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Development and Evaluation of an Educational Intervention to Enhance Deep Learning and Study Skills among Pharmacy Students in Zambia

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Abstract **Background:** Existing evidence suggests that most students undertaking health science programmes lack adequate learning and study skills. **Aim:** To develop and assess the potential effect of a deep learning and study skills elective module on undergraduate pharmacy students' learning approach. **Methods:** A quasi-experimental study adopting a pretest-posttest design was conducted. An elective module dubbed 'Orientation and Approaches to Deep Learning and Study Skills' (OADLSS) was developed and experimented as an adjunct educational intervention. Forty-six (46) undergraduate pharmacy students were enrolled with 25 participants undertaking the OADLSS module and 21 participants constituting the non-intervention (control) group. The Approaches and Study Skills Inventory for Students (ASSIST) questionnaire was used to measure learning approaches before and 4-weeks after the intervention. Student's t-tests and margins plots were used to compare approaches to learning within and across groups. **Results:** Participants that undertook the OADLSS elective module found it relevant and useful for enhancing their learning. Mean scores for strategic learning approach significantly reduced from 27.20 ± 1.94 (95%CI: 26.40 – 28.00) to 26.00 ± 3.09 (95% CI: 24.72 – 27.28, p = 0.0245) among OADLSS participants compared to controls (25.05 ± 4.38; 95%CI: 23.06 – 27.04 to 24.38 ± 3.28; 95%CI: 22.89 – 25.87, p = 0.5079). Deep learning scores minimally increased from 23.68 ± 3.26 (95%CI: 22.23 – 25.03) to 24.08 ± 3.64 (95%CI: 22.58 – 25.58) but this was not statistically significant (p = 0.5924) and did not predict high academic performance after the OADLSS intervention. **Conclusion:** An adjunct learning and study skills intervention produced minimal immediate changes to deep learning and studying approach. The potential influence of the educational intervention can be further enhanced by accompanying changes to the learning environment, educational strategies of the curriculum and educators, including assessment modalities utilised.

Keywords Approaches to learning, Pharmacy students, Quasi-experiment, Study skills, Zambia

1. Introduction

Globally, health professions education programmes are shifting paradigms from a focus on educational processes to learning outcomes [1]. How students learn and ways they undertake academic tasks has the potential to enhance or undermine their learning outcomes [2,3]. Approaches to Learning (ATL) refer to qualitatively distinct ways and methods students go about their learning, adopt motive strategies for engaging learning tasks and take to studying [4]. The three dominant ATL are: 'Deep', 'Surface' and 'Strategic' approach, respectively [4]. A deep approach is characterised by students' intention to understand, apply knowledge, engage evidence and relate ideas in the subject. A surface approach is characterised by a student's intention to accomplish minimum tasks in the discipline, routine memorisation and fear of failure. Strategic approach is characterised by organised studying where the student's intention is to maximise efficiency and efficacy, paying special attention mainly to assessment demands and achieving high grades [4-6]. Research evidence has shown that students that adopt passive, surface ATL rarely do well in medical school whereas active, deep learning was more likely to be associated with higher quality learning outcomes for health sciences [7].

A growing body of evidence suggests that most students undertaking health professions programmes lack adequate

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study skills [8-10] - a situation which can negatively impact on their learning efficacy [11]. In Zambia, there was a recurring concern that undergraduate pharmacy students were predominantly strategic learners motivated by achieving rote learning outcomes [12] and lacked adequate study skills essential for meaningful learning [10]. Parpala and colleagues also found that pharmacy students tend to adopt a surface rather than a deep approach to learning [13]. Studies show that instructional design and interventions fostering environments that promote deep learning can bring about changes to student learning approaches and outcomes by various degrees [14-16]. Cognitive constructivism and metacognition have been demonstrated to help students become aware of their strengths and weaknesses as learners, enable them to gain a level of awareness above the subject matter, including thinking about tasks and contexts in different learning situations, and themselves as learners in those different contexts [17]. This study developed and piloted a deep learning and study skills elective module dubbed ‘Orientation and Approaches to Deep Learning and Study Skills’ (OADLSS), and assessed its potential effect on undergraduate pharmacy students’ learning and studying approach on a Bachelor of Pharmacy degree programme.

2. Methods

2.1. Study Design

This was a quasi-experimental study adopting a pretest-posttest design.

2.2. Setting and Participants

Participants were Year 1 and 2 undergraduate pharmacy students at the University of Zambia – the largest and leading public university in Zambia. The university offers a full-time four-year Bachelor of Pharmacy (B.Pharm.) degree programme.

2.3. Design and Development of the Educational Intervention

The OADLSS elective module was locally designed by the authors using instructional design principles posited by Rowntree (1981), and Gagne and Briggs (1974) [19,20]. The module syllabus was modelled from educational principles and resources from Entwistle and Ramsden’s “Understanding Student Learning”, Chapter Four to Six [3] and Pritchards’ “Studying and Learning at University: Vital skills for success in your degree”, p.5 – 174 [21]. The module design, its educational objectives, content and face validity were iteratively examined, peer-reviewed and validated through a two-round Delphi technique involving four local qualified experts in medical education at the university. The first Delphi round involved sending via email to the four identified subject matter experts the draft outline of the module containing the proposed title, aims, and objectives, suggested content, contact hours, and educational resource requirements. Individual comments were solicited on the suitability, clarity or ambiguity of the module objectives, and alignment of content, instructional methods and cognitive level aimed to be attained. The comments were collated from the first round and suggested refinements incorporated into the subsequent draft module. Alongside, current literature and resources were iteratively reviewed, and relevant content for the module updated accordingly. In the second Delphi round, the revised draft module outline was again sent for experts’ valid opinions. All four experts gave positive comments and consensus attained in agreement to the suggested design aspects. The finalised version was considered for the study.

The OADLSS elective module aimed to help students develop and adopt a deep approach to their learning and studying pharmaceutical sciences. Participants attended a 2-hour scheduled contact session each day for 5 uninterrupted days. The module content was delivered using expository and exploratory learning activities consisting self-reflective exercises.

2.4. Sample Size

The sample size for a two-sided two-sample mean assumed a non-intervention (control) group mean score of 16 for deep learning approach [12], a mean difference of 4 with the intervention (experimental) group, at a significance level of 5% and desired power of 80%, and assuming both groups had a standard deviation of 5. The computed sample size was 52 (with N per group = 26). A total of 49 pharmacy students consented to participate in the study. In the absence of randomisation, enrolled participants self-selected to undertake the OADLSS elective module on the basis of presumed need or desire for the intervention [18]. Twenty-six participants self-selected to participate on the OADLSS elective module (experimental intervention group) whereas a matched non-intervention (control) group consisted of 23 participants from the same cohort not exposed to the OADLSS. Participants were followed-up for one academic year of 28 weeks duration.

2.5. Procedure

The OADLSS elective was advertised initially as an adjunct elective module offered to those Year 1 and 2 undergraduate pharmacy students interested in improving their learning and study skills. Adverts were placed through posters on official class notice boards and mailing lists during the first and second week of the first term for the 2017 to 2018 academic year. The OADLSS sessions were conducted during the first term recess.

A modified short-version of the Approaches and Study Skills Inventory for Students (ASSIST) questionnaire – a pre-validated tool developed by Tait, Entwistle and McCune was employed to measure participants’ ATL before and 4-weeks after the OADLSS intervention. The ASSIST is a self-administered tool that asks students to rate the extent of their agreement or disagreement on a 5-point Likert scale (with 1 being lowest and 5 being highest) to a series of related items that cover aspects of a specific construct. Summing the responses across items produces a score for each learning approach. On the ASSIST short version, each learning approach (i.e. deep, surface or strategic) has six conceptually distinct items which are related to the learning approach [22].

2.6. Data Analysis

The ASSIST item scores were aggregated as follows: ratios of summed scores to items of each construct were calculated by addition of numerical values of Likert scales (where, ‘Agree’ = 5; ‘Agree somewhat’ = 4; ‘Unsure’ = 3; ‘Disagree somewhat’ = 2; ‘Disagree’ = 1); For ease of comparison, item scores for each main approach (‘Deep’, ‘Strategic’ and ‘Surface’) were grouped and aggregated to reach an overall total score from the number of contributing items, allowing a maximum score of 30 and a minimum score of 6 per approach category. For the ATL categories, the greater the difference between the scores for ‘Deep’ vs. ‘Strategic’ vs. ‘Surface’ scores, the greater the dominance of the particular learning approach. Where the difference between the scores in each construct was small, the dominance for either approach was considered relatively weak [2]. The construct with the highest total score was considered indicative of the predominant ATL. Cronbach’s alpha was used to ascertain the pre- and post-test reliability the ASSIST tool.

The Shapiro-Wilk test was used to confirm the normality of data. ATL scores were presented as means ± SD with 95% confidence intervals. ATL mean scores before and 4-weeks after the intervention were compared within each group using a paired t-test. An unpaired t-test was used to compare mean scores for ATL scales between the experimental and control (non-intervention) group. A logistic regression model was constructed using the exposure variables of interest, except the model did not fit (model chi-square p-value >0.05) hence, average margins of effect plots were used to examine the probability of exposure to the OADLSS intervention predicting better academic performance. For statistical inference, a two-tailed p-value <0.05 was accepted. Data were analysed using Stata 13 software *(StataCorp LP, USA)*.

2.7. Ethical Considerations

Approval for this study was granted by the University of Zambia Biomedical Research Ethics Committee (IRB00001131 of IORG0000774). The approval reference is 008-06-17.

3. Results

3.1. Participants’ Demographic Characteristics

Only 46 out of the 49 participants enrolled in the study that successfully completed the pre- and post-test evaluations throughout the follow-up period were analysed per protocol. There were 31 (67%) male and 15 (33%) female participants. Statistically, there was no significant difference in the distribution of male and female participants, and other demographic characteristics between the two groups (Table 1).

Table 1. Demographic Characteristics of the Participants

Characteristic	Intervention (N=25)	Non-intervention (N=21)	p-value*
Sex (M:F)*	17:8	14:7	0.923
Age	23 (21 – 24)	22 (21 – 24)	0.680
Year of Study*			
• Year 1	9	10	0.425
• Year 2	16	11	
Mode of admission*			
• Quota entry	20	19	0.324
• Direct entry	5	2	
Prior learning*			
• A-level Sciences	19	17	0.685
• Dip. Pharm.	6	4	
Study time per week	20 (18 – 28)	24 (15 – 30)	0.820

*Chi-square test was used. For continuous variables median (interquartile range) are shown. M: male; F: female; Dip. Pharm.: diploma in pharmacy.

3.2. Participants’ Evaluation of the OADLSS Module

Table 2 shows the rating and evaluation of the OADLSS by participants exposed to the module (n = 25). Verbatim feedback from participants indicated that the module was found relevant and positively rated by the majority (Table 2).

3.3. Learning Approaches before and after the OADLSS Intervention

Cronbach’s alpha coefficients of the ATL scales varied between 0.69 and 0.73. The overall alpha coefficient was 0.72 which was acceptable consistency. Table 4 shows comparisons of the pre- and post-test mean scores for deep, strategic and surface ATL within and between groups at baseline and 4-weeks after the OADLSS intervention, respectively. After the intervention, the mean scores for strategic learning approach among participants exposed to the OADLSS significantly reduced (Table 3). The OADLSS-exposed group showed a marginal increase in deep learning approach scores compared to controls. However, this was not statistically significant.

Generally, there was not a statistically significant mean difference in grade point average (GPA) scores attained in the official summative examinations between participants exposed to the OADLSS compared to those not exposed. Next, we examined the correlation between the three ATL scores and GPA. Despite there being positive correlations between deep and strategic ATL and GPA, this was not statistically significant (Table 4).

Table 2. Participant's Feedback on Most Beneficial Aspects, What did not go well and Major Aspects Learnt from the OADLSS Module

Feature Evaluated	Key aspects derived from participants' grouped responses to open-ended questions	Selected quotes from participant written responses to open-ended questions
Aspects of the OADLSS module that went well for participants	1. Critical thinking skills *(n = 13)* 2. Time management session *(n = 11)* 3. Deep learning strategies *(n = 8)* 4. Study strategies *(n = 7)* 5. Dealing with distractions *(n = 5)* 6. Learning styles *(n = 4)* 7. Approaches to learning *(n = 3)* 8. Note-taking methods *(n = 2)*	*"Critical thinking session seems to have improved the (way) I use logic and understanding"* *"The segment on critical thinking really helped me…., I also learnt that managing my time is important"* *"Time management session went well for me"* *"I realised that deep learning is the most efficient"* *"How to develop strategies of deep learning and skills needed for critical thinking was good for me…"*
Aspects of the OADLSS module did not go so well for participants	1. Session time insufficient *(n = 6)* 2. Teaching styles not covered *(n = 2)* 3. Content coverage *(n = 2)*	*"I think we needed more time than we had for the seminar"* *"…I felt we needed to have more time - probably 2 weeks…."* *"The duration was short"* *"Style of teaching and lecturing…"* *"What or how much effort lecturers put in in their teaching styles…."*
Key things learnt from the OADLSS module that participants wish to apply in their own learning and studying	1. Managing study time *(n = 13)* 2. Deep Learning *(n = 9)* 3. Applying critical thinking *(n = 6)* 4. Applying learning styles *(n = 4)* 5. Studying strategies *(n = 4)*	*"I learnt how to become a good learner, allocate time for studies"* *"….time management, critical thinking and broadening my learning style"* *"I have learnt that I have to analyse the must know, good to know and nice to know information…"*

Table 3. Comparison of Pre- and Post-test ATL Scores across and within Groups

Variable		**Intervention group (n = 25)** Mean ± SD	**Non-intervention group (n = 21)** Mean ± SD	Mean difference	95% CI	t statistic *(p-value)*
Deep learning	Pre-test	23.68 ± 3.26	23.62 ± 3.17	0.06 ± 0.95	-1.86 to 1.98	0.064 *(0.949)*
	Post-test	24.08 ± 3.64	23.76 ± 3.11	0.32 ± 1.01	-1.72 to 2.35	0.315 *(0.7541)*
	Mean Difference	0.40	0.14			
	95% CI	-1.92 to 1.12	-1.74 to 1.45			
	t *(p-value)*	0.543 *(0.5924)*	0.187 *(0.8534)*			
Strategic learning	Pre-test	27.20 ± 1.94	25.05 ± 4.38	2.15 ± 0.97	0.19 to 4.11	2.218 *(0.0318)**
	Post-test	26.00 ± 3.09	24.38 ± 3.28	-1.62 ± 0.94	-3.52 to 0.28	1.720 *(0.0925)*
	Mean Difference	-1.20	-0.67			
	95% CI	0.17 to 2.23	-1.39 to 2.73			
	t *(p-value)*	2.400 *(0.0245)**	0.674 *(0.5079)*			
Surface learning	Pre-test	15.88 ± 4.33	17.57 ± 4.01	-1.69 ± 1.24	-4.19 to 0.81	1.364 *(0.179)*
	Post-test	14.52 ± 3.96	15.48 ± 4.06	-0.96 ± 1.19	-3.35 to 1.43	0.807 *(0.4242)*
	Mean Difference	-1.36	-2.09			
	95% CI	-0.76 to 3.48	-0.35 to 4.54			
	t *(p-value)*	1.325 *(0.1975)*	1.786 *(0.0892)*			
GPA	Endpoint	2.51 ± 0.53	2.47 ± 0.39	0.04 ± 0.15	-0.25 to 0.34	0.2929 *(0.771)*
	95% CI	2.29 to 2.74	2.28 to 2.66			

**Student t-test statistically significant; GPA: grade point average*

Table 4. Correlation matrix showing relationships among variables

	Age	Deep ATL	Strategic ATL	Surface ATL	GPA
Age	1.0000				
Deep ATL	0.0339	1.0000			
Strategic ATL	0.1874	0.2990*	1.0000		
Surface ATL	-0.2124	0.2054	-0.0638	1.0000	
GPA	-0.2193	0.2582	0.2007	0.1197	1.0000

*GPA: grade point average; *p value <0.05*

3.4. Predictive Margins of the Intervention

After constructing a logistic regression model, average margins of effect plots were used to predict the probability of attaining a higher GPA score if exposed to the OADLSS intervention. Our findings showed that, holding all other variables constant in the learning environment, a strategic ATL increased the probability of passing the examinations with a GPA score≥ 2.5 by 1.6% (95% CI: -5.11 to 8.38). As strategic learning score increased, the probability of predicting a higher GPA also increased (Figure 1).

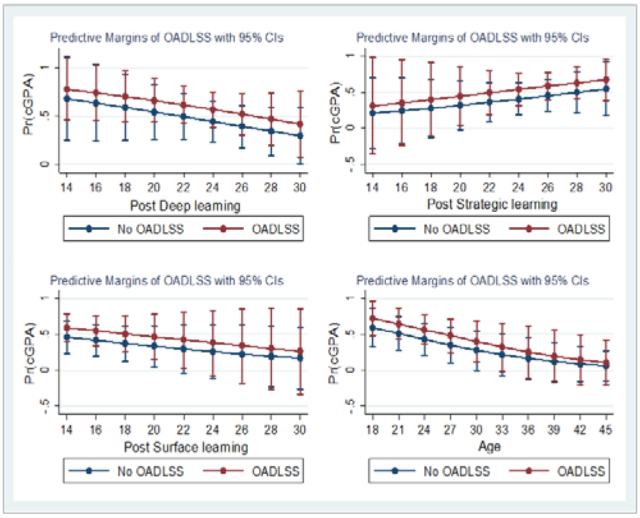

Figure 1. Predictive margins of the OADLSS intervention on learning approaches and academic performance in assessments

4. Discussion

This study developed and evaluated effects of a deep learning and study skills elective module on undergraduate pharmacy students' ATL. The similarities in the baseline characteristics of the experimental and control groups suggested they were equally matched even in the absence of randomisation. Among participants exposed to the OADLSS elective module, the majority found it relevant and useful for enhancing their learning and studying. Participants indicated the module enhanced their generic critical thinking and time management skills (Table 2). This finding collaborated with Kridoitis and Swart who also showed that students that participated on a Lifelong Learning Skills (LLLS) module added to the first year medical students' curriculum at the University of the Free State in South Africa, believed that the LLLS module enhanced their generic skills and that it was beneficial to them [23]. The educational value of such metacognitive interventions are clearly evident.

Though the evidence of immediate positive change towards adopting a deep learning approach after exposure to the OADLSS was relatively weak in this study, participants' feedback (Table 2) about the module was inconsonant with current evidence suggesting that instructional design based on cognitive constructivism can influence attainment of meaningful learning, critical thinking, and problem-solving skills among pharmacy students [24,25]. The fact that participants exposed to the OADLSS intervention did not register a remarkable increase in their deep approach scores may not necessarily imply they were neither self-aware nor capable of adopting deep learning. To the contrary, this somewhat agreed with Fox and colleagues' argument that such a contrasting finding may reflect that while additional time and attention, including appropriate learning methods, should be allocated for the explicit application of deep learning skills in pharmacy education, it is difficult to demonstrate immediate effects of improved metacognitive processes since much of this self-regulation happens internally [26]. We also contended that in addition to modifying the above facets of the learning environment at the university, extra consideration should also be given to utilising the most appropriate assessment methods that seek to promote and detect deep learning attributes in the learners.

Whereas other similar studies showed that significant increase in deep learning using an online instructional module was possible [27], Novak and colleagues in USA also showed that pharmacy students' learning style changed before and after a problem-based learning experience. They argued that students' learning preferences may change according to how the learning was structured, demands of educators, assignments, or assessments [28]. Similarly, our findings serve to validate the essential need for shifting paradigms in instructional design in pharmaceutical education programmes to deliberately include methods that enhance deep learning.

In the absence of accompanying changes or modifying the generic learning environment through curriculum change [29], interventions such as the OADLSS may prove inefficacious or continue to show marginal effects in favour of the strategic learning approach. Hall and colleagues were able to demonstrate the impact of changing the learning environment to promote deep learning among accountancy students. Their study showed that students exhibited a small but statistically significant increase in their deep learning approach and a small but statistically significant reduction in their surface learning approach when the learning environment centred on group-based problem-solving activities [30]. Other evidence suggested that excessive course workload [12], structure of lectures, educators' lack of enthusiasm, and absence of feedback or guidance to students were crucial elements of the learning environment that maintained students preference towards a particular ATL [31], such that in the absence of that approach the students would not cope well with the educational demands of the particular learning activity. It will be interesting to evaluate the influence of changing the learning environment from the current predominantly expository teaching and learning methods used by the undergraduate pharmacy curriculum to more integrated, exploratory and problem-solving methods of teaching and learning on pharmacy students' ATL in Zambia. This is potentially future work.

That strategic learning remained the predominant approach was not very surprising. Our findings agreed with existing evidence that suggests pharmacy students generally tend towards being high achieving [26] and are predominantly strategic learners [12]. The dominance of strategic learning among participants, despite efforts to raise their metacognitive awareness of deep learning through the OADLSS intervention, may be in response to the inadvertent educational demands placed on them by the curriculum and educators. Comparison of our findings to other studies, Taylor and Harding also showed qualitative evidence that rote learning was adopted by many pharmacy students as the principal learning strategy in order to cope with their studies, even though the students perceived that approach as not ideal in terms of preparing for their future professional roles [32]. Smith and colleagues also found little change in mean scores for application directed approach to learning (related to deep learning) among undergraduate pharmacy students in Australia. They argued that pharmacy students' ATL may be influenced more by the learning environment than the discipline of study [33].

On whether a student's ATL could predict academic performance in the current educational environment on the pharmacy degree programme at the university, our findings showed that adopting a strategic approach increased the probability of scoring a higher GPA score (Figure 1). This finding may also partly explain why strategic learning remained seemingly more preferred among participants. It should be re-stated here that the OADLSS elective module was neither intended to increase test competence nor moderate academic performance in assessments but rather to raise metacognitive awareness of, and promote a deep ATL and study skills which the student may opt to or not adopt in their learning needs. In health sciences, a deep ATL has been shown to produce higher quality learning outcomes [7]. A reinforced argument by Biggs, and recently by Varunki and colleagues, suggests that some students might always apply a certain ATL regardless of the learning environment [34,35].

4.1. Implications on Educational Policy and Practice

How students learn on health professions' programmes has huge implications on their future educational outcomes and professional practice. For professional programmes like pharmacy that require acquisition of requisite knowledge and skill in the pharmaceutical sciences, competence requirements of pharmacists' practice go beyond memorising concepts learnt in pharmacy school but more about the application of requisite knowledge and skill, critical thinking and problem solving – all attributes of deep learning. Mattick and colleagues demonstrated empirical evidence that a deep approach to learning was associated with higher quality educational outcomes and practice in health sciences [7]. From findings of this study, we initially contend that educational interventions such as learning skills courses aimed at promoting meaningful learning can do well to be mainstreamed as components of curriculum. Moreover, going forward, these need to be complimented by education systems adopting teaching and learning methods, assessment modalities and educational strategies of the curriculum promoting deep learning.

4.2. Limitations of the Study

We were aware the monocentric nature of the study being done at one public university in Zambia and one population of interest may have limited the generalizability of the findings. However, the overall intent of the study was not to generalize but to demonstrate the potential effects of an innovative educational intervention. The OADLSS module was novel and tried for the first time in this study. In the absence of a known standard or similar study skills elective course currently offered on the bachelor's degree programmes in Zambia, no standard comparator was used. The elective module did not account for or contribute any course credits. Mere attendance with no formal assessment component may have affected the level of uptake and utilisation of concepts.

5. Conclusions

Participants found the OADLSS elective module beneficial for enhancing deep learning and study skills. However, the positive rating was not accompanied by immediate significant changes to their deep learning approach but there was a statistically significant decrease in the strategic approach among those exposed to the intervention. Accompanying changes to the learning environment, educational strategies of curriculum and educators, including the assessment modalities used at the university will be required to mainstream deep learning in pharmaceutical education. These are potential studies for the future.

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