Correlations between Deep, Surface or Strategic Learning Styles and Perceptions of Collaborative Learning in Higher Education

Stephen M. Rutherford, Galina Limorenko and Andrew M. Shore
School of Biosciences, Cardiff University, United Kingdom

Abstract

Collaborative Learning (CL), where students work together to develop shared understanding, is effective within the classroom. By co-constructing knowledge, learners benefit from the collective experience of others to supplement their learning. However, the extent to which students engage in collaborative activity outside of formal learning, and the basis of perceptions of the value of CL, is largely unknown. This study investigated correlations between experience and perceptions of CL vs. deep, surface or strategic learning styles. Preferences were for solitary learning over pair-based learning, over small/large groups. Preferences were not significantly different between age, gender, subject or year of study. Surface learners showed preference for group study, while strategic learners and deep learners tended towards solitary approaches. However, students did recognise the value of collaborative activity to learning. Findings suggest that students may require more training in, or scaffolding of, CL activities, if students are to engage with beneficial CL approaches.

1. Introduction

An imperative for supporting effective student learning and positive outcomes in Higher Education (HE), is understanding the way in which students study. Active learning [1], where students investigate information themselves and create their own understanding, is needed to develop students as independent and lifelong learners – a key aim of HE [2]. A well-proven pedagogy for enhancing and encouraging active learning is Collaborative Learning (CL), where students work together to discuss and solve problems, developing a shared understanding [3]. CL has been shown to enhance student academic outcomes [4,5] as well as enhance development of social and group skills, communication skills, confidence, and metacognitive ability [6]. The key factor for CL is the ability for learners to discuss material with each other, engaging in discussion that leads to each participant supporting the learning of their peers [7].

The paradigm for HE is that much of the learning undertaken is expected to be independent and self-directed by the student. Such self-directed learning (SDL) is better referred to as student-mediated learning (SML) as it can be driven either by the individual student or as part of a peer-based interactive relationship (such as paired study partners or study groups). Despite this being a significant requirement of tertiary education, the understanding of how students engage with this approach is limited. In particular, the extent to which students engage in CL during SML is poorly understood. Lee *et al.* [8] suggested that CL and SDL are mutually supportive of one another. Scott *et al*. [5, 9] also showed that, given a modicum of scaffolding, students will form collaborative study groups outside of class, which are highly effective. Students engaging in collaborative SML identified several benefits, such as increased efficiency of studying, the ability to ask questions of peers and discuss answers, and positive reinforcement of morale through interactions with encouraging colleagues. However, the studies cited above noted that engagement with CL-based study was limited, and the majority of students did not join in such activities – despite their being identified as effective strategies by those who did participate. This lack of engagement suggests that prevalent perceptions of CL are potentially negative amongst students in HE, and yet sub-groups of individuals do appear to find CL worthwhile. Identifying any prevalent demographics of these groups would be useful in supporting engagement with CL activity and encouraging students to build effective and mutually-supportive learning communities outside of the classroom.

Aside from basic demographics of age, educational level, subject specificity or gender, a key demographic with which to evaluate any correlations with perceptions of CL would be deep, surface and strategic learning styles [10, 11]. Characteristics of these learning styles are summarised in Table 1, and they can be assessed reliably via the 'Approaches to Study Skills Inventory for Students' (ASSIST) developed by Entwhistle and co-workers [12]. The ASSIST survey is a questionnaire of 60 questions clustered into 5 groups, each of 4 questions aligning to deep, surface or strategic behaviours. ASSIST has been verified as a diagnostic approach, and is the most extensively used and tested inventory for identification of learning methods, approaches and styles of students in HE institutions [13]. Individual students are likely to exhibit elements of deep, strategic and surface strategies, although it is common for one or two of the learning styles to

dominate. In particular, undergraduate students are ideally expected to exhibit strategies which align with deep learning (the development of holistic, broad understanding of a subject), although this is often reported not to be the case [14].

Table 1. Characteristics of Learning Styles

Strategic	Surface	Deep
Organised studying	Lack of purpose	Seeking of meaning
Time management	Unrelated memorising	Relating ideas
Alert to demands of assessment	Syllabus boundedness	Use of evidence
Achieving	Fear of failure	Interest in ideas
Monitoring effectiveness	Transmitting information	Supporting understanding

The analysis reported here aims to investigate correlations between learning styles and preferences for solitary, small or large group study environments, as well as general perceptions of the value of CL. The study used a quantitative approach, aligning the ASSIST questionnaire with questions testing students' perceptions of CL. The analysis suggests that general preferences are for solitary study over group-based activity, though surface learners prefer group-based learning activities, while deep and strategic learners tend towards more-solitary approaches and/or away from group activities. Surprisingly, however, students displaying all learning styles do seem to recognise the value of CL towards learning. These findings suggest that although they see CL as a beneficial activity for learning, there is often a reluctance to engage with it outside of scaffolded in-class activities.

2. Methodology

This study was undertaken with Undergraduate students within a research-intensive UK University. Ethical approval was obtained from the researchers' home department Research Ethics Committee.

An online survey was issued *via* the web-based 'Survey Monkey' platform. Students were recruited to the survey *via* email. To reveal the extent of students' deep, surface and strategic learning styles, the online survey used the ASSIST questionnaire questions [12], but with the terminology in the questions modified to be appropriate for an HE setting, rather than secondary education. In the ASSIST questionnaire, participants are asked a series of 60 questions about their preferences of, or typical engagement with, a range of learning and teaching activities. There are 20 questions (arranged in the analysis into 5 thematic groups of 4 questions each – see Table 2) relating to each of deep, surface or strategic learning activities. A series of 10 additional questions was added to the ASSIST questionnaire, interspersed between the published questions, to identify attitudes towards typical CL approaches. Participants were also asked to rank their preferences for named solitary, pair-wise or group learning activities. The ranking scale was converted into a 5-point Likert scale for ease of comparative analysis with ASSIST data [15]. The survey was circulated to students from all Undergraduate year groups, Year 1 to Year 4 (Undergraduate Masters) and across 7 academic Schools (Biosciences, Business, Maths, Modern Languages, Music, Engineering, Earth Sciences). As the ASSIST questionnaire was a slightly modified version with 10 new questions, Principal Component Analysis of the results of the 60 original ASSIST questions was undertaken to confirm the grouping of deep, surface and strategic traits, as with the original work by Entwhistle *et al.* [13]. Descriptive statistics, Analysis of Variance and regression analyses were used to identify trends and correlations in data relative to preferences for CL.

3. Results

A total of 527 students took part in the online survey. 64% of respondents were female and 55.6% were from the School of Biosciences. 94% were 21 years old or younger when they started the course.

3.1 Confirmation of validity of ASSIST

Factor analysis shows that responses to the question groups within each learning style largely cluster with other questions of that learning style, with high scores for reliability (Cronbach's alpha). In the social sciences context the factor loadings of 0.3 and above are considered significant and are usually published in scientific reports, here the factor loadings between 0.3 and 0.6 are considered moderate and above 0.6 are considered high [12].

These data support the validity of the ASSIST questionnaire used in this analysis, and re-confirm the findings of Entwhistle and co-workers [13]

3.2 Preferred Learning Environments

There were no significant differences between preferences for CL, correlated against age, gender, subject specialism or academic year of study. The proportions of students exhibiting strategic, surface or deep learning strategies also showed no significant not correlated with any demographic groupings. It was therefore possible to treat the respondents as a homogeneous group for cohort analysis.

Participants ranked 8 learning environments in order of preference. These environments were then clustered into 3 groups: Solitary study, working in

Table 2. Factor Analysis of ASSIST data.
Principal Factor Analysis with oblimin rotation, Cronbach's alpha values and correlation values between factors of ASSIST questionnaire data. The 5 Thematic question groups for each learning style are listed and contribute to each factor loading.

Factor		Strategic (I)	Surface (II)	Deep (III)
Scores of learning styles				
Strategic		0.777		
Surface			0.945	
Deep				0.847
DEEP STRATEGY				
Seeking meaning				0.716
Relating ideas				0.820
Use of evidence				0.743
Interest in ideas				0.658
Teaching that supports understanding			-0.331	0.547
STRATEGIC APPROACH				
Organised study		0.739		
Time management		0.786		
Assessment demands awareness		0.374	0.340	0.301
Achieving		0.673		
Monitoring effectiveness		0.483		0.386
SURFACE APPROACH				
Lack of purpose		-0.342	0.529	
Unrelated memorising			0.792	
Syllabus-boundness			0.686	
Fear of failure			0.835	
Teaching that transfers information			0.536	
Cronbach's alpha (reliability measure)				
Strategic (I)	0.929			
Surface (II)	0.919			
Deep (III)	0.920			
		I	**II**	**III**
Correlation between factors	**I**	1.000		
	II	-0.257	1.000	
	III	0.142	-0.205	1.000

Table 3. Study environment preferences for whole cohort (n=527)

Study environment preference	Mean values	Standard deviation
Solitary	6.407	1.678
Pairs	4.792	1.809
Group(3+)	2.740	1.619

pairs, working in groups of 3+. Mean values across the whole sample show a very clear preference for solitary study over other forms, and pairwise over group-based study (Table 3). There was therefore a general cohort-level preference for solitary activity over progressively larger groups.

In order to identify any correlations between learning style and study environment preferences, the responses to the ranking of environments was correlated with ASSIST results. The proportions of students displaying each of strategic, surface and deep characteristics are shown in Table 4. Although there was a general bias towards deep learning styles (over 50% of respondents displayed characteristics of deep learners), there were no single classes of learning styles that dominated on their own. This supports previous work [16] suggesting that most students exhibit a mixture of at least two learning style approaches.

Table 4. Distribution of learning styles within the overall cohort (n=527).
Upwards/downwards arrow = aggregate Likert score for questions within this category was above/below the cohort mean (out of 100) respectively

Learning style			n	%
Strategic	*Surface*	*Deep*		**Total**
↑	↑	↑	85	17.45
↑	↓	↑	107	21.97
↓	↑	↑	52	10.68
↓	↓	↑	38	7.80
↑	↑	↓	54	11.09
↑	↓	↓	42	8.62
↓	↑	↓	81	16.63
↓	↓	↓	28	5.75
58.298	**68.632**	**48.822**	**Cohort Mean**	

Analysis of Variance revealed several significant relationships between learning styles and preferences for study environments (Table 5). A preference for solitary study environment was positively associated with the strategic approach (linear regression, $F=12.091$, $r=0.156$, $t=3.477$, $p=0.001$), and negatively associated with surface learning (linear regression, $F=4.191$, $r = -0.093$, $p=0.041$). Preference for studying in pairs showed a significant negative correlation with surface strategies (linear regression; $F=3.897$, $r= -0.089$, $p=0.049$). No significant associations were found for studying in pairs versus

Table 5. Correlations between learning styles and environment preferences for whole cohort (n=527)

Preferred Study environment	Learning Style		
	Strategic	**Surface**	**Deep**
Solitary	Positive	Negative (weak)	-
Pairs	Negative	-	-
Group (3+)	Negative	Positive	Negative (weak)

deep and surface characteristics. Preference for a group study environment showed a significant negative association with deep learning style (linear regression, F=7.282, r= -0.122, p=0.007), however correlation coefficients are weak. A stronger negative correlation with strategic learning style (linear regression, F=10.04, r = -0.019, p=0.002) was observed. A slight positive correlation was found with surface learning style (linear regression, F=11.281, r=0.151, p=0.001). There is therefore a significant trend for surface learner characteristics to be associated with group-based study, in opposition to the trend in deep learning and strategic learning which tend more towards solitary environments.

3.3 Perceptions of the value of CL activities

Across the sample, there were no significant trends over students' perceived value of any study approach. Mean scores of responses (Table 6; a score of 3 being a neutral response) show that there are no approaches which were seen as more valuable than others. Producing and sharing resources with other students trended towards being seen as slightly-less valuable, but this was not a significant difference. It is interesting that the standard deviation is higher for sharing resources and peer teaching, than for other concepts, which demonstrates more variance in the attitudes of the sample than for 'working on my own' and 'working with another student'. This lack of a significant difference between perceptions of value of CL approaches contrasts with the preferences for learning environment results shown in Table 3, which showed a distinct preference for solitary learning. Students therefore appear to show a personal preference, but do not appear in these data to view any one study approach as being of more or less use than another. Again, it was possible that individual students' learning styles might influence their perceptions of the value of specific study methods, so a series of analyses of variance were undertaken.

Table 6. Perceived value of studying activity, for whole cohort (n=527)

Preferred Study Activity	Mean values	Standard deviation
Working on Own	3.643	0.674
Working with Another Student	3.899	0.829
Sharing Online Resources	3.162	1.084
Peer Teaching	3.623	1.021

An analysis of the individual learning styles correlated with perceptions of learning methodologies showed some degree of significance (Table 7). Deep-learning characteristics displayed a significant positive association with seeing value in collaboration with another student (linear regression, F=4.824, r=0.099, p=0.029). Strategic approach scores were significantly positively associated with solitary study preference to the group study environment (linear regression, F=4.208, r=0.092, p=0.041). No significant association was found for Surface style scores with solitary study. However, a significant positive association was observed between surface learning strategies and 'working with another student' (linear regression, F=6.746, r=0.116, p=0.010). A significant correlation was observed between alignment with surface learning approaches and both 'resource sharing' (linear regression, F=6.170, r=0.111, p=0.013) and 'peer teaching' (linear regression, F=20.087, r=0.198, p<0.0001); all correlation coefficients are weak.

Table 7. Perceived value of studying activity, correlated with Learning Style

Perceived Value of Study Activity	Learning Style		
	Strategic	Surface	Deep
Working on Own	Positive	none	none
Working with Another Student	none	Positive (weak)	Positive
Sharing Resources	none	Positive (weak)	none
Peer Teaching	none	Positive (weak)	none

4. Discussion

There are several observations of note from this study. Firstly, despite the assumption of many educators in HE that students will tend to develop from surface to deep learners as they progress through their studies, there do not appear to be clear demographic differences in the distribution of strategic, surface or deep learning strategies in progressive years of academic study of the participants. Similarly, attitudes towards CL show no significant differences between subject discipline areas, or between genders or ages.

A notable finding is that, when taken as a general cohort, HE students tend to prefer working independently, when undertaking SML, rather than working with the mutual support of peer and/or collaborative environments. This finding is not unexpected, and supports previous findings regarding attitudes towards group work in HE [17]. However, an additional observation is that although students appear to prefer independent working, over larger groups, this is based more on preference, rather than a perception that non-solitary study has less worth as a learning activity. The decision to

work independently, therefore, may be an active decision based on their desire to be able to focus on a project of one's own, without undue distraction from the (possibly unwelcome) interaction of others.

Students who exhibit different learning styles do not categorise neatly into groups with specific preferences for, or perceived value of, collaborative or solitary learning approaches. There was a weak correlation between surface learning strategies and a preference for group-based learning activities. Similarly, there was a weak correlation between deep and strategic learning approaches and a preference for solitary study activities, or at least negative correlations away from group study. The fact that these correlations were frequently weak in nature probably reflects the innate limited nature of the relationship, rather than an experimental restriction from sample size, as the number of respondents to the qualitative survey was relatively high. It is, therefore, not possible to link specific learning styles with either solitary, pair-wise, or collaborative behaviour to any robust extent. It is therefore likely that preferences towards approaches for learning are based on individual personal experience on the part of the learner, rather than a predictable behaviour based on a learning style approach. It is also, therefore, not possible to predict study choice preferences based on learning styles or approaches, as the learning styles themselves are difficult to define clearly.

However, there was an overall trend for learners exhibiting deep and strategic preferences to tend towards solitary or pair-wise learning, and those displaying surface approaches to generally prefer group-based approaches. This could potentially highlight the perceived benefits to a surface learner of sharing the workload of studying, and perhaps a perceived benefit of maximizing opportunities for sharing factual information with peers. It might also have been expected for strategic and deep learners to focus more towards collaborative activities in order to gain other perspectives and deepen understanding, but this appears not to be the case. Given the general preference in HE for deep learning as the ideal strategy, these results might suggest that group-work is a less-than-ideal learning strategy in HE learning and teaching activities.

Interestingly, although students display a clear preference overall for solitary learning, they do recognize that collaborative activities are viable learning approaches, and value them no less than solitary study in terms of their efficacy. There is, therefore, a disconnect between what students perceive as effective and what they personally prefer to do, given the choice. The motivations of students for choosing particular study approaches is therefore something that will be important to investigate further by more-qualitative methodologies.

5. Conclusions

Overall, the findings presented here suggest that solitary study is preferred by most students, over pairwise or CL-based study activities. There are correlations between learning style approaches and preferences for/perceptions of CL, but these do not vary or develop across different demographics of students and/or stages of learning development. Further research is needed to identify why students prefer individual rather than collaborative activity in their learning outside of the classroom.

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6. References

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