

# Group Decision Support System for Assessment of Projects in Information Systems

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## Abstract

Assessment of students' projects has a strong influence on their approaches to learning. This study investigates the effects of using a collaborative assessment method on students' approaches to learning. The collaborative assessment method, using a Group Decision Support System (GDSS), has been utilised for assessing the outcomes of students' projects. The assessment method focuses on group decision making between students and teachers through electronic meetings for discussing, negotiating, formulating, re-negotiating and revising the content of the assessment requirement. The assessment requirement specifies what students will learn, how this will be accomplished, within what period of time and what the criteria of assessment will be. A GDSS has been developed to provide an electronic environment for supporting the collaborative assessment process. A mathematical decision method is proposed and implemented in the GDSS for selection of the assessment criteria and for contribution of the corresponding weights. Within this educational setting, students play an active and collaborative role in the assessment process. Students' participation in the construction of this assessment will enhance their perception of assessment requirement. It will generate the effects of assessment on learning, and thus encourage deep and effective approaches to learning. The effectiveness of the proposed GDSS is empirically tested in a controlled laboratory experiment.

## Introduction

Students' approaches to learning can be classified into surface, deep and achieving approaches (Biggs, 1992; Biggs, 1996). They greatly influence the quality and outcomes of learning. A learning approach consists of two elements: *motive* and *strategy*. The motive describes the reasons why students learn, while the strategy defines the methods that students use to complete their learning tasks.

Recent studies (Biggs, 1989; Biggs, 1991; Kember and Gow, 1991) conducted in several tertiary institutions in Hong Kong show that the achieving and deep approach of students have declined as the students progress through a course. The reasons for the decline can be caused by surface assessment demands, heavy workloads and other factors which can influence students to adopt a surface approach in their study tasks. In the surface approach, students see university education as a means to get a degree and obtain a desirable job based on their extrinsic motivation. Their main objective is to meet the minimum examination standard. Thus they have a tendency to minimise their study efforts to meet this minimum standard.

In order to change students' attitudes and encourage them to adopt a deep approach to learning, many education research projects (Biggs, 1989; Biggs, 1991; Biggs, 1996; Donald, 1976; Imrie, 1995; Ma, 1994; Tompkins and McGraw, 1988) have been conducted to further understand the relationship between different teaching and assessment methods related to students' approaches to learn-

ing. These studies (Biggs, 1991; Ma, 1994) indicate that problem based learning (PBL) encourages students to take deep or achieving approaches to learning. They also show that the learning contract is an effective tool to help implement the assessment of PBL (Donald, 1976; Tompkins and McGraw, 1988). In this paper, PBL and the learning contract are integrated so that students and lecturers can negotiate the assessment requirement for the outcomes of PBL in the form of projects. A group decision support system (GDSS), named the Electronic Learning Contract System (ELCS), has been developed and used to support the learning contract negotiation processes between a group of students and lecturers in a process of PBL. The ELC method has been used in assessing the outcomes of students' projects in the Department of Information Systems at the City University of Hong Kong. Empirical data has been obtained using Biggs' Study Process Questionnaire (SPQ) (Biggs, 1996). T-tests are conducted to analyse the data collected on the impact of the new assessment method on students' approaches to learning.

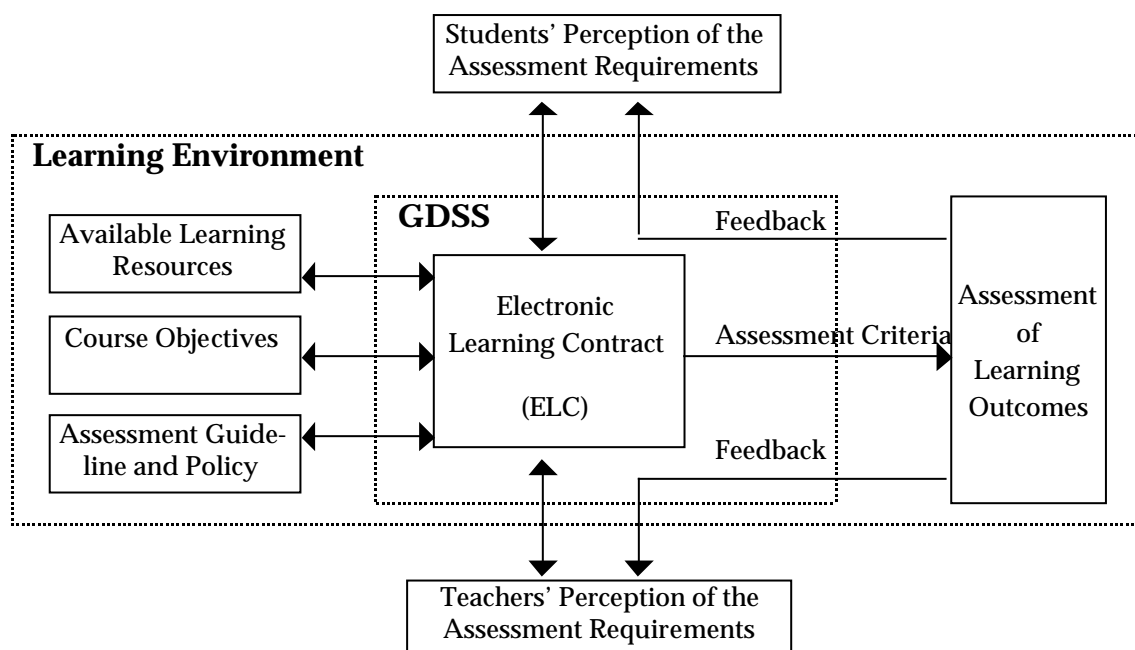
## Electronic Learning Contract

Donald (1976) defines a learning contract as a document drawn up by a student and his instructor. The contract specifies what the student will learn, how this task will be accomplished, within what period of time it will be completed and what the criteria of evaluation will be.

The learning contract is not just a document, but is a process that encourages intrinsic motivation, active learning and student-teacher interaction. Tompkins and McGraw (1995) also emphasise the importance of the process, including the relationship between the student and teacher as well as the negotiation that occurs throughout the learning experience.

In this paper, an Electronic Learning Contract (ELC) is a continuous renegotiable working agreement between students and teachers. It focuses on group decision making processes through electronic meetings in relation to the outcomes of students' learning. A conceptual model of the ELC is shown in Figure 1.

Figure 1: A Conceptual Model of the Electronic Learning Contract.



In the process of ELC, the following eight stages tasks can be carried out:

- Stage 1: Lecturers design and draft the list of assessment criteria based on the project objectives, the available resources and the assessment guideline and policy of the institution.
- Stage 2: Based on their perception of the assessment requirements, students and lecturers discuss and negotiate the content of the proposed assessment criteria using the GDSS.
- Stage 3: The lecturers then filter the generated opinions and prepare a ballot for students and lecturers to select the assessment criteria for the project using the GDSS.
- Stage 4: Students and lecturers select and rate the assessment criteria with respect to the objectives of the project.
- Stage 5: The lecturers then process the result of the vote and formulate the final set of assessment criteria using the GDSS.

When the final set of the assessment criteria are announced, students are allowed to contribute their opinions regarding the results. Using the Delphi method, students and lecturers will then vote again until most of the group is satisfied with the results. The final decision, however, is subject to the professional judgement of the lecturers.

- Stage 6: Students and lecturers can express their opinion using the GDSS on the agreed assessment criteria throughout the duration of the course. The list of the agreed assessment criteria is subject to change if necessary. Students and lecturers can request revision of the assessment.
- Stage 7: Lecturers will assess the students' learning outcomes according to the agreed assessment criteria covering the entire course. This method is used so that students both obtain continuous feedback from the lecturers and express their opinions on lecturers' comments on their performance.
- Stage 8: Students also have the opportunity to self-assess their own performance and peer-assess other students.

Students can input their comment on the performance of their own and that of other students. With this method, lecturers can further understand how students see themselves, other students and the learning environment so that lecturers can adjust their teaching methods and content as well as the learning environment accordingly.

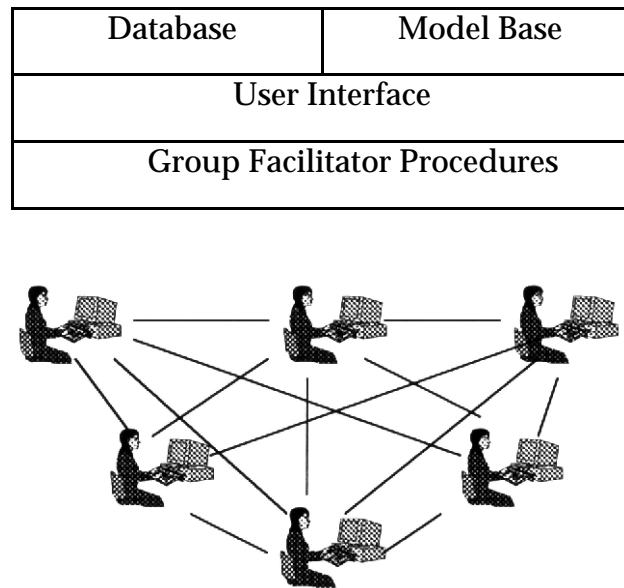
To implement the above ELC processes for the assessment of PBL, a GDSS is used to assist the contracting processes among students and lecturers.

## **Design and Implementation of the ELCS**

GDSS is an interactive computer-based system that facilitates the solution of unstructured problems by a group of decision makers (DeSanctis and Gallupe, 1987). It supports more tasks than just decision making and focuses on the processes used by working groups. It is an information technology based environment that supports group meetings, which may be distributed geographically and temporally (Turban, 1995). Group tasks include communication, planning, idea generation, problem solving, issue discussion, negotiation, conflict resolution and collaborative group activities. The components of the GDSS are arranged to support the process of decision making. The software components of GDSS include a decision model base, database and easy-to-use and flexible user interface for improvements of the decision making process, as are shown in Figure 2.

ELCS is a special purpose GDSS developed for supporting the contracting processes of ELC for the assessment of PBL. It also consists of all the basic elements of GDSS as previously mentioned.

Figure 2: A model of GDSS (Turban, 1995)



The traditional negotiated learning contract is made between one lecturer and one student. Therefore, it is quite easy for both sides to decide and agree upon the contract. On the other hand, agreeing upon a learning contract by a number of students and lecturers would be quite difficult. In order to smoothen the contracting processes and formulate a fair and non-threatening electronic learning contract, a multi-criteria decision model (Chang and Chen, 1994; Grabisch, 1995) can be used for the assessment criteria selection.

In the process of ELC, there is a group of  $n$  decision makers ( $D_1, D_2, \dots, D_n$ ) who are responsible for evaluating the appropriateness of  $m$  alternatives of assessment criteria ( $A_1, A_2, \dots, A_m$ ) under each of  $k$  decision criteria ( $C_1, C_2, \dots, C_k$ ) as well as the importance of the weight of the decision criteria. The decision criteria can be used as the course objectives, assessment guidelines and policies of the institution as well as the available learning resources. Let  $S_{itj}$  be the rating assigned to alternative  $A_i$  by decision maker  $D_j$  under decision criterion  $C_t$ ; and  $W_{tj}$  be the weight given to  $C_t$  by decision maker  $D_j$ . The committee has to aggregate the rating  $S_{itj}$  of  $n$  decision makers for each alternative  $A_i$  versus each criterion  $C_t$  to obtain the rating  $S_{it}$ . Each pooled  $S_{it}$  can further be weighted by weight  $W_t$  according to the relative importance of the  $k$  decision criteria. Then, the final score  $F_i$  for each  $A_i$  can be obtained by aggregating  $S_{it}$  and  $W_t$  as shown in Equation 1. The most appropriate alternatives are selected by ranking the corresponding  $F_i$ .

$$F_i = \sum_{j=1}^n \sum_{t=1}^k R_{itj} * W_{tj}$$

where  $R_{itj}$  is the rating assigned to alternative  $A_i$  under decision criterion  $C_t$  by decision maker  $D_j$ , and  $W_{tj}$  is the weight given to  $C_t$  by decision maker  $D_j$ .

Decision makers can just enter the rating for each alternative under every decision criterion and the weight for each decision criterion using the data input forms provided by the GDSS.

The GDSS will then process the inputted data using the built-in decision model. The result of the voting will then be ready for retrieval by students and lecturers.

Figure 3: A database schema for the GDSS

**PERSON**(PID, Name);  
**LECTURER**(PID, Appointment, Duty);  
**STUDENT**(PID, Contribution, LearnAppr);  
**PROJECT**(Proj-No, Total-Mark);  
**ASSIGN**(PID, Proj-No);  
**A\_ CRITERIA**(ANo, AssessmentCriteriaName);  
**D\_ CRITERIA**(CNo, DecisionCriteriaName);  
**RATING**(ANo, CNo, PID, Rating-Score);  
**WEIGHT**(CNo, PID, CNo-Weight).

A database schema for the decision model of the GDSS as shown in Figure 3. It is used to store necessary data for processing decisions while the user interface is to allow the group to perform a joint function such as information entry, voting or ranking alternatives through electronic meetings (Gray, Mandviwalla, Olfman and Satzinger, 1993). To the user, the system is the interface. One example of the public screens of the proposed GDSS is shown in Figure 4.

Figure 4: A screen for weighting the decision criteria

The screenshot shows a Microsoft Access window titled "Weight Attributes" with a menu bar (File, Edit, View, Records, Window, Help) and a toolbar. The form displays the following information:

- Title:** Weight Attributes
- Name:** Cheung Chi Wan
- Student:** [Empty field]
- Quality Attributes:** A table with two columns: Quality Attributes and Weighting (From 1 to 10).

Quality Attributes	Weighting (From 1 to 10)
Accuracy	7
Auditability	6
Conciseness	5
Correctness	4
Error tolerance	5
Flexibility	5
Maintainability	3

At the bottom of the form, there is a "Confirm" button. The status bar at the bottom shows "Form View", "FLTR", and "NUM".

Finally, the goal of the GDSS is to improve the productivity and effectiveness of electronic decision making meetings, either by speeding up the decision making process or by improving the quality of the resulting ELC. This goal is accomplished by providing support to the exchange of ideas, opinions and preferences within the group.

# Empirical Test of the New Assessment Method

## Research Hypotheses

The effectiveness of ELC is empirically tested in a controlled laboratory experiment. The objective of the experiment is to evaluate the effect of ELC on students' approaches to learning, which has two components namely: (1) motive: why the learning is needed; (2) strategy: how to perform the learning task (Biggs, 1992; Biggs, 1996). There are three common types of approaches to learning: surface, deep and achieving. Since this is only an empirical study, the experiment focuses on the impact of ELC on the surface approach to learning.

Based on the premise that ELC is beneficial to the students, the following hypotheses are made:

H1: Students in the ELC group will have lower surface motives than students in the Non-ELC group.

H2: Students in the ELC group will have lower surface strategies than students in the Non-ELC group.

H3: Students in the ELC group will have lower surface approaches than students in the Non-ELC group.

The research hypotheses state that the surface motive, surface strategy and surface approach could be discouraged by the introduction of ELC for the assessment of student projects. Students would then be encouraged to develop deep and achieving approaches to learning.

## Experimental Design

The ELC system has been used in several teaching modules, such as the Decision Support System (DSS) module and the Advanced Database (AD) module in the Department of Information Systems at the City University of Hong Kong. Forty students enrolled in the DSS module participated in this study. They were randomly separated into two groups, one with ELC and one without. The group with ELC followed the eight stages of ELC contracting processes as previously mentioned. Subjective data were collected using the SPQ (Biggs, 1992) from both groups of students.

As mentioned in the three hypotheses, the dependent variables in this study are: surface motive, surface strategy and surface approach where surface approach equals to the sum of the scores of surface motive and surface strategy. Finally, t-tests have been used to analyse the data using SPSS (Norusis, 1992). The t-test is suitable for testing the hypotheses because the independent variable has only two nominal levels.

## Results

The means and standard deviations (given in parentheses) for the three dependent variables in this study are: surface motive, surface strategy and surface approaches to learning of the two groups as shown in Table 1. The surface approach scores equal to the sum of the surface motive scores and surface strategy scores.

Table 1: Scores for dependent variables

Measure	Without ELC Mean (Std. Dev.)	With ELC Mean (Std. Dev.)
Surface Motive	23.00 (4.57)	19.35 (4.50)
Surface Strategy	20.75 (4.05)	20.20 (2.07)
Surface Approach	43.75 (7.26)	39.55 (5.56)

The t values and significance levels are shown in Table 2. The t-test results indicate that hypotheses H1 and H3 are both significant while H2 is not supported.

Table 2: T-test results

Measure	t score	p score (* significant at 0.05)
Surface Motive	-2.55	0.008 *
Surface Strategy	-0.54	0.296
Surface Approach	-2.05	0.024 *

The results confirm that the ELC could indeed lower the surface motive and surface approach which is desirable in the learning situation. However, the results also indicate that students would still use the unchanged surface strategy to accomplish the learning task even though they have a lower surface motive.

## Summary

In this paper, an electronic learning contract system has been implemented and used for the assessment of PBL. It is a special purpose GDSS which provides an environment for electronic meeting, negotiation and formulation of the ELC. The multi-criteria decision model has been embedded in the ELCS for selecting the assessment criteria. It is to provide a good way for the subjective selection of assessment criteria and for the contribution of the corresponding weights.

The empirical test of the new assessment method indicates that the introduction of the ELC for the assessment of PBL has a positive effect on discouraging the surface motive and surface approach to learning.

Although the electronic learning contract system in this paper is primarily designed to run on the university campus-wide computer network, it can be installed on the Internet so that more stakeholders of the assessment policy in higher education, such as parents and future employers etc. can contribute their ideas in the assessment criteria decision processes. ELC can be applied for courses running on a full-time, part-time or distance learning basis at both educational institutions and business organisations.