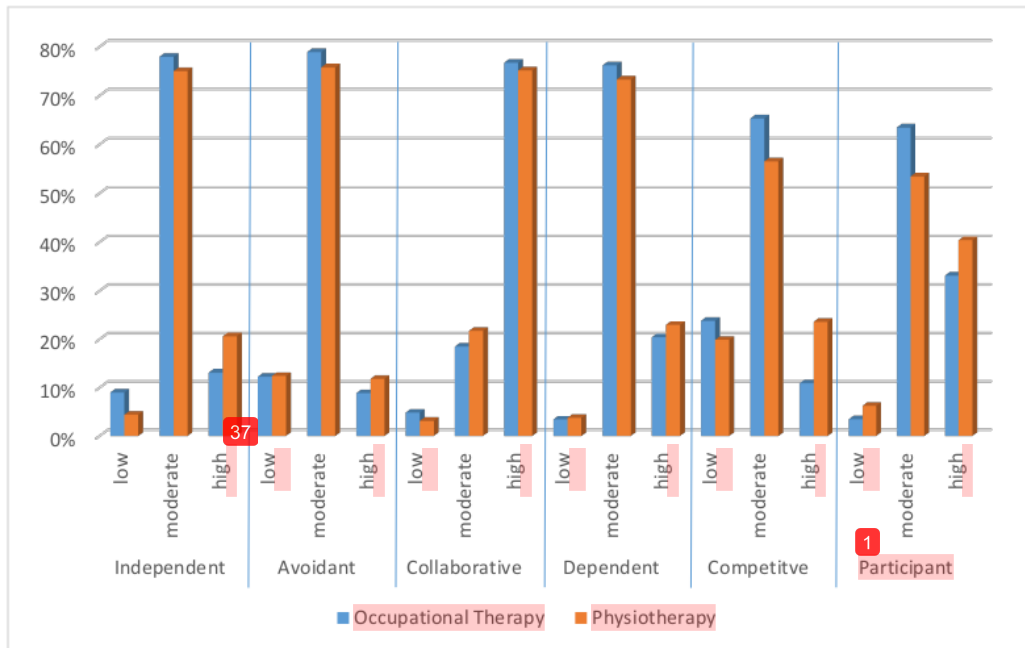
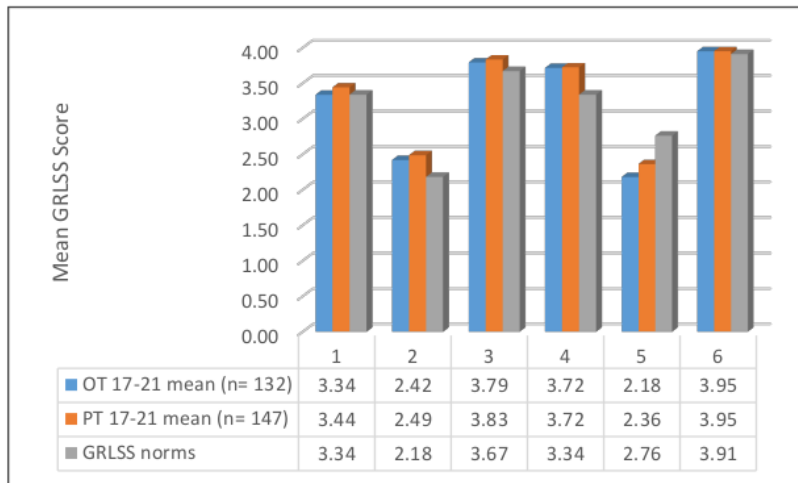


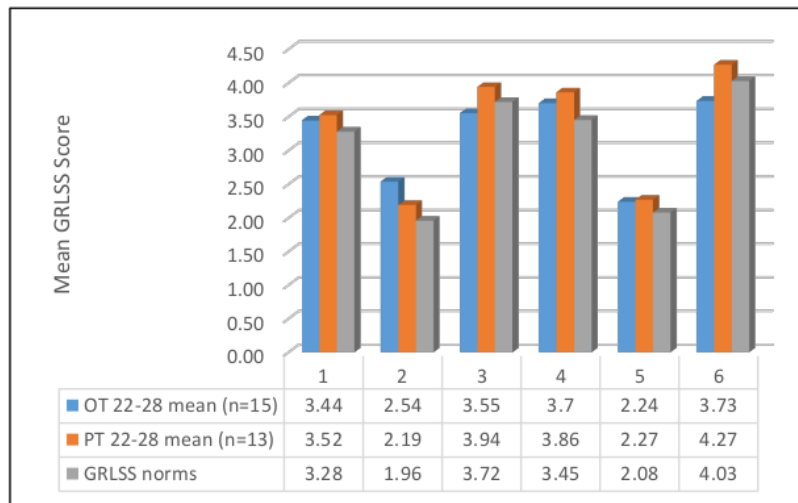
Figure 2: Comparison of level of learning style preference between the OT and PT students (n=313)

Age norms and degree enrolment

Figure 3a and 3b illustrate how the occupational therapy and physiotherapy student learning style preferences compare to the norms for the age range 17-21 years and 22-28 years respectively. The younger students of both degrees scored generally above the age norm in all learning styles except for the competitive style, for which both groups scored well below the Grasha-Reichmann Learning Style Scales Inventory norm of 2.76 (Figure 3a). Interestingly, the older student groups both score well above the Grasha-Reichmann Learning Style Scales Inventory age norm for the avoidant learning style and the occupational therapy students mean scores fall below the Grasha-Reichmann Learning Style Scales Inventory norms for the collaborative and participant learning styles.



A: Comparison of the student mean scores to the GRLSS age norm for 17-21 year olds



B: Comparison of the student mean scores to the GRLSS age norm for 22-28 year olds

Figure 3 Comparison of the student mean scores to the GRLSS age norm

GRLSS = Grasha-Riechmann Student Learning Style Survey (GRSLSS); 1 = independent; 2 = avoidant; 3 = collaborative; 4 = dependent; 5 = competitive; 6 = participant

OT – Occupational therapy

PT – Physiotherapy

<Figure 3 approximately here>

4
Relationship between demographic characteristics and learning styles

Table V outlines the comparative statistics to describe the relationship between the demographic variables and learning styles.

<Table V approximately here>

4
Table V: Relationship between socio-demographic characteristics and learning styles

	Independent	Avoidant	Collaborative	Dependent	Competitive	Participant
Gender						
Male	3.46 (0.45)	2.59 (0.67)	3.88 (0.58)	3.7 (0.43)	2.67 (0.65)	3.82 (0.61)
Female	3.39 (0.44)	2.42 (0.53)	3.79 (0.53)	3.73 (0.46)	2.20 (0.62)	3.98 (0.48)
p-value	0.361	0.123 ^a	0.324	0.644	0.001	0.132 ^a
<i>d</i>	0.146	0.142	0.158	0.074	0.757	0.139
Year of study						
First year	3.38 (0.44)	2.29 (0.54)	3.97 (0.48)	3.77 (0.42)	2.36 (0.61)	4.08 (0.48)
Second year	3.39 (0.39)	2.49 (0.55)	3.73 (0.53)	3.75 (0.46)	2.19 (0.64)	3.87 (0.48)
Third year	3.45 (0.48)	2.59 (0.54)	3.7 (0.58)	3.64 (0.47)	2.26 (0.68)	3.9 (0.52)
p-value	0.512	<0.001	<0.001	0.102	0.145	0.004
Partial Eta Squared	0.004	0.05	0.053	0.015	0.013	0.036
Ethnicity						
African	3.4 (0.44)	2.51 (0.64)	3.92 (0.57)	3.84 (0.39)	2.41 (0.66)	3.99 (0.58)
White	3.4 (0.42)	2.42 (0.52)	3.75 (0.51)	3.70 (0.47)	2.24 (0.62)	3.96 (0.48)
Indian	3.4 (0.49)	2.5 (0.55)	3.85 (0.5)	3.62 (0.38)	2.16 (0.69)	3.91 (0.48)
Coloured	3.52 (0.38)	2.56 (0.47)	3.72 (0.66)	3.59 (0.62)	2.07 (0.76)	3.87 (0.41)
Other	3.28 (0.5)	2.34 (0.66)	3.76 (0.65)	3.71 (0.66)	2.42 (0.45)	3.85 (0.48)
p-value	0.313	0.064	0.401	0.707	0.634	0.79
Partial Eta Squared	0.017	0.031	0.014	0.008	0.009	0.008
Provinces						
Gauteng	3.39 (0.44)	2.46 (0.54)	3.77 (0.54)	3.71 (0.45)	2.24 (0.63)	3.92 (0.49)
KwaZulu-Natal	3.42 (0.41)	2.53 (0.63)	4 (0.57)	3.81 (0.56)	2.33 (0.6)	4.06 (0.53)
Limpopo	3.45 (0.54)	2.17 (0.63)	4.19 (0.5)	3.95 (0.28)	2.61 (0.86)	4.39 (0.49)
Other	3.55 (0.42)	2.44 (0.69)	3.79 (0.5)	3.73 (0.48)	2.39 (0.63)	4 (0.49)
p-value	0.212	0.124	0.245	0.344	0.425	0.119
Partial Eta Squared	0.038	0.044	0.036	0.031	0.028	0.045
Sports participation						
Yes	3.41 (0.42)	2.43 (0.53)	3.81 (0.54)	3.72 (0.47)	2.27 (0.63)	3.95 (0.49)

No	3.38 (0.52)	2.54 (0.66)	3.81 (0.53)	3.73 (0.40)	2.27 (0.72)	3.98 (0.57)
p-value	0.672	0.179	0.958	0.921	0.948	0.652
<i>d</i>	0.064	0.203	0.008	0.015	0.01	0.068

Gender and play sport: Independent T-test and Mann Whitney U^a

Ethnicity, Provinces and year of study: MANOVA

Gender: More male students preferred the competitive learning style when compared to female students, and this finding had a large effect size ($p=0.001$; $r=0.757$). No gender difference in terms of any of the other learning styles existed (Table V).

Year of study: First years had significantly lower avoidant scores than both second and third years ($p<0.001$) while having significantly higher collaborative scores than both second and third-year students ($p=0.003$) and third-year students ($p=0.001$). Additionally, first-year students had significantly higher participant learning style scores than both second year ($p=0.007$) and third-year students ($p=0.007$) (Table V).

Ethnicity: No significant differences in learning styles were found based on the self-selected ethnicity of the participants.

Province: No significant differences in learning styles were found based on the home province of the students in the sample.

Sports participation: Students could indicate whether they participated in sport or not. This information was compared to the students' learning styles. There was no significant difference between students' learning styles and their participation in sport ($p > 0.05$) (Table V).

Academic performance and learning styles

To determine the association between academic performance and learning styles, linear regression models with individual subject scores (percentages) including matric English (77.51 ± 6.51), first-year physics (65.32 ± 10.59), and second-year anatomy (69.21 ± 8.65) as well as the average of these scores (69.02 ± 10.75) were set as the dependent variables, while the learning style scores were set as predictors. The age, department, and gender of the participants was controlled for. As illustrated in Table VI below, participants with competitive learning were more likely to achieve higher grades in Matric English as well as first-year physics. No learning

styles were significant predictors of second-year anatomy grades. When testing the means of these grades, it was found that only the competitive learning style was a significant predictor of academic achievement in the sample.

<Table VI approximately here>

Table VI: Learning styles as linear predictors of academic achievement

Predictors	Matric English			First Year Physics			2nd Year Anatomy			Mean Mark		
	Estimates	95%CI	p	Estimates	95%CI	p	Estimates	95%CI	p	Estimates	95%CI	p
(Intercept)	77.41	51.79 – 103.02	<0.001	53.75	6.79 – 100.70	0.027	57.69	13.44 – 101.95	0.013	112.26	88.86 – 135.66	<0.001
Avoidant	-0.9	-3.48 – 1.68	0.495	-1.1	-6.58 – 4.38	0.695	-0.76	-5.21 – 3.68	0.738	-3.54	-6.19 – -0.89	0.009
Participant	-0.25	-3.20 – 2.70	0.87	0.99	-6.00 – 7.97	0.783	-2.4	-7.54 – 2.75	0.364	-0.46	-3.65 – 2.74	0.78
Collaborative	0.53	-1.80 – 2.85	0.657	-2.91	-7.06 – 1.23	0.172	-2.47	-6.13 – 1.19	0.19	0.34	-1.93 – 2.60	0.771
Independent	-0.6	-3.11 – 1.91	0.642	3.51	-1.72 – 8.74	0.192	0.12	-4.02 – 4.26	0.955	1.81	-0.83 – 4.44	0.18
Competitive	2.28	0.60 – 3.96	0.009	3.62	0.22 – 7.02	0.04	0.28	-2.54 – 3.10	0.848	2.12	0.34 – 3.90	0.02
Observations	130			102			87			285		
R2 /	0.270 /			0.140 /			0.144 /			0.282 /		
R2 adjusted	0.222			0.066			0.056			0.262		

Discussion

Learning style is how a person prefers to learn and can be based on knowledge and/or experience³¹. Previous studies confirmed that, although students often have a preferred learning style, most students are multimodal learners, using more than one learning style³²⁻³⁴. Similarly, 58.4% of the occupational therapy and physiotherapy students at the University (*information removed to allow for anonymous peer-review*) preferred more than one learning style when measured using the GRSLSS. The importance of understanding the learning style lies in its use and therefore the meaningful contribution a facilitator needs to explore different strategies in learner self-awareness and articulation with learning style. Furthermore, learners can be encouraged to explore beyond their formal learning style³⁵.

Interestingly, in this group of students the learning styles that were dominant and in the high category as categorised through the GRSLSS ranking (shown in Table II), were the collaborative followed by participant style (presented in Figure 1). Those in the moderate category were avoidant, independent and dependent. Although students presented with a combination of learning styles, most students in this study scored in the high preference range for the collaborative learning style. Chen et al.³⁶ describe collaborative learning as “the extent to which the environment allows for interactions among the learners to acquire knowledge and skills and complete the tasks”. The teacher needs to create opportunities for students and be approachable while students need to acquire information and share it with peers and teachers³⁷. The occupational therapy and physiotherapy departments already include a variety of teaching activities to cater for the collaborative learning style such as working in small groups (projects and discussions), flipped classrooms and problem-based learning.

The learning styles of the students in this study were varied (Figure 1). The learning activities these students prefer are also likely to be diverse. Students with a competitive learning style are motivated by doing better than their peers³⁸. As such, due to their yearn to be the dominant figure in the classroom would prefer group activities where they can receive recognition in front of their peers³⁹. The independent learner, on the other hand, prefers to work alone at his or her own pace³⁸. Also, these students who are independent learners participate in projects independently and determine their personal goals and learning process²³. From the results of our study, both occupational therapy and physiotherapy students prefer the collaborative style, although more physiotherapy students preferred the independent and competitive styles than occupational therapy students (Figure 2). Also, physiotherapy students scored higher in the competitive

category than occupational therapy students, however, this finding ³⁶ needs to be interpreted with caution due to the small effect size (Table IV).

Interestingly, some literature points to the fact that despite knowing students learning styles and adapting to them in terms of teaching approaches, the outcomes in terms of academic performance remain unchanged. They explained that students' preferred learning style might vary depending on their age, subject matter and environment. This may point, facilitators being more nuanced in their approach, to adapting to learning styles by taking into consideration these anticipated changes in age, environment and subject matter ⁴⁰. This study then sought to understand how the different demographic variables namely age, gender, ethnicity, place of origin, year of study and sport participation, and relate to ⁴⁰ the learning styles.

When the occupational therapy and physiotherapy students learning style preferences were compared to the age norms suggested by Grasha ¹¹ it was evident that the younger students, aged 17-21 years, scored well below the normative mean for the avoidant learning style. This result was consistent with findings by Shead et al. ³. Further consistent with Shead et al. ³ the older students (aged 22-28 year) scored notably ¹ above the normative mean for the avoidant learning style, particularly evident with the ¹ occupational therapy students. These older occupational therapy students also scored below the mean for the collaborative and participant learning styles. Twelve of the 15 occupational therapy students in this age group were in their third year of study, which is well known to be a high-pressure year juggling five subject courses and their first exposure to assessing and treating clinical cases in a variety of settings. The older physiotherapy group were more distributed across the years of study, possibly accounting for the consistency of their scores to their younger physiotherapy counterparts.

Gender played a role ¹³ in the competitive learning style category where ²⁰ male students scored higher than female students and the only learning style where a large effects size ⁴ in terms of gender comparison was present. In another South African study, Shead et al. ³ found that female students preferred the dependent learning style, while the majority of male students preferred the participant learning style. In their study, the competitive style was the least preferred style amongst both male and female students. Although it should be noted that their study only included 17 male students, while our study included 46 male students. However, no difference in the competitive learning style was found amongst science and humanities students, while differences were detected in all other styles (female n=493; male n=546) ¹⁴. The higher scores attained by male students in the competitive category, therefore, seem to be unique to our study and further research is needed to explore the role players. Physiotherapy students also showed a higher

score in the competitive style, when compared to occupational therapy students, however, the majority of male students (n=44) formed part of the physiotherapy cohort, while only two were occupational therapy students. The difference between the two departments may just be a function of the number of male vs female students who formed part of the cohorts.

When looking at students' preferred learning style in this study, it is interesting to note the students' learning style seems to vary over the four years of study with first-year students scoring higher in the collaborative and participant styles in comparison to second- and third-year students who presented with higher average scores in the avoidant learning style. First-year students come to university often excited, motivated and open to new learning experiences ⁴¹. These students are probably used to didactic learning in school and are now exposed to a variety of teaching methods, including more group work. In this study, even though first-year students appear to be less avoidant compared to second and third-year students, Amira et al. ⁴² found that age was not a predictive factor for the avoidant learning style. Avoidant learners do not participate in activities and appear to be disinterested ¹¹. Second- and third-year students, on the other hand, have already been exposed to collaborative and group work in their first and second year of university and may dislike this type of learning. In this study, these students appeared to be less collaborative and participative than the first-year students. Students are often marks driven and working in groups with challenging dynamics is likely to impact on a student's marks. It is, therefore, possible that second- and third-year students prefer to work more independently and rely on their own effort rather than working in groups. It is further possible, due to the exponential increase in workload and the complexity of the work from first to second to the third year that these students struggle to manage their workload and therefore present with a more avoidant learning style ¹¹. It is important to consider this finding in light of being trained as a professional, as the ability to work collaboratively is vital for health care professionals to provide quality patient care ⁴³. Raising a students' awareness of their preferred learning style will be of benefit as students with a propensity for dependent and avoidant learning styles may experience difficulties in adapting to participative learning environments that emphasise teamwork, motivation, individual responsibility, and team dependence. Çolak ⁴⁴ reports that such students have a propensity for surface learning and become withdrawn, employ more surface learning and aim for attaining minimum requirements. Students with cooperative and competitive learning have been reported to achieve better deep learning scores ⁴⁴. Facilitators who create an environment to expose students to a variety of learning styles will likely gain better results.

The group of students in this study were diverse in their background and ethnicity (Table 1). Inequalities within the education system in South Africa created by the legacy of apartheid has called on all higher education institutes to engage with diversity actively. Diversity awareness is thus currently on the agenda of all South African Universities due to the political history of the country. Diversity should be considered and incorporated into all aspects of teaching. The results of this study, however, did not support this belief as there was no relationship between students' ethnicity or the province that they came from and their learning styles. Amira et al.⁴² also found that ethnicity did not affect learning styles of students at the Universiti Kebangsaan in Malaysia. Students presented with a variety of learning styles regardless of their ethnicity or where they came from.¹³ According to Zoghi et al.⁴⁵, learning styles are seen as patterns of behaviour influenced by various factors such as experience, values and roles and not merely personality characteristics.²³ This is important, as teachers need to include a variety of activities to suit different learning styles based on the students' inherent learning style regardless of ethnicity, providing an opportunity for learning in a way that different students within different subject areas and environment can engage.⁵

Our results show that participants with a competitive learning style were significantly more likely to achieve higher grades in matric English, first-year physics and overall marks, however this only applies to a 17.5% [(n=54 of 309) (Figure 1)] of our sample who scored in the high range for this learning style). The avoidant learning style did not show any significant relationship in the specific subjects of physics, English and anatomy but in the overall average mark, a significant decrease was evident. These results show that the 10.4% [(n=32 of 309) (Figure 1)] of students in this study who scored in the high range for the avoidant learning style may perform in individual subjects but cumulatively their performance may be declining. This is unsurprising given that avoidant learners are known to withdraw slowly and participate less⁴⁴. A study by İlçin et al.⁷ among physiotherapy students in Turkey reported similar results where there was a negative correlation between avoidance learning styles and academic performance.⁵ Amira et al.⁴², found a decrease in academic performance in students with a collaborative learning style, which was not the case in this study. The competitive learning style in this study was however associated with an increase in academic performance which was the opposite in Amira et al.⁴², study. Competitive learners compete with other learners and prefer a teacher-centred classroom where activities are provided, while the participatory learner wants to participate in activities and prefer discussion-based lectures²³.

Conclusion

While ⁴ it is important to understand learning styles for both the students and the facilitator, the application in the teaching space should be carefully considered for the selection of teaching approaches and activities. Overall, ¹ there is little difference between the learning styles of the occupational therapy and physiotherapy students in this study, with the predominant preferred learning styles being the collaborative and participant learning styles. Both programmes are well suited to cater for the collaborative and participant learning styles through small group teaching and the active nature of clinical skills development. There may be benefit in monitoring the students who develop a tendency towards the avoidant style (which tends to happen more in the older students and later years of study), as they may be more at risk of poor academic performance than their peers.

Acknowledgements

The authors acknowledge the contribution of Prof Douglas Maleka, Prof Patricia de Witt and Mrs Julie Jay ³⁹ in this research.

Competing interest

The authors declare no competing interest.

References

1. Council on Higher Education. South African Higher Education Reviewed: Two decades of Democracy. Pretoria: Council on Higher Education; 2016.
2. Coffield F, Moseley D, Hall E, Ecclestone K, Coffield F, Moseley D, et al. Learning styles and pedagogy in post-16 learning: A systematic and critical review. 2004.
3. Shead D, Roos R, Olivier B, Ihunwo A. Learning styles of physiotherapy students and teaching styles of their lecturers in undergraduate gross anatomy education. *African Journal of Health Professions Education*. 2018;10(4):228-34.
4. Rice S, McKendree J. e-Learning. In: Swanwick T, editor. *Understanding medical education: evidence, theory and practice*. 2nd ed. West Sussex: John Wiley & Sons Ltd; 2013. p. 161-73.
5. Husmann PR, O'Loughlin VD. Another nail in the coffin for learning styles? Disparities among undergraduate anatomy students' study strategies, class performance, and reported VARK learning styles. *Anatomical sciences education*. 2019;12(1):6-19.
6. Kirschner PA. Stop propagating the learning styles myth. *Computers & Education*. 2017;106:166-71.
7. İlçin N, Tomruk M, Yeşilyaprak SS, Karadibak D, Savcı S. The relationship between learning styles and academic performance in TURKISH physiotherapy students. *BMC Medical Education*. 2018;18(1):291.
8. Novak S, Shah S, Wilson JP, Lawson KA, Salzman RD. Pharmacy students' learning styles before and after a problem-based learning experience. *American Journal of Pharmaceutical Education*. 2006;70(4):1-8.
9. Samantaray A, Mishra SK, Dash S. Assessment of Learning Styles of Undergraduate Medical Students. *Indian Journal of Public Health Research & Development*. 2017;8(3):322-5.
10. Vaughn LM, Baker RC. Do different pairings of teaching styles and learning styles make a difference? Preceptor and resident perceptions. *Teaching and Learning in Medicine*. 2008;20(3):239-47.
11. Grasha AF. *Teaching with style: A practical guide to enhancing learning by understanding teaching and learning styles*. Pittsburgh: Alliance publishers; 1996.
12. Crawford SY, Alhreish SK, Popovich NG. Comparison of learning styles of pharmacy students and faculty members. *American Journal of Pharmaceutical Education*. 2012;76(10):1-6.
13. Manee F, Nadar M, Jahrami H. Learning styles of allied health sciences students at Kuwait University. *International Journal of Therapy and Rehabilitation*. 2013;20(5):255-9.

14. Baneshi AR, Tezerjani MD, Mokhtarpour H. Grasha-richmann college students' learning styles of classroom participation: Role of gender and major. *Journal of Advances in Medical Education & Professionalism*. 2014;2(3):103-7.
15. Barman A, Jaafar R, Rahim AFbA. Medical Students' Learning Styles in Universiti Sains Malaysia. *International Medical Journal*. 2009;16(4):257-60.
16. Brown T, Cosgriff T, French G. Learning Style Preferences of Occupational Therapy, Physiotherapy and Speech Pathology Students: A Comparative Study. *The Internet Journal of Allied Health Sciences and Practice*. 2008;6(3):1-12.
17. Brown T, Vryens V, Williams B, Jaberzadeh S, Roller L, Palermo C, et al. The learning styles of undergraduate occupational therapy and physiotherapy students from one Australian university using the Kolb learning style inventory. *Irish Journal of Occupational Therapy*. 2009;37(2):22-8
18. French G, Cosgriff T, Brown T. Learning style preferences of Australian occupational therapy students. *Australian Occupational Therapy Journal*. 2007;54:S58-S65.
19. Llorens LA, Adams SP. Learning style preferences of occupational therapy students. *The American Journal of Occupational Therapy*. 1978;32(3):161-4.
20. Ferrell BG. A factor analytic comparison of four learning-styles instruments. *Journal of Educational Psychology*. 1983;75(1):33-9.
21. Mountford H, Jones S, Tucker B. Learning styles of entry-level physiotherapy students. *Advances in Physiotherapy*. 2006;8(3):128-36.
22. Wessel J, Loomis J, Rennie S, Brook P, Hoddinott J, Aherne M. Learning styles and perceived problem-solving ability of students in a baccalaureate physiotherapy programme. *Physiotherapy Theory and Practice*. 1999;15(1):17-24.
23. Azarkhordad F, Mehdinezhad V. Explaining the students' learning styles based on Grasha-Riechmann's student learning styles. *Journal of Administrative Management Education and Training*. 2016;12(6):241-7.
24. Auyeung P, Sands J. A cross cultural study of the learning style of accounting students. *Accounting & Finance*. 1996;36(2):261-74.
25. Gündüz N, Özcan D. Learning styles of students from different cultures and studying in Near East University. *Procedia-Social and Behavioral Sciences*. 2010;9:5-10.
26. Kolb AY, Kolb DA. Learning styles and learning spaces: Enhancing experiential learning in higher education. *Academy of Management Learning & Education*. 2005;4(2):193-212.
27. Von Elm E, Altman DG, Egger M, Pocock SJ, Gøtzsche PC, Vandenbroucke JP, et al. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement:

- guidelines for reporting observational studies. *Journal of Clinical Epidemiology*. 2008;61(4):344-9.
28. Grasha AF. The dynamics of one-on-one teaching. *College Teaching*. 2002;50(4):139-46.
29. Babadogan C, Kilic G. Learning modalities of sixth grade students and the learning and teaching modalities of the English teachers at primary schools. *Procedia-Social and Behavioral Sciences*. 2012;46:2467-71.
30. Pautz N, Olivier B, Steyn F. The use of parametric effect sizes in single study musculoskeletal physiotherapy research: A practical primer. *Physical Therapy in Sport*. 2018;32:87-97.
31. Hsieh S-W, Jang Y-R, Hwang G-J, Chen N-S. Effects of teaching and learning styles on students' reflection levels for ubiquitous learning. *Computers & Education*. 2011;57(1):1194-201.
32. Peters D, Jones G, Peters J. Preferred 'learning styles' in students studying sports-related programmes in higher education in the United Kingdom. *Studies in Higher Education*. 2008;33(2):155-66.
33. Nuzhat A, Salem RO, Hamdan NA, Ashour N. Gender differences in learning styles and academic performance of medical students in Saudi Arabia. *Medical Teacher*. 2013;35(sup1):S78-S82.
34. Alkhasawneh IM, Mrayyan MT, Docherty C, Alashram S, Yousef HY. Problem-based learning (PBL): assessing students' learning preferences using VARK. *Nurse Education Today*. 2008;28(5):572-9.
35. Sadler-Smith E, J. Smith P. Strategies for accommodating individuals' styles and preferences in flexible learning programmes. *British Journal of Educational Technology*. 2004;35(4):395-412.
36. Chen C, Jones KT, Xu S. The Association between Students' Style of Learning Preferences, Social Presence, Collaborative Learning and Learning Outcomes. *Journal of Educators Online*. 2018;15(1):1-16.
37. Grasha AF. A matter of style: The teacher as expert, formal authority, personal model, facilitator, and delegator. *College Teaching*. 1994;42(4):142-9.
38. Diaz DP, Cartnal RB. Students' learning styles in two classes: Online distance learning and equivalent on-campus. *College Teaching*. 1999;47(4):130-5.
39. Amir R, Jelas ZM, Rahman S. Learning styles of university students: Implications for teaching and learning. *World Applied Sciences Journal*. 2011;14(2):22-6.

40. Dinçol S, Temel S, Oskay ÖÖ, Erdoğan ÜI, Yılmaz A. The effect of matching learning styles with teaching styles on success. *Procedia-Social and Behavioral Sciences*. 2011;15:854-8.
41. Kantanis T. The role of social transition in students': adjustment to the first-year of university. *Journal of Institutional Research*. 2000;9(1):100-10.
42. Amira R, Jelas ZM. Teaching and learning styles in higher education institutions: Do they match? *Procedia-Social and Behavioral Sciences*. 2010;7:680-4.
43. Zwarenstein M, Goldman J, Reeves S. Interprofessional collaboration: effects of practice-based interventions on professional practice and healthcare outcomes. *Cochrane Database of Systematic Reviews*. 2009;8(3):1-26.
44. Çolak E. The effect of cooperative learning on the learning approaches of students with different learning styles. *Eurasian Journal of Educational Research*. 2015;15(59):17-34.
45. Zoghi M, Brown T, Williams B, Roller L, Jaberzadeh S, Palermo C, et al. Learning style preferences of Australian health science students. *Journal of Allied Health*. 2010;39(2):95-103.

Learning styles

ORIGINALITY REPORT

% **15**
SIMILARITY INDEX

% **10**
INTERNET SOURCES

% **9**
PUBLICATIONS

% **12**
STUDENT PAPERS

PRIMARY SOURCES

1 Submitted to University of Witwatersrand % **2**
Student Paper

2 Sunan Sriphai. "An investigation of learning styles influencing mathematics achievement of seventh-grade students", Educational Research and Reviews, 2011 % **1**
Publication

3 www.terrificscience.org % **1**
Internet Source

4 Submitted to Higher Education Commission Pakistan % **1**
Student Paper

5 worldwidescience.org % **1**
Internet Source

6 bmcmmededuc.biomedcentral.com % **1**
Internet Source

7 Submitted to Halesowen College <% **1**
Student Paper

8

Internet Source

<% 1

9

issuu.com

Internet Source

<% 1

10

Submitted to University of Brighton

Student Paper

<% 1

11

www.sajsm.org.za

Internet Source

<% 1

12

researchspace.auckland.ac.nz

Internet Source

<% 1

13

Submitted to Walden University

Student Paper

<% 1

14

Bell-Jenje, T., B. Olivier, W. Wood, S. Rogers, A. Green, and W. McKinon. "The association between loss of ankle dorsiflexion range of movement, and hip adduction and internal rotation during a step down test", Manual Therapy, 2016.

Publication

<% 1

15

Submitted to Grand Canyon University

Student Paper

<% 1

16

hub.hku.hk

Internet Source

<% 1

17

Jean Barclay. "Assessing the benefits of

<% 1

learning logs", Education + Training, 1996

Publication

18

uir.unisa.ac.za

Internet Source

<% 1

19

Submitted to Northern Caribbean University

Student Paper

<% 1

20

www.emeraldinsight.com

Internet Source

<% 1

21

besjournals.onlinelibrary.wiley.com

Internet Source

<% 1

22

Yvonne H. A. Bouman. "Changes in quality of life in forensic psychiatric outpatients after 6 months of community-based treatment", *Personality and Mental Health*, 07/15/2010

Publication

<% 1

23

Submitted to University of Hull

Student Paper

<% 1

24

link.springer.com

Internet Source

<% 1

25

www.ejer.com.tr

Internet Source

<% 1

26

U. N. Umesh, Martin Tan, Donald E. Stem. "Analysis of multiple response in marketing research: Estimating the degree of association", *Marketing Letters*, 1992

<% 1

27 Submitted to Laureate Higher Education Group <% 1
Student Paper

28 bmcpediatr.biomedcentral.com <% 1
Internet Source

29 revodontolunesp.com.br <% 1
Internet Source

30 ÇOLAK, Esmâ. "The Effect of Cooperative Learning on the Learning Approaches of Students with Different Learning Styles", Anı Yayıncılık, 2015. <% 1
Publication

31 İsmail Yüksel, Ercüment Türkses. "chapter 73 Cross-Sectional Evaluation of Distance Education Students' Learning Styles and Critical Thinking Dispositions in Turkey", IGI Global, 2016 <% 1
Publication

32 s3.amazonaws.com <% 1
Internet Source

33 erepository.uonbi.ac.ke:8080 <% 1
Internet Source

34 Submitted to Northcentral <% 1
Student Paper

35 Submitted to Glasgow Caledonian University

36

www.gov.uk

Internet Source

<% 1

37

Abu Romman , Abdul Raheem Saleh
Mohammad. "The Effect of Match / Mismatch of
Teaching-Learning Styles on Secondary Stage
Students' Achievement in English in Jordan",
The Effect of Match / Mismatch of Teaching-
Learning Styles on Secondary Stage Students'
Achievement in English in Jordan

Publication

<% 1

38

Submitted to Newman College

Student Paper

<% 1

39

jfrh.tums.ac.ir

Internet Source

<% 1

40

demo.ands.org.au

Internet Source

<% 1

41

Jong Li Ling, Ling Siew Ching. "Learning styles
of fundamental mathematics students", 2010
International Conference on Science and Social
Research (CSSR 2010), 2010

Publication

<% 1

42

www.ijern.com

Internet Source

<% 1

43

www.ncbi.nlm.nih.gov

Internet Source

<% 1

44

Lillian Sung, Arif Manji, Joseph Beyene, L. Lee Dupuis, Sarah Alexander, Robert Phillips, Thomas Lehrnbecher. "Fluoroquinolones in Children With Fever and Neutropenia", The Pediatric Infectious Disease Journal, 2012

Publication

<% 1

EXCLUDE QUOTES ON

EXCLUDE ON

BIBLIOGRAPHY

EXCLUDE MATCHES < 10 WORDS