

Cognitive Style and Attitudes Towards Using Online Learning and Assessment Methods

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Abstract: The studies described in this paper sought to investigate several forms of online learning and assessment methods in terms their efficacy in facilitating student learning. The studies also sought to investigate how participants rated each method. Attitudes toward computer-assisted learning were not related to performance on each of the online methods employed, whereas some relationships were noted between cognitive styles and online learning and assessment. Finally, evaluation feedback from participants indicated that each online task was rated positively. Implications of the findings for further implementation of online instructional methods are discussed.

Keywords: Cognitive style, literature search, online discussion, online assessment

1. Introduction

There are numerous clear theoretical advantages of online instructional methods. Firstly, such methods provide for flexible learning, meaning that the student can progress at his or her own pace; secondly, such methods provide the facility for student centred learning, making the student responsible for his/her own learning. Finally, implementing online methods of instruction, means that material can be made available on demand from anywhere at any time provided the learner has the facility for taking advantage of such a system.

A variety of different online learning paradigms are now being utilised across higher education and therefore it would now seem timely to evaluate such systems in terms of their effectiveness. Three online methods are utilised in this paper. These are a literature search, an online discussion and an online assessment system. These three methods were chosen as being representative of the types of tasks students typically engage in through the medium of e-learning. It is also suggested that individual difference factors such as attitudes towards computer-based learning and cognitive learning style may be relevant to include in this investigation. The rationale for this is given below in sections 1.2 to 1.4. However, firstly a description of cognitive style is given.

1.1 Cognitive Style

Riding (1991) suggested that all cognitive styles could be categorised according to two orthogonal dimensions. These are the wholist-analytic dimension and the verbaliser-imager dimension.

1.1.1 Wholist-analytic style

Wholist-analytic cognitive style can be defined as the tendency for individuals to process information either as an integrated whole or in discrete parts of that whole. In practical terms, analytics are able to apprehend ideas or concepts in parts, but have difficulty integrating such ideas into complete wholes. However, wholists are able to view ideas as complete wholes, but are unable to separate these ideas into discrete parts (see Figure 1).

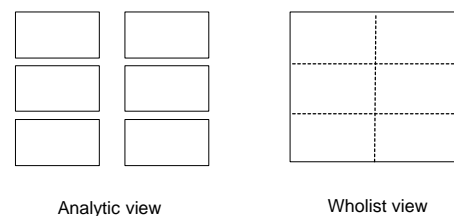


Figure 1: Analytic and Wholist views of information (Riding, 1991)

1.1.2 Verbaliser-imager cognitive style

The verbaliser-imager cognitive style can be defined quite simply as an individual's tendency to process information either in words or in images. Verbalisers are superior at working with verbal information, (Riding and Mathias, 1991; Riding and Watts, 1997) whereas imagers are better at working with visual and spatial information.

Both the wholist-analytic and verbaliser-imager cognitive styles can be assessed using the Cognitive Styles Analysis (CSA) detailed in section 2.2.1 below.

1.2 Online literature search

Searching for information sources online is now a skill with which most undergraduate students have to be familiar. Previous research suggests that the skill of searching for information is in some respects related to cognitive style. For example, cognitive style differences have been noted in searching for information in a database and this topic was investigated by Ford, Wood and Walsh (1994) and Wood, Ford and Walsh (1992). In these studies, searching strategies were classified in terms of relative breadth or depth. A high usage of the operator 'OR' to link keywords represents a relatively broad strategy, whereas a use of 'AND' a relatively narrow strategy. Their results showed that wholistic learners displayed a broader approach than analytic learners, in that they made significantly greater use of OR in searching. However, they also used more truncation than analytic learners, and made more use of 'AND', a finding not in accord with their hypothesis. While the issue of the use of different search strategies between individuals with different cognitive styles seems unsettled, the success rate at searching for information may yield more useful data. It is this issue that the current study seeks to address.

1.3 Online discussion

It would seem to be generally accepted that educational environments where students interact in seminars leads to good collaborative learning. Research shows that there are clear educational advantages to be derived from collaborative learning activities (Del Marie Rysavy and Sales, 1991; Slavin, 1996). When students work in groups and small teams, the interactions and activities frequently involve higher order and reflective thinking. Face to face talk therefore theoretically assists students to share knowledge and interactions often lead to the creation of new ideas.

However, the issues surrounding online discussion are perhaps less well understood. In a traditional face-to-face environment, support for learners can be provided immediately. Yet, with online systems, support for learners in the form of interaction with instructors is not always so immediate.

Furthermore, in computer-based learning environments, the language through which new ideas are expressed are reduced to print and graphics and interactions between learners and instructors are reduced to levels that can be supported by the technology. Also,

in online discussion sessions, other factors such as non-verbal cues are removed, making discussion between participants more difficult.

Given these factors it is pertinent to investigate whether attitudes to educational technology and cognitive style are useful learner characteristics to take into account when designing learning environments that include an element of online discussion. This is principally because cognitive style also has a bearing on the way in which individuals interact socially. For example verbalisers are typically more outgoing than imagers (Riding, 1991), therefore it is theoretically possible that verbalisers will be less reluctant to engage in online discussion compared to imagers.

1.4 Online assessment

Online assessment may be defined as a method of using computers to deliver and analyse tests or exams and such systems have been around since the seventies. Yet in many ways the internet provides a new way of delivering assessment material. This is because it is independent of time and place. Assessment can essentially be divided into two types. Firstly, formative assessment at the end of a period of study, whereby the results are used in order to determine examination outcome. Secondly, summative assessment, which is an assessment which may be administered during the presentation of a course as a means of checking on student learning. Furthermore, students may also assess themselves periodically in order to check on progress.

Within any assessment system question types may vary. For example, questions may include short essay type questions, true or false type questions, or multiple-choice questions. There are many potential advantages of online assessment to learners. For example, tests are available on demand and at any time. Furthermore, computerised assessment systems give immediate feedback to the user; therefore users learn by taking the test. However, online assessment systems also have a drawback in that students who perceive themselves as possessing poor IT skills may be disadvantaged. Therefore a study of individual differences in attitudes towards computer-based learning is relevant here. Furthermore, individual differences in approach to different question types have been found between individuals possessing different cognitive styles, (Riding and Read, 1996) and therefore it is possible that this may have an

impact on the success with which they engage with online assessment.

1.5 Summary

In summary then, this study seeks to evaluate by comparing student attitudes towards computer-assisted learning, cognitive style and student feedback, three different types of online learning and assessment methods, an online literature search, an online discussion, and finally an online assessment system.

2. Method

2.1 Participants

Participants in this study were fifty, first year undergraduate university students, (9 males and 41 females). The mean age was 23.24 with a standard deviation of 7.49. Ages ranged from 18 to 46. All participants were single honours psychology students who received credit for participation in this study.

2.2 Instruments

2.2.1 Cognitive Styles Analysis (Riding, 1991)

The Cognitive Styles Analysis is a computer presented test used to determine an individual's position on the Wholist-Analytic and Verbal-Imagery style dimensions. It consists of three subtests. The first contains items relating to the verbaliser-imager style, the second set of items relates to the wholist dimension of style and the third set of items relates to the analytic dimension of style. The test taker is required to react by simply pressing either a 'true' or 'false' button in response to each question item. The computer then calculates an individual's position on each style dimension by comparing response times between the verbal and imagery items and the wholist and analytic items on the test.

Test-retest reliability of this instrument as reported by Peterson et al (2002) is as follows. For the verbaliser-imager scores ($r=0.70$ $p < 0.00$) and for the wholist-analytic scores ($r=0.81$, $p < 0.00$). For the purpose of data analysis, WA categories of wholist, intermediate and analytic were identified according to the following scores, ≤ 1.02 wholist, $1.03 - 1.35$ intermediate, ≥ 1.36 analytic. The VI categories of verbaliser, bimodal and imager were identified as ≤ 0.98 verbaliser, $0.99 - 1.09$ bimodal and ≥ 1.10 imager. This procedure is according to the standardisation scores for this style dimension (Riding, 1991).

2.2.2 Computer Attitude Test (Smalley, Graff and Saunders 2001)

This computer attitudes test developed by Smalley Graff and Saunders (2001) consists of thirty seven items assessing three components of attitudes towards computers, namely, affective, behavioural and cognitive. Responses to each item are made on a five point Likert type scale.

Firstly, internal consistency was calculated using Cronbach's Alpha for each of the three components, affective (0.93), behavioural (0.65) and cognitive (0.65). These coefficients indicate a high level of internal consistency for the each attitude component. Cronbach's Alpha for the original development study are affective (0.95), behavioural (0.71) and cognitive (0.88) and total (0.95). Correlations were calculated for the scores between each of the four components, and with the total score. These are shown in table 1 below.

Table 1: Correlations between attitude components

	Behavioural	Cognitive	Total
Affective	0.52**	0.76**	0.94**
Behavioural		0.74**	0.75**
Cognitive			0.90**

** $p < 0.01$

The correlations between the scores on each of the four components of the scale and with the total score indicate that the components and the scale are significantly correlated with each other. All correlations reach significance at $p < 0.01$, illustrating that each component contributes to the total score.

Test retest reliability from the original development study (Smalley, Graff and Saunders 2001) is ($r=0.84$ $p < 0.001$).

3. Online literature search

3.1 Procedure

This study involved an online search whereby participants were required to retrieve information in response to fifteen questions, the answers to which could be found on the WWW. Typical tasks involved retrieval of simple pieces of information such as the names of journal editors etc. Participants were awarded 1 point for each completely correct

answer to any of the questions. No strict time limit was set for the search activity.

3.2 Results

3.2.1 Attitudes to computers

Firstly, Table 2 presents the correlations between each attitude component and total attitude score with the scores achieved for the literature search. None of the correlations are significant indicating no relationship exists between attitudes to computers and the literature search task.

Table 2: Correlations between attitudes to computers and scores for the literature search task

	Affective	Behavioural	Cognitive	Total Attitude
Literature Search	0.06	-0.07	0.01	0.03

3.2.2 Cognitive style

Figure 2 displays the mean scores for literature search task performance and wholist, intermediate and analytic cognitive styles.

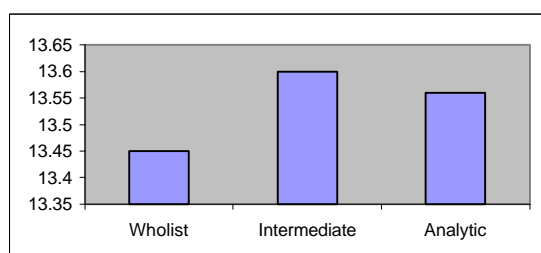


Figure 2: Wholist-analytic cognitive style, and scores for search performance

Intermediates performed best whereas wholists performed least well. A one-way ANOVA was carried out for wholist, intermediate, analytic cognitive styles for search performance scores, however, the results did not reach significance.

Figure 3 displays the mean scores for literature search task performance and verbaliser, bimodal and imager cognitive styles.

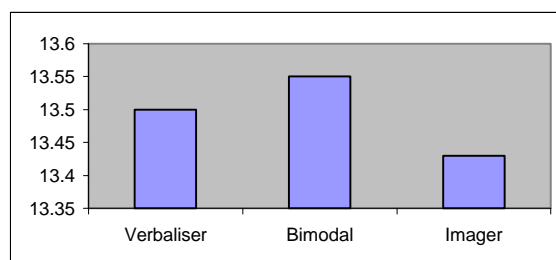


Figure 3: Verbaliser-imager cognitive style, and scores for search task performance

Bimodals performed best whereas imagers performed least well. A one-way ANOVA was carried out for verbaliser, bimodal and imager cognitive styles for search performance scores, however, the results did not reach significance.

3.2.3 Student Evaluation Questionnaire data

Finally, Figure 4 shows participant ratings for the literature search task.

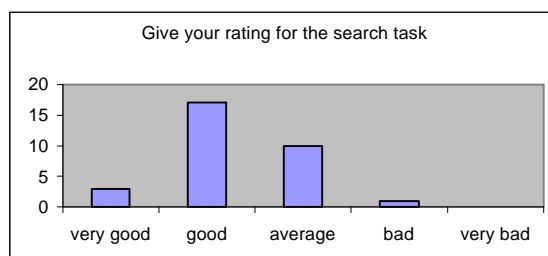


Figure 4: Student ratings for library search task

No statistical analysis was performed here, however, the results illustrate that most participants rated this type of task as good.

4. Online discussion

4.1 Procedure

This study involved students engaging in an online discussion about a question set by their lecturer. Students were awarded a score for the amount of substantive discussion engaged in during this task.

4.2 Results

4.2.1 Attitudes to computers

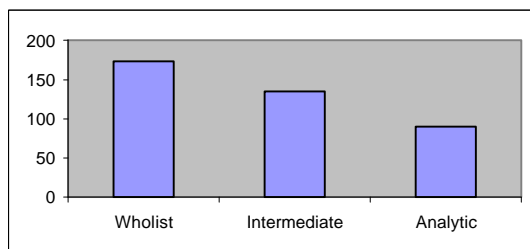
Table 3 presents the correlations between each attitude component and total attitude score with the scores awarded for the online discussion. None of the correlations are significant indicating no relationship exists between attitudes to computers and ability at the online discussion task.

Table 3: Correlations between attitudes to computers and scores for the online discussion task

	Affective	Behav- ioural	Cognitive	Total Attitude
Online Discussion Scores	0.01	-0.02	0.10	0.02

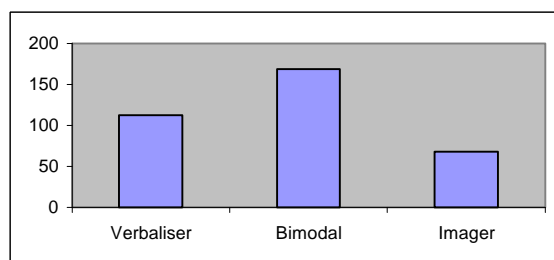
4.2.2 Cognitive style

Figure 5 displays the mean scores for the online discussion and wholist, intermediate and analytic cognitive styles.

**Figure 5:** Wholist-analytic cognitive style, and scores for online discussion

Intermediates performed best whereas wholists performed least well. A one-way ANOVA was carried out for wholist, intermediate, analytic cognitive styles for search performance scores, however, the results did not reach significance.

Figure 6 displays the mean scores for the online discussion and verbaliser, bimodal and imager cognitive styles.

**Figure 6:** Verbaliser, bimodal, imager cognitive style, and scores for online discussion

Bimodals performed best on this task, whereas imagers performed least well. A one-way ANOVA was carried out for verbaliser, bimodal and imager cognitive styles for online discussion scores. An effect approaching significance was observed ($F(2,40) = 3.11, p = 0.06$). A Tukey post hoc test indicated significant differences between bimodals and imagers. However, there were no significant differences observed between verbalisers and bimodals or between verbalisers and imagers.

5. Online Assessment

5.1 Procedure

This study involved participants answering questions online regarding information from a module they were taking. A variety of question types were utilised in this part of the project which were free response, true / false questions, multiple-choice questions and an essay question. Some questions gave immediate feedback on the accuracy of the answer and others did not. Participants were awarded points for correct responses. No time limit was set for this activity.

5.2 Results

5.2.1 Attitudes to computers

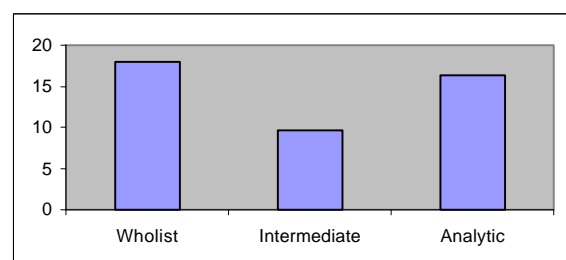
Table 4 presents the correlations between each attitude component and total attitude score with the results for the online assessment. None of the correlations are significant indicating no relationship exists between attitudes to computers and results for the online assessment.

Table 4: Correlations between attitudes to computers and scores for the online assessment

	Affective	Behav- ioural	Cognitive	Total Attitude
Online Assessment Scores	-0.22	-0.10	-0.18	0.28

5.2.2 Cognitive style

Figure 7 displays the mean scores for the online assessment and wholist, intermediate and analytic cognitive styles.

**Figure 7:** Wholist-analytic cognitive style, and scores for online assessment

The performance of wholists and analytics was approximately equal although the performance of intermediates is inferior to the other two styles. A one-way ANOVA was carried out for wholist, intermediate, analytic cognitive styles for online assessment scores. A significant

effect was observed here, ($F(2, 38) = 3.91, p < 0.05$). A Tukey post hoc test indicated significant differences between wholists and intermediates. However, there were no significant differences observed between wholists and analytics or between analytics and intermediates.

Figure 8 displays the mean scores for the online assessment for verbaliser, bimodal and imager cognitive styles.

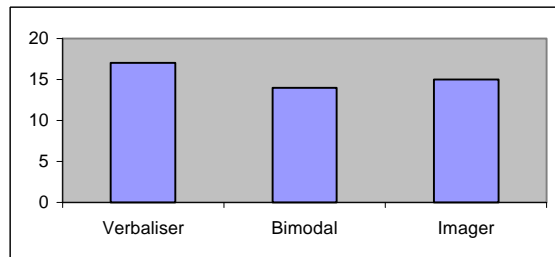


Figure 8: Verbaliser, bimodal and imager cognitive style, and scores for the online assessment

Very little difference can be observed between verbalisers, bimodals and imagers. A one-way ANOVA revealed no significant differences between cognitive styles.

5.2.3 Student Evaluation Questionnaire data

No statistical test was performed for this part of the study, however, Figure 9 shows participant ratings for the online assessment. The results illustrate that the general response to online assessment was generally good.

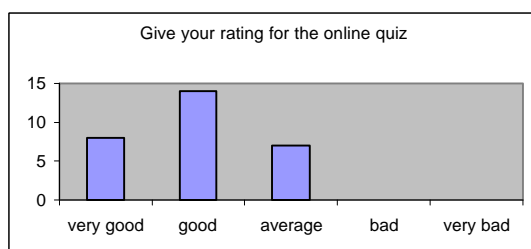


Figure 9: Student ratings for online assessment task

6. Discussion

The overall findings from this investigation suggests that attitudes toward computers are not related to performance on each of the online tasks employed here, although there are some connections between cognitive style and performance on these tasks.

For the online search task, the results show no relationship between attitudes towards computers and performance at this task. Similarly, the results show no differences in

performance on the online search task for participants identified as possessing different cognitive styles. The findings of Ford, Wood and Walsh (1994) and Wood, Ford and Walsh (1992) suggested that individuals possessing different cognitive styles employ different search strategies. If this were the case in this study, then this did not result in differences in performance. The evaluation questionnaire data for perceived usefulness of this task however, suggests that the majority of participants found it useful.

For the online discussion, the results again show no relationship between attitudes to computers and online discussion performance. However, for cognitive style wholists outperformed analytics, which is consistent with the idea of wholists, being typically more outgoing than analytics (Riding, 1991). Furthermore, a relationship approaching significance was noted between and cognitive style and the online discussion task, with bimodals outperforming verbalisers and imagers. On a more practical note, several issues were encountered in the implementation of this activity. Firstly, it took students a little time to get used to this system of online discussion, when they were more used to face to face interaction. Furthermore, management of such a system of seminars required extra time from the tutor in judging just when to contribute a comment in order to keep the discussion active. However, one of the advantages of this activity was that because the tutor monitored the contribution to the discussion by students, all students were encouraged to contribute. Those who might naturally be more reserved had the opportunity to consider their contributions rather than being forced to make them too spontaneously. More work on the techniques involved in such a system is however needed in order to make improvements.

For the online assessment, the results revealed, as with the above tasks, that no relationship was evident between attitudes to computers and performance. However, a significant effect was noted for wholist-analytic cognitive style with analytics and wholists outperforming intermediates. This would seem therefore to be an important consideration for the design of such systems. No differences were observed between individuals with a verbaliser bimodal or imager style. Further research looking at the methods of online assessment would need to focus on the types of questions preferred and performed best by

individuals with different cognitive style characteristics.

Generally, it is suggested that the overall culture of using online methods for instruction is an issue which needs to be assessed. Traditionally, courses are taught without online support, and one of the areas would seem to involve educating students to utilise online methods more readily.

7. Conclusion

This study looked at three different areas of online delivery and methods of assessment, which were online searches, an online discussion and an online assessment system. These methods were chosen as being the types of task with which learners would typically engage throughout higher education. In terms of individual differences in the efficacy of such methods the results may be summarised as follows. Few differences were found on each of the three tasks between individuals with differing attitudes towards computers. However, some differences were found between individuals identified with different cognitive styles. Evaluation of the methods used from the participants in this study was generally positive.

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