Peer Assisted Learning 2023/24: An Evaluation

Access and Participation Impact Report

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February 2025

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Executive Summary

The activity

Peer Assisted Learning (PAL) at the University of Reading is a model of peer-led academic support in which second or third year students deliver group learning activities for first year students. It is based on the idea that when formal instruction is supplemented by peer-only, cooperative environments, students better 'adjust quickly to university life, improve their study habits, acquire a clear view of course direction and expectations and enhance their understanding of the subject matter' (Capstick, 2004). PAL is common to higher education and positive outcomes based on comprehensive evaluation are well-established (Loviseck & Cloutier 2001).

The evaluation

The evaluation methodology was Type 2, as there was a comparison of pre-post survey scores for sense of belonging, academic confidence and study skills, and a comparison of attainment outcomes (exam result) for participants and non-participants.

Main findings

- In Henley Business School (HBS), post-PAL survey scores increased for sense of belonging, confidence in ability to achieve good grades and cognition skills but differences were not statistically significant. There was a very small sample size (n = 8).
- In the School of Pharmacy, post-PAL survey scores showed statistically significant improvements ($p < 0.05$) across all measures except cognitive/study skills, with small-to-medium effect sizes.
- When pooling the data, statistically significant improvements were observed in most areas, particularly for sense of belonging, confidence and cognitive skills.
- For exam results, matched analysis showed a significant impact of PAL in HBS, though this was not matched for prior attainment. In Pharmacy, there was no significant impact, but mean exam scores were above a high 2:1 for both groups.

Conclusions/recommendations

This study evaluated the impact of Peer Assisted Learning (PAL) on student success at the University of Reading by analysing survey responses from Henley Business School and the School of Pharmacy students before and after participation in PAL. It also attempted new methodology to link to exam results. While survey results from Henley Business School showed no statistically significant changes, students in the School of Pharmacy reported significant improvements across all measured outcomes except cognitive skills. When combined, post-activity scores were generally higher, with a moderate effect size of 0.5, suggesting PAL positively influences students' sense of belonging and self-perceptions of academic and cognitive skills. Exam scores were significantly higher for PAL students in HBS, but not Pharmacy. This is a

complicated picture as HBS students were not matched on prior attainment for analysis, and Pharmacy student groups (doing PAL and not) both had mean scores that were high 2:1 or above. Future research will aim to gather more survey data, construct matched comparison groups including prior attainment, and some measure of engagement if possible to better assess PAL's independent effects. More schools that are running PAL will be included in analysis. Longer term data on continuation will also add insight.

Introduction

Caveats to the report

This report is part of the first cycle of more robust evaluation in line with our new Access and Participation Plan. Therefore, we acknowledge that the evaluation still has limitations and we do not intend to over-claim the strength of any conclusions.

In particular, it is noted that this evaluation is based primarily on self-reported data, which can be impacted by many factors. There were practical challenges to data collection, and it is acknowledged that the limited sample size of pre- and post-intervention data reduces the robustness of claims about the programme's effectiveness beyond immediate reactions. Additionally, not all variables were controlled for in the analysis of exam scores. Nevertheless, the data here still provide valuable insights into engagement and the immediate perceived benefits of the programme. Future evaluations will aim to strengthen data collection, ensuring a larger sample of pre- and post-intervention measures, and include controls for comparison groups where possible. Long-term data will also become available.

Rationale

The Access and Participation Plan sets out targets to close continuation gaps that affect widening participation groups, particularly Black and mature students who are considered at risk of insufficient academic and personal support.

Cohort	Overall (4-year average) continuation gap size
Black	5.9pp
Mature	8.1pp

Table 1 - Differences in rates of retention between APP target students and their counterparts

For undergraduate students, the largest continuation gaps occur between Part 1 and Part 2. It is theorised that since Peer Assisted Learning (PAL) supports students' sense of belonging and academic development during this period since it helps ease the transition to university.

Intervention

PAL involves higher-year students – “PAL Leaders” (typically level three, although in some cases level two) - supporting new entrants in weekly, peer-only study support sessions. The PAL Leaders facilitate group activities and ask questions to provoke learning, rather than specifically teaching the students. The idea is that students learn from each other as well as the PAL leader. The students themselves determine the focus of the sessions by evaluating their understanding of the course content and the elements they feel they would like to improve upon.

One critical benefit of PAL is that the student-only environment leads to a safe and trusting setting to engage with the content in ways that may not feel accessible to students with staff present, thus tackling the ‘hidden curriculum’ (Capstick, 2004).

Four PAL Leaders were recruited to deliver PAL to two separate groups of students enrolled onto the module *Business in Practice: Accounting for Managers.* Eighteen Leaders recruited for Pharmacy. These PAL schemes took place over the course over the autumn term.

Context

PAL is delivered to a self-selecting group of students who choose to attend voluntarily. It is therefore open to students of all backgrounds and data is not collected to determine whether attendees align with APP target groups. However, both schools linked to this study have the highest proportions of target students, generally, when compared to the rest of the institution.

Future evaluations will be able to provide detailed demographic information on PAL attendees due to new data systems.

PAL in Henley Business School was in its first year and considered a small, pilot scheme in the academic year pertaining to this study (2023-24). This contrasts with the School of Pharmacy where PAL is well-established. This evaluation report covers the academic year 2023-2024.

Link to Access & Participation Plan (APP)

	Objective	**Target(s)**
IS3	Ensure that underrepresented students remain on course and complete their studies with equivalent success rates to the wider student population by 2030.	Achieve parity in rates of continuation between Black and white undergraduate cohorts by 2030, from a baseline gap of 8.4pp. Achieve parity in rates of continuation between young and mature cohorts by 2030, from a baseline gap of 7.9pp.

Previous evaluation

Surveys have been conducted in previous iterations of PAL however it is not possible to use this historical data as a basis for comparison to this evaluation, which is more extensive.

Methodology

Research questions

- Does participation in PAL significantly increase students' reported sense of belonging?
- Does participation in PAL significantly increase students' reported academic confidence?
- Does participation in PAL significantly increase students' reported study strategy skills?
- Longer term: Do we see improved continuation rates amongst target students (Black, and mature)? (note, this data is not yet available).
- Note, a further evaluation question was added: does PAL have an impact on exam scores?

Participants

In Henley Business School, two groups of 25 students enrolled in PAL initially. Attendance varied week-to-week, the lowest attendance rate being 4 and the highest being 13. 18 students were recorded as fully participating in PAL from HBS, based on information provided by the PAL convenor. In Pharmacy, 21 students were recorded as fully participating in PAL, based on completing pre and post surveys.

Data collection

Two surveys were administered during this study. Participants were invited to complete a 'pre-activity' questionnaire in the opening PAL session. The students who attended the last session were invited to complete the 'post-activity' questionnaire. This questionnaire was also circulated via email message to capture responses from students not in attendance at the final session.

The survey design used Likert scales to measure four key domains: i) a sense of belonging ii) confidence in ability to achieve good grades iii) self-perception of ability to use course materials and teaching resources effectively and iv) cognitive skills.

The ‘sense of belonging’ and ‘cognitive skills’ domains are measured through two respective sets of four questions, the results of which were aggregated in the data analysis. The mean values for these domains are therefore the average mean across the four questions. The questions themselves derive from validate scales provided by TASO and NERUPI (See Table 1).

What data will be collected?	Survey questions
Students reported sense of belonging (TASO)	1. feel I belong at university. 2. I made the right decision in choosing to study at this university. 3. I feel supported by this university. 4. I see myself as part of the university community.
Students reported academic confidence (adapted from NERUPI)	1. I feel confident in my ability to achieve good grades 2. I can use course materials and teaching resources effectively
Students reported study strategy/cognitive skills (slightly adapted from TASO)	1. I can find key ideas easily when reading a text for my studies. 2. I can assess how reliable information is when reading a text for my studies. 3. I can clearly explain my ideas, even when writing about complicated things. 4. I can confidently explain my ideas in small group discussions.

Table 2 - The survey questions asked pre and post PAL participation

Ethics and Data Security

All participants were over the age of 18 and were informed that the data they provided on the survey would be used for evaluation purposes. No individuals are identified in this report.

Data analysis

Surveys

The survey data was transposed from Microsoft Forms to Microsoft Excel and prepared by removing duplicate or incomplete entries. Paired t-tests were conducted using Excel’s in-built T.Test function to produce values related to the pre and post

survey responses. As described previously, an average mean was produced by combining questions.

Attainment

For the attainment comparison, data was gathered on student attainment on the exam (as deemed most relevant by the PAL convenor in the school). Additional data for matching was gathered from our internal data team.

Henley Business School:

PAL participants were matched on gender, fee status, ethnicity, household income, IMD quintile, and young/mature status using Propensity Score Matching in Stata, after which statistical comparisons of the groups were carried out, also in Stata. UCAS points were not included in this analysis which does limit the conclusions; this will be included in future iterations.

Pharmacy:

PAL participants were matched on gender, fee status, ethnicity, household income, IMD quintile, young/mature status and UCAS entry tariff using Propensity Score Matching in Stata, after which statistical comparisons of the groups were carried out, also in Stata.

Type of evaluation

This evaluation is ‘Type 2’ as it measures whether the expected changes took place before and after the activity.

Additionally, there is a quasi-experimental design element, as matched comparison groups were created using Propensity Score Matching to investigate the impact on attainment.

Limitations

Known limitations may include:

- **Response rates:** Virtually all the respondents were among those students who attended the most sessions. It is difficult therefore to determine the degree to which attendance is linked with outcomes, making generalisation difficult. Response rates were also quite low, leading to small sample sizes for analysis.
- **Response bias:** the students may have included socially biased responses, for example if they wished to provide evidence that would reflect well on the PAL Leader who they had developed a positive relationship with.
- **Maturation effect:** as this study did not utilise a control group it is difficult to determine whether students’ sense of belonging, confidence and cognitive skills would have developed organically because of other factors. The matching goes some way to mitigate this with reference to exam scores.

- **Survey fatigue:** Reading students typically report being asked to complete a considerable number of surveys. Some respondents may rush through one or more surveys affecting the reliability of the responses.
- **Matching:** Students were not able to be matched on every relevant variable; in particular, there was no matching possible on motivation/engagement, and for HBS no UCAS score, both of which may have had a significant impact on exam attainment.

Results

Surveys

A summary of the t-test schools for the two respective subjects included in this study, followed by the combined results, is given below. See the appendix for the full test results.

Henley Business School: Business in Practice: Accounting for managers

Concept	'before' Mean (*SD*)	'after' Mean (SD)	Statistical test	Effect size
Sense of belonging (average)	3.02 (*0.78*)	3.54 (*0.80*)	t(7) = -1.41, *p* = 0.21	*d* = 0.67
Confidence in ability to achieve good grades	3.14 (*0.83*)	3.43 (*0.73*)	t(6) = -0.60, *p* = 0.56	*d* = 0.34
Self-perception of ability to use course materials and teaching resources effectively	3.43 (*0.49*)	3.00 (*0.76*)	t(6), 1.16, *p* = 0.29	*d* = -0.87
Cognitive skills (average)	2.71 (*0.83*)	3.48 (*0.69*)	t(6), -1.71, *p* = 0.14	*d* = 0.92

Post-PAL scores for the aggregated sense of belonging questions (*M* = 3.54) were higher than the pre-PAL scores (*M* = 3.02). A paired samples t-test found this difference to be insignificant (*t(7)* = -1.41, *p* = 0.21). The effect size measured using Cohen's D is 0.67; this is considered a medium effect. The analysis was likely under-powered, due to the final sample size being 8.

Post-PAL scores for confidence in ability to achieve good grades (*M* = 3.43) were higher than pre-PAL scores (*M* = 3.14). A paired samples t-test found this difference to be insignificant (*t(7)* = -0.6, *p* = 0.56). The effect size is 0.34, considered a small effect.

Post-PAL scores for 'I can use course materials and teaching resources effectively' were lower (*M* = 3.0) than pre-PAL scores (*M* = 3.4). A paired samples t-test found this difference to be insignificant (*t(7)* = 1.16, *p* = 0.29). The effect size is -0.86.

Post-PAL scores for the aggregated cognitive skills questions were higher (*M* = 3.50) than pre-PAL scores (*M* = 2.7). A paired samples t-test found this difference to be insignificant *(t(7)* = -1.71, *p* = 0.14). The effect size is 0.92 which is considered a medium effect.

Pharmacy: Professional Practice 1

	'before' Mean (*SD*)	**'after' Mean (*SD*)**	**Statistical test**	**Effect size**
Sense of belonging (average)	3.58 (*0.95*)	4.13 (*0.71*)	t(20), -2.09, *p* = 0.05	*d* = 0.57
Confidence in ability to achieve good grades	3.19 (*1.02*)	3.81 (*0.91*)	t(20), -1.89, *p* = 0.07	*d* = 0.56
Self-perception of ability to use course materials and teaching resources effectively	3.43 (*1.08*)	3.86 (*0.85*)	t(20), -2.01, *p* = 0.06	*d* =0.43
Cognitive skills (average)	3.31 (*0.95*)	3.93 (*0.80*)	t(20), -2.68, *p* = 0.01	*d* = 0.71

Post-PAL scores for the aggregated sense of belonging questions were higher (*M* = 4.13) than pre-PAL scores (*M* = 3.58). A paired samples t-test found this difference to be significant (*t(20)* = -2.09, *p* = 0.05). The effect size is 0.57, considered a medium effect.

Post-PAL scores for confidence in ability to achieve good grades (*M* = 3.81) were higher than pre-PAL scores (*M* = 3.19). A paired samples t-test found this difference to be insignificant (*t(20)* = -1.89, *p*= 0.07). The effect size is 0.56 which is considered a medium effect.

Post-PAL scores for ability to use course materials and teaching resources effectively (*M* = 3.86) were higher than pre-PAL scores (*M* = 3.42). A paired samples t-test found this difference to be marginally significant (*t* = -2.01, *p*= 0.058). The effect size is 0.42 which is considered a small effect.

Post-PAL scores for the cognitive skills average (*M* = 3.92) were higher than pre-PAL scores (*M* = 3.31). A paired samples t-test found this difference to be significant (*t* = -2.68, *p* = 0.01). The effect size is 0.71 which is considered a medium effect.

Combined results

	'before' Mean (*SD*)	**'after' Mean (*SD*)**	**Statistical test**	**Effect size**

Sense of belonging (average)	3.44 (*0.96*)	3.98 (*0.67*)	t(27), -2.53, *p* = 0.02	*d* = 0.57
Confidence in ability to achieve good grades	3.18 (*1.04*)	3.71 (*0.75*)	t(27), -1.99, *p* = 0.06	*d* = 0.52
Self-perception of ability to use course materials and teaching resources effectively	3.43 (*0.90*)	3.64 (*0.77*)	t(27), -1.1, *p* = 0.28	*d* = 0.24
Cognitive skills (average)	3.16 (*0.90*)	3.82 (*0.70*)	t(27), -3.24, p = 0.003	*d* = 0.73

Post-PAL scores for the sense of belonging average (M = 3.98) were higher than pre-PAL scores (M = 3.44). A paired samples t-test found this difference to be significant (t (27) = -2.5, *p* = 0.02). The effect size is 0.6 which is considered a medium effect.

Post-PAL scores for confidence in ability to achieve good grades were higher (M = 3.71) than pre-PAL scores (M = 3.18). A paired samples t-test found this difference to be insignificant (t(27) = -2, p = 0.06). The effect size is 0.5 which is considered a medium effect.

Post-PAL scores for ability to use course materials and teaching resources effectively were slightly higher (M = 3.6) than pre-PAL scores (M = 3.4). A paired samples t-test found this difference to be insignificant (t(27) = -1, p = 0.3). The effect size is 0.2; a small effect.

Post-PAL scores for the cognitive skills average (M = 3.8) were higher than pre-PAL scores (M = 3.2). A paired samples t-test found this difference to be significant (t(27) = -3.2, p = 0.003). The effect size is 0.7 which is considered a medium effect.

Attainment

The following section presents a summary of the attainment results for PAL and non-PAL students, who were matched using Propensity Score Matching.

HBS

We gathered exam scores for the exam most relevant to the PAL content. There were 18 students who did PAL, and 560 who did not. An unsorted regression showed that those who did PAL had significantly higher exam scores with a difference of 15.9 points, *F* (1, 576) = 7.65, *p* = 0.01.

When looking at participation in PAL, a regression including gender, fee status, ethnicity, household income and IMD quintile showed that this model significantly predicted participation in PAL; this means that those factors predicted who chose to take part in PAL.

Therefore, Propensity Score Matching was used to create a matched group of students to those who did PAL. They were matched on the same variables (gender, fee status, ethnicity, household income and IMD quintile) using Stata *teffects psmatch*

command and looking at the Average Treatment Effect on the Treated (ATET). The matched analysis result showed that students doing PAL scored 11 points higher than the matched group, $p = 0.03$. Therefore, it appears that PAL has a small but significant effect on exam score, when the aforementioned variables are taken into account.

Pharmacy

We gathered exam scores for those who did PAL (21) and those who did not (144). Analysis of the unsorted groups showed no significant difference between the groups ($p = 0.5$); those who did PAL scored on average 72.71 and those who did not scored 69.66. These means are both above a high 2:1, indicating that there may not have been scope for PAL to improve scores.

When looking at participation in PAL, a regression including gender, fee status, ethnicity, household income, IMD quintile and UCAS score showed that the model as a whole did not significantly predict participation in PAL, although household income alone was marginally significant ($p = 0.055$).

Propensity Score Matching was used to create a matched group to the PAL group. This matched on the same variables as HBS, but also included UCAS tariff as a proxy for prior attainment. As above, this used Stata *teffects psmatch* command and looking at the Average Treatment Effect on the Treated (ATET). The matched analysis showed that PAL participants score 1.2 points higher, a difference that is not significant ($p = 0.87$).

Conclusions & recommendations

The purpose of this study was to assess the impact of Peer Assisted Learning (PAL) on a range of intermediate outcomes associated with success in higher education. Specifically, we used paired samples t-tests to compare average survey responses before and after attending one or more Peer Assisted Learning sessions over the course of one term. We collected survey responses from students in Henley Business School and the School of Pharmacy, yielding 8 and 21 validated responses respectively. Our analysis revealed that PAL is having a positive impact on its participants, though not statistically significant in all cases.

While the surveyed averages were generally higher post-PAL activity, no statistically significant responses were found amongst the sample from Henley Business School. In the School of Pharmacy, the mean test scores were all higher post-activity, and all t-tests were statistically significant, except cognitive skills.

Combining the results produced higher mean scores post-activity with all results showing statistical significance except for self-perception of ability to use course materials and teaching resources effectively. Further, the average effect size of 0.5 for the combined scores indicates a moderately meaningful effect, supporting the hypothesis that the PAL model can lead to gains in a sense of belonging and self-perceptions of academic and cognitive skills.

The analysis of attainment between PAL participants and non-participants yields a complicated picture. For HBS participants, there was a significant impact of doing PAL, when predictor variables were taken into account; however, this did not include UCAS as a measure of prior attainment.

For Pharmacy, there was no significant impact of doing PAL, both for unmatched and matched comparisons. It should be noted that both groups were scoring at least (on average) a high 2:1 in this exam, meaning PAL may not have had much 'room' for impact.

These analyses were an attempt to try new methodology to link additional data and therefore should be considered as only part of the picture. Future analysis will ensure to include UCAS as a predictor, and hope to have greater numbers for more robust analysis.

Overall, it does appear that PAL is having a positive impact on student perceptions of sense of belonging, academic confidence and skills; which is translating to exam results in some contexts. PAL should be continued, and more detailed analysis of the next cycle should help to clarify the impact of PAL, which may be different in each school. It would also be beneficial to study the different contexts of PAL more closely; as this may differ between schools.

There are some limitations to the study. The sample sizes were relatively small affecting the reliability of the findings and preventing a robust analysis of the connection between the number of sessions attended and reported outcomes. Developing data processes further, and the collection of longer term continuation data to enable testing of a more refined research question ("*Do we see improved continuation rates amongst specific target student groupings e.g. Black heritage or mature students"*) will lead to a more robust evaluation. Practical methods for increasing engagement with the surveys may also benefit future evaluations.

Notes

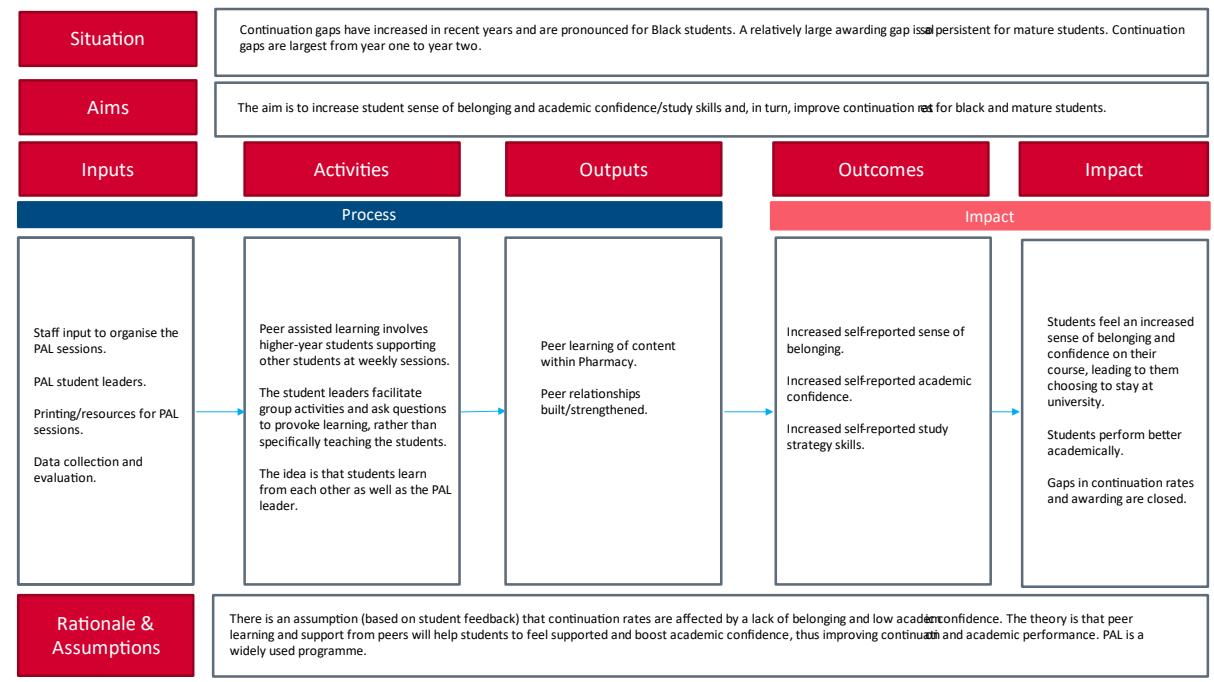
This report has been reviewed by members of the Access and Participation Evaluation Subcommittee (APES).

References

Capstick, S. (2004) *Benefits and Shortcomings of Peer Assisted Learning (PAL) in Higher Education: an appraisal by students*,

Loviseck, A. & Cloutier, N. (2001) *Supplemental Instruction and the enhancement of student performance in economics principles.* The American Economist, 41(2), 70- 76.

Appendix A – Theory of Change



Appendix B – full results

Henley Business School: Business in Practice: Accounting for managers

t-Test: Paired Two Sample for Means: sense of belonging average

	Sense of belonging average (pre)	*Sense of belonging average (post)*
Mean	3.017143	3.535714
Variance	0.702957	0.738095
Observations	7	7
Pearson Correlation	0.342031	
Hypothesized Mean Difference	0	
df	6	
t Stat	-1.4089	
P(T<=t) one-tail	0.10426	
t Critical one-tail	1.94318	
P(T<=t) two-tail	0.208521	
Effect size	0.668063	

t-Test: Paired Two Sample for Means: confidence in ability to achieve good grades

	I feel confident in my ability to achieve good grades (pre)	*I feel confident in my ability to achieve good grades (post)*
Mean	3.142857143	3.428571
Variance	0.80952381	0.619048
Observations	7	7
Pearson Correlation	-0.100900919	
Hypothesized Mean Difference	0	
df	6	
t Stat	-0.603022689	
P(T<=t) one-tail	0.284285628	
t Critical one-tail	1.943180281	
P(T<=t) two-tail	0.568571257	
t Critical two-tail	2.446911851	

Effect size	0.34299717	

t-Test: Paired Two Sample for Means: self-perception of ability to use course materials and teaching resources effectively

	I can use course materials and teaching resources effectively (pre)	*I can use course materials and teaching resources effectively (post)*
Mean	3.428571429	3
Variance	0.285714286	0.666666667
Observations	7	7
Pearson Correlation	0	
Hypothesized Mean Difference	0	
df	6	
t Stat	1.161895004	
P(T<=t) one-tail	0.144701612	
t Critical one-tail	1.943180281	
P(T<=t) two-tail	0.289403225	
t Critical two-tail	2.446911851	
Effect size	-0.866025404	

t-Test: Paired Two Sample for Means: cognitive skills average

	Cognitive skills average (pre)	*Cognitive skills average (post)*
Mean	2.714286	3.477273
Variance	0.800595	0.551653
Observations	7	7
Pearson Correlation	-0.03705	
Hypothesized Mean Difference	0	
df	6	
t Stat	-1.70518	
P(T<=t) one-tail	0.069521	
t Critical one-tail	1.94318	
P(T<=t) two-tail	0.139041	

t Critical two-tail	2.446912	
Effect size	0.921052	

School of Pharmacy: Professional Practice 1

t-Test: Paired Two Sample for Means: sense of belonging average

	Sense of belonging average (pre)	*Sense of belonging average (post)*
Mean	3.583333	4.130952
Variance	0.983333	0.322619
Observations	21	21
Pearson Correlation	-0.11466	
Hypothesized Mean Difference	0	
df	20	
t Stat	-2.09481	
P(T<=t) one-tail	0.024562	
t Critical one-tail	1.724718	
P(T<=t) two-tail	0.049125	
t Critical two-tail	2.085963	
Effect size	0.565878	

t-Test: Paired Two Sample for Means: confidence in ability to achieve good grades

	I feel confident in my ability to achieve good grades (pre)	*I feel confident in my ability to achieve good grades (post)*
Mean	3.19047619	3.80952381
Variance	1.261904762	0.561904762
Observations	21	21
Pearson Correlation	-0.251649499	
Hypothesized Mean Difference	0	
df	20	
t Stat	-1.892223157	
P(T<=t) one-tail	0.036514281	

t Critical one-tail	1.724718243	
P(T<=t) two-tail	0.073028562	
t Critical two-tail	2.085963447	
Effect size	0.564683916	

t-Test: Paired Two Sample for Means: self-perception of ability to use course materials and teaching resources effectively

	I can use course materials and teaching resources effectively (pre)	*I can use course materials and teaching resources effectively (post)*
Mean	3.428571	3.857143
Variance	1.057143	0.428571
Observations	21	21
Pearson Correlation	0.392641	
Hypothesized Mean Difference	0	
df	20	
t Stat	-2.00745	
P(T<=t) one-tail	0.029203	
t Critical one-tail	1.724718	
P(T<=t) two-tail	0.058406	
t Critical two-tail	2.085963	
Effect size	0.427121	

t-Test: Paired Two Sample for Means: cognitive skills average

	Cognitive skills average (pre)	*Cognitive skills average (post)*
Mean	3.309524	3.928571
Variance	0.805655	0.463393
Observations	21	21
Pearson Correlation	0.124939	
Hypothesized Mean Difference	0	

df	20	
t Stat	-2.68491	
P(T<=t) one-tail	0.00712	
t Critical one-tail	1.724718	
P(T<=t) two-tail	0.01424	
t Critical two-tail	2.085963	
Effect size	0.706715	

Combined results

t-Test: Paired Two Sample for Means: sense of belonging average

	Sense of belonging average (pre)	*Sense of belonging average (post)*
Mean	3.441785714	3.982142857
Variance	0.946941138	0.471891534
Observations	28	28
Pearson Correlation	0.108367414	
Hypothesized Mean Difference	0	
df	27	
t Stat	-2.533281361	
P(T<=t) one-tail	0.008708576	
t Critical one-tail	1.703288446	
P(T<=t) two-tail	0.017417152	
t Critical two-tail	2.051830516	
Effect size	0.565479074	

t-Test: Paired Two Sample for Means: confidence in ability to achieve good grades

	I feel confident in my ability to achieve good grades. (pre)	*I feel confident in my ability to achieve good grades. (post)*
Mean	3.178571429	3.714285714
Variance	1.115079365	0.582010582
Observations	28	28

Pearson Correlation	-0.210169574	
Hypothesized Mean Difference	0	
df	27	
t Stat	-1.986798536	
P(T<=t) one-tail	0.028589559	
t Critical one-tail	1.703288446	
P(T<=t) two-tail	0.057179118	
t Critical two-tail	2.051830516	
Effect size	0.516627443	

t-Test: Paired Two Sample for Means: self-perception of ability to use course materials and teaching resources effectively

	I can use course materials and teaching resources effectively.	*I can use course materials and teaching resources effectively.*
Mean	3.428571429	3.642857143
Variance	0.846560847	0.608465608
Observations	28	28
Pearson Correlation	0.272767619	
Hypothesized Mean Difference	0	
df	27	
t Stat	-1.099524999	
P(T<=t) one-tail	0.140623338	
t Critical one-tail	1.703288446	
P(T<=t) two-tail	0.281246677	
t Critical two-tail	2.051830516	
Effect size	0.237170825	

t-Test: Paired Two Sample for Means: cognitive skills average

	Cognitive skills average	*Cognitive skills average*
Mean	3.160714286	3.815746753

Variance	0.843584656	0.505446101
Observations	28	28
Pearson Correlation	0.158212253	
Hypothesized Mean Difference	0	
df	27	
t Stat	-3.242878347	
P(T<=t) one-tail	0.001571194	
t Critical one-tail	1.703288446	
P(T<=t) two-tail	0.003142388	
t Critical two-tail	2.051830516	
Effect size	0.726265852	