

RESEARCH ARTICLES

Pharmacy Students' Approaches to Learning in Undergraduate and Graduate Entry Programs

Lorraine Smith, PhD,^a Ines Krass, PhD,^a Erica Sainsbury, PhD,^a and Grenville Rose, PhD^b

^aFaculty of Pharmacy, University of Sydney, NSW, Australia

^bAftercare, Sydney, NSW, Australia

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Objectives. To compare longitudinal data with previous cross-sectional data regarding Australian undergraduate pharmacy students' approaches to learning, and explore the differences in approaches to learning between undergraduate and postgraduate cohorts.

Methods. Longitudinal, repeated measures design using a validated self-report survey instrument were used to gather data.

Results. Undergraduate students' preferences for meaning directed, undirected, and reproduction-directed approaches to learning displayed the same pattern across the 2 studies; however, application-directed scores increased significantly in the second half of the undergraduate degree program. Commencing postgraduate students' approaches to learning were similar to finishing undergraduate students, and this group was significantly more oriented towards meaning-directed learning compared to undergraduate students.

Conclusions. Pharmacy students' maturation in approach to their learning was evident and this bodes well for pharmacists' engaging in life-long learning and capacity to work in increasingly complex health settings.

Keywords: lifelong learning, learning, Vermunt's Inventory of Learning Styles, longitudinal study

INTRODUCTION

The scope of pharmacy practice has changed greatly over the past 20 years.¹ No longer regarded simply as the providers of medicines, pharmacists are expected to deliver a range of patient-centered primary care services designed to meet the complex needs of patients, including medication and lifestyle management, provision of advice and counseling, and screening for disease.² Pharmacists commonly work within multidisciplinary teams, sharing responsibility for patients with long-term chronic conditions,³ and their sphere of expertise spans medicinal substances as well as disease state management services and models of chronic care.^{4,5} Accordingly, the educational content of pharmacy courses is increasingly geared towards producing a pharmacy graduate possessing not only pharmaceutical knowledge but also critical-thinking and problem-solving skills for applying this knowledge to "real world" clinical settings.⁶

Recent changes to the educational content of Australian professional pharmacy degrees⁷⁻⁹ mirror similar changes

worldwide^{10,11}: the intake of knowledge and its reproduction, delivered via traditional models of didactic teaching (the "transmission of knowledge"¹²) is no longer adequate for pharmacy students. However, students commonly struggle to integrate their pharmaceutical knowledge with the multifaceted medical needs of their patients. For example, pharmacy students have difficulty applying pharmacokinetic principles to patient care, a process Brackett and Reuning termed *contextual transfer of learning*.¹³ A longitudinal assessment of pharmacy students' critical thinking skills found that while these skills increased over the course of a pharmacy degree program, students' motivation to think critically did not.¹⁴

In Australia, tertiary pharmacy education has evolved rapidly in the last decade, with a significant proliferation in degree programs (from 6 in 1996 to 21 in 2009), and changes to the content and modes of delivery (eg, online learning, problem-based learning)⁸ Since then, graduate-entry master's level courses have been introduced. These allow accelerated completion of the academic requirements for pharmacist registration (2 years instead of 4) by students already holding a relevant undergraduate degree. These students have already been exposed to tertiary education models of learning and achievement, in contrast

Corresponding Author: Lorraine Smith, PhD, Faculty of Pharmacy, The University of Sydney, NSW, Australia.
Tel: 61-2-9036-7079. Fax: 61-2-9351-4391.
E-mail: lorraine.smith@sydney.edu.au

to students entering the undergraduate pharmacy program, who are in most cases high school graduates with no prior tertiary education. The University of Sydney introduced its master of pharmacy degree program in 2003.

Approaches to Learning

The ideal learning environment promotes students' motivation to master and acquire a deep understanding of course material, as well as develops self-directed and independent study skills.^{15,16} This mastery approach to learning is particularly important for the acquisition of critical-thinking and problem-solving skills and for fostering a desire for the lifelong learning attributes that many schools of pharmacy desire in their graduates.^{6,12,17} These approaches to learning also are believed to lead to enhanced academic performance.¹⁵ Furthermore, academics often expect students' approaches to learning to mature as they progress through the degree program. While this is supported in theory,^{15,16} findings from research into the extent to which students' approaches to learning change or mature over the course of a curriculum are equivocal. While 2 studies of university students' progression through their degree programs found increases in deep-processing strategies and self-regulated learning behaviors, another investigation of university students showed no improvements in productive approaches over time.¹⁷⁻¹⁹ Hastings et al's study of pharmacy students' motivation over the course of their degree revealed significant decreases in their desire to develop mastery and deep understanding of course material.²⁰ Similarly, Sansgiry found that the quality of pharmacy students' study strategies decreased over the 3 years of the degree program.²¹

An earlier cross-sectional investigation showed that students in all 4 undergraduate years at the University of Sydney preferred external sources of regulation and demonstrated little evidence of adopting deep-processing strategies or self-regulation to master their course material.²² However, students had a strong preference for learning material that could be used and applied in the professional setting, regardless of their year in the degree program. The relationship between approaches to learning and academic achievement was also investigated, and showed a significant negative relationship between academic achievement and preferences for deep-processing strategies, and a significant positive relationship between achievement and preferences for vocationally oriented learning. However, within this cross-sectional study, students of different years were exposed to slightly different curricula, since the curriculum was modified somewhat each year in order to improve it. A longitudinal study, on the other hand, has the additional benefit of allowing investigation of a single cohort exposed to the same curriculum.

Little definitive research has been undertaken into the approaches to learning adopted by postgraduate pharmacy students during their studies. Furthermore, research investigating the differences in approaches to learning between this group of students and their less "educationally mature" undergraduate peers is also lacking. For this study, we postulated that Australian students undertaking a postgraduate master of pharmacy course would be more self-regulated in their learning and prefer to adopt deeper learning strategies as a result of having completed a previous degree. This paper reports the results of a longitudinal study building upon the earlier cross-sectional investigation into Australian undergraduate pharmacy students' approaches to learning,²² together with an exploration of the differences in approaches to learning between undergraduate and postgraduate pharmacy students.

The specific objectives of the study were to:

- (1) compare the results of the earlier cross-sectional study of undergraduate students' approaches to learning with a longitudinal study of a single cohort (bachelor of pharmacy [BPharm]).
- (2) investigate the approaches to learning of a cohort of students who had already completed a university degree (postgraduate cohort, master of pharmacy [MPharm]).
- (3) compare the approaches to learning adopted by undergraduate and postgraduate students (BPharm vs. MPharm).

METHODS

The project utilized a longitudinal, repeated-measures design and was carried out between March 2005 and November 2008. Ethics approval from the University of Sydney Human Ethics Committee was obtained prior to commencement of this study. All students beginning the BPharm degree program in 2005 and the MPharm degree in 2006 were invited to participate in the study.

Vermunt's Inventory of Learning Styles was used to measure students' approaches to learning.²³ This validated, 120-item instrument comprises 4 scales: Meaning Directed, indicating students' preferences for deep processing, self-regulation and a belief that learning is defined by the construction of knowledge; Reproduction Directed, indicating students' preferences for surface learning, externally sourced regulation and a belief that learning is defined by the intake of knowledge; Undirected, indicating students' dependence on external sources of help, poor self-regulation and ambivalence regarding their studies; Application Directed, indicating students' beliefs that learning is the use of knowledge along with a strong vocational orientation. A more detailed description of the composition and psychometric properties of the Inventory of Learning

Styles is reported in our earlier publication.²² Sociodemographic data were also collected, including gender, entry pathway to university, language spoken at home, ethnic/cultural identification, and hours worked.

Data collection took place at the beginning, middle, and end of the degree program for both cohorts, and is detailed in Table 1. Students were provided with a participant information sheet outlining the rationale for the study and inviting them to participate. Noncompletion of the survey instrument indicated the student did not wish to volunteer, while completion of the survey instrument implied consent. The procedure was undertaken either during lecture or tutorial time. The time taken to complete the questionnaire was approximately 20 minutes.

Analyses were performed in Systat12 (Systat12 Software Inc, Chicago, IL), and SPSS (SPSS, Inc, Chicago, IL). Descriptive statistics of baseline data regarding degree program, age, and gender are reported. Missing data were replaced with the variable mean; less than 4% of the data were missing in any variable. The Shapiro-Wilk test determined that the variables were normally distributed, and Levene's test for homogeneity of variance found that there was no heteroscedasticity, even when comparing postgraduate results (28) against undergraduate results (201). Repeated measures analysis of variance was conducted within learning styles across 3 time points for both undergraduate and postgraduate students. Groups were matched across the 3 time points.

Greenhouse-Geisser and Huyn-Feldt epsilons above 0.95 were obtained for all variables in the repeated measures analyses. One way within measures ANOVAs were conducted on learning style averaged across time points for both the undergraduate and postgraduate groups. Bonferroni corrected pairwise comparisons were conducted where main effects were significant.

RESULTS

Two hundred twenty-nine students were included in the study, with the majority enrolled in the BPharm de-

Table 1. Data Collection Points for BPharm and MPharm Student Groups

	BPharm			MPharm	
	Year 1	Year 2	Year 4	Year 1	Year 2
March 2005	T1 ^a				
March 2006				T1	
November 2006		T2 ^b		T2	
November 2007				T3	
November 2008			T3 ^c		

^a T1 = beginning of degree

^b T2 = middle of degree

^c T3 = end of degree

gree (Table 2). In keeping with long-term trends, 69% were female and this was consistent across both cohorts. The majority of the BPharm cohort (83%) gained entry through the completion of final-year high school examinations, while all of the students in the MPharm cohort had completed a tertiary degree.

The results of the longitudinal study for both undergraduate and postgraduate cohorts are presented in Table 3. Our first objective was to assess the degree of alignment between the findings of the cross-sectional study²² and the results of the current longitudinal study. Table 4 summarizes the comparisons between the results of these 2 studies.

In relation to meaning directed, reproduction directed, and undirected approaches, the results from the current study were in close alignment with those of the cross-sectional study. Meaning directed scores declined from the beginning to the middle of the degree program (T1 → T2 [$p < 0.01$] vs. year 1 to year 2/3) and recovered to baseline by the end (T2 → T3 [$p = 0.01$] vs. year 2/3 to year 4), while reproduction directed approaches declined from year 1 and subsequently remained stable (T1 → T2/3 [$p < 0.01$] vs. year 1 to years 2-4). Undirected approaches did not change significantly across the 4 years of the degree, whether measured by cross section or longitudinally. In contrast, scores in application directed approaches increased significantly in the second half of the longitudinal study (T2 → T3, $p < 0.01$), whereas no changes were seen in the cross-sectional study.

The second objective was to evaluate changes in approaches to learning of a cohort of students who had already completed a university degree. The postgraduate students displayed a slightly different pattern of results from those of their undergraduate counterparts (Table 3), particularly in relation to meaning-directed approaches in which an increasing preference was apparent from the beginning to the end of the degree. Scores improved significantly from T1 → T2 ($p = 0.01$) and further from T2 → T3 ($p = 0.05$). As was the case with undergraduate students, scores for reproduction directed and undirected approaches did not change significantly over the course of their degree. Unlike the undergraduate results, application-directed approaches did not change significantly, although there was a trend towards sequential increases that approached significance ($p = 0.06$). The lack of

Table 2. Demographics of Study Participants at Baseline, N = 229

	BPharm	MPharm
Number of participants	201	28
Response rate, %	86	74
Age, Mean (SD)	20.5 (2.86)	22.4 (1.7)
Gender, % female	68	71

Table 3. BPharm and MPharm Students' Approaches to Learning

Learning Approach	Cohort	Students' Scores, Mean (95% CI)			P
		Beginning	Middle	End	
Meaning Directed	BPharm	65.0 (63.6-66.3)	61.1 (60.0-62.6)	64.7 (63.1-66.3)	< 0.01
Meaning Directed	MPharm	63.8 (60.1-67.4)	66.5 (63.4-69.5)	71.0 (67.4-74.7)	0.01
Reproduction Directed	BPharm	68.0 (66.1-68.7)	61.0 (59.7-62.3)	62.3 (60.8-63.9)	< 0.01
Reproduction Directed	MPharm	64.0 (60.8-67.2)	62.2 (58.5-66.0)	63.3 (60.0-66.6)	0.75
Undirected	BPharm	65.3 (64.9-66.6)	64.6 (63.3-65.8)	65.9 (64.8-67.1)	0.31
Undirected	MPharm	64.4 (61.2-67.5)	64.8 (60.5-69.0)	65.2 (62.1-68.4)	0.94
Application Directed	BPharm	81.8 (80.5-83.0)	81.2 (79.7-82.7)	87.0 (85.6-88.3)	<0.01
Application Directed	MPharm	85.0 (81.8-88.2)	87.2 (83.5-90.9)	90.4 (87.6-93.2)	0.06

significance may reflect the very high initial scores for application directed approaches for this cohort.

Comparison of Undergraduate and Postgraduate Students' Approaches to Learning

The third objective was to determine the extent to which students who had prior experience of undertaking and completing an undergraduate degree would display a greater preference for meaningful learning and self-regulation compared to their undergraduate counterparts. We conducted a comparison based on the average of each group of students' scores for each of the 4 scales across time (Table 5).

The postgraduate students were significantly more oriented towards meaningful learning than their less-experienced tertiary peers. They also showed a stronger vocational preference for applying in their profession the knowledge they had acquired. Application directed scores for both groups of students were significantly higher than any of the other learning approaches; this was consistent with the cross-sectional study.²² There were no significant differences between the 2 groups of students in their preferences for reproduction directed or undirected approaches to learning.

DISCUSSION

This study extended our earlier investigations into the approaches to learning preferred by pharmacy students at the University of Sydney, and the longitudinal study among undergraduate students has generally confirmed the results of the cross-sectional study previously reported.²² Meaning directed, undirected, and reproduction-directed approaches all displayed the same patterns in the 2 studies, suggesting that our previous conclusions were valid. Students demonstrated lower preferences for deep-processing strategies and self-regulation, and preferred to rely on external sources of assistance and regulation, thus constraining their capacity to engage in independent learning, both during and after university. Similarly, only patchy evidence of maturation of approach was evident in either study: in both, meaning-directed approaches declined from the beginning to the middle of the degree but regained their initial levels by the end. Reproduction-directed approaches declined from first year to a plateau across the remaining 3 years, and undirected approaches remained constant, suggesting that they retained their initial ambivalence toward their learning orientations.

In the current study, the highest preference was for application-directed approaches, reinforcing our earlier

Table 4. Significant Differences in Undergraduate Student Approaches to Learning Scores in Cross-Sectional and Longitudinal Studies

Learning Approach	Pairwise Comparisons ^a	
	Cross-Sectional Study	Current Longitudinal Study
Meaning directed	Year 1 vs Year 2 (↓)	T1 → T2 (↓)
	Year 1 vs Year 3 (↓)	
	Year 2 vs Year 4 (↑)	T2 → T3 (↑)
	Year 3 vs Year 4 (↑)	
Reproduction directed	Year 1 vs Year 2-4 (↓)	T1 → T2/3 (↓)
Undirected	no change	no change
Application directed	no change	T2 → T3 (↑)

^a Arrows = ↓ means that the score was significantly lower at the second time point; ↑ means that the score was significantly increased at the second time point

Table 5. Comparison of BPharm and MPharm Averaged Scores

Learning Approach	Students' Scores, Mean (95% CI)		P
	Undergraduate	Postgraduate	
Meaning Directed	63.6 (62.8-64.4)	67.1 (65.0-69.2)	<0.01
Reproduction Directed	63.6 (62.8-64.3)	63.2 (61.2-65.2)	0.73
Undirected	65.3 (64.5-66.0)	64.8 (62.9-66.7)	0.66
Application Directed	83.3 (82.4-84.1)	87.5 (85.7-89.4)	<0.01

observation that pharmacy students are strongly vocationally focused and believe that learning is associated with the use rather than acquisition or construction of knowledge. However, one significant difference was apparent. Undergraduate pharmacy students in the current study demonstrated an increase in their preference for application-directed approaches from the middle to the end of their degree, in contrast to those who took part in the cross-sectional study. Progressive changes in the final year curriculum between 2005 and 2008 may have contributed to this difference. These progressive changes involved reduction of the number of units of study from 12 to 6, with concomitant integration and streamlining of both content and delivery, and reduction in the extent of assessment. These changes were accompanied by improved perceptions by final-year students as evaluated by the University's Student Course Evaluation Questionnaire.²⁴⁻²⁷ Administered in 2005 and 2007, this survey showed that the percentage of students who: felt the assessments were appropriate increased from 31% to 48%; felt the workload was appropriate increased from 11% to 24%; and indicated an increase in overall satisfaction increased from 59% to 70%.²⁸ Although this conclusion is tentative, it nonetheless highlights the importance of considering the learning environment as a critical element of student behaviors. The next stage of our research will explore this aspect by investigating approaches to learning of pharmacy students who have experienced a significantly revised curriculum which has been recently implemented, and comparing the results with those of the study reported here.

The comparison of the undergraduate students' approaches to learning with their postgraduate peers showed that, although both groups displayed significant differences in meaning-directed approaches across their degrees, the scores increased consistently throughout the MPharm degree, rather than exhibiting the pattern of decline and recovery observed for BPharm students. The primary similarity was that both groups demonstrated no changes in undirected approaches throughout their degrees, and the scores for the 2 cohorts for this approach were not significantly different.

Reproduction-directed approaches remained unchanged across the MPharm degree in contrast to the de-

cline observed in the early stages of the BPharm degree, and the increase in application-directed approaches through the MPharm degree was not significant compared to that observed for BPharm students.

An interesting phenomenon was observed when comparing the 2 cohorts in that, for all scales, there were no significant differences ($p > 0.3$) between the scores of the BPharm students at the end of their degree and the MPharm students at the beginning. This finding supports the comparability of the 2 groups, since the learning approaches of the 2 groups at the same point in their university experience (the end of an undergraduate degree) were similar. Taken together with the findings for the MPharm cohort, this suggests that students who undertake a second tertiary qualification may be more likely to recognize the importance of adopting deep approaches to learning and maintaining self-regulation. While the differences in curriculum and delivery between undergraduate and postgraduate courses and the smaller size of the MPharm cohort likely contributed to the more productive approaches adopted by the latter group, the fact that they undertook a second degree may be significant in mediating the adoption of different approaches to learning. Mediating influences might include a greater motivation for undertaking the additional qualification, the increased costs associated with the second degree (postgraduate students are required to pay approximately fivefold greater fees), and the older students' more mature outlook towards study. The results of this study are more encouraging than those of the cross-sectional study in terms of observing development of students' approaches to learning over time. In common with the study by Vermunt and colleagues,^{17,18} students in both the BPharm and MPharm cohorts in this study demonstrated significant increases over the course of their study in their preference for deep-processing strategies and self-regulation. In both cohorts, differences in curriculum and delivery may have been mediating factors in some of the observed changes; however, further research is necessary to elucidate the mechanisms by which any mediation occurred. Ongoing research is directed towards investigation of the approaches to learning adopted by BPharm students exposed to a substantially revised curriculum, together with an exploration of the learning

motivations of these students and their perceptions of the curriculum. Together, these data will inform our efforts to create stimulating learning environments that will equip future pharmacy graduates with the requisite knowledge and skills for enhanced pharmacy practice. These efforts have borne fruit in a number of ways including a new third-year undergraduate curriculum that will involve a streamlined approach to therapeutics that integrates basic and clinical sciences with social and practical aspects of the delivery of pharmacy services. We anticipate that this will encourage students to adopt deeper approaches to learning by facilitating the construction and application of their understanding.

CONCLUSION

The results of the longitudinal study of pharmacy students' approaches to learning lend support to the results of our earlier cross-sectional study; namely, that students demonstrate a strong preference for the more pragmatic application-directed approaches, which emphasize the practical use of knowledge, and a weaker preference for meaning-directed approaches, which focus on deep processing and self-regulation. However, one significant difference was found: in later years, students adopted meaning-directed approaches to a greater extent than in earlier years, suggesting some maturation in approach that was not evident in the cross-sectional study. MPharm students appeared to commence their postgraduate study with approaches very similar to those of BPharm students as they finished their undergraduate degree, suggesting some continuum of approach; however, these students demonstrated clear maturation over the duration of their MPharm degree in both meaning-directed and application-directed approaches.

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