Effects Of Discovery Learning And Student Assessment On Academic Success

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ABSTRACT
In this study the effect of Discovery Learning and course evaluation based on Bloom's Taxonomy on the academic success of undergraduate students in Northern Cyprus was investigated. One demographic questionnaire was distributed to 829 students and two questionnaires were distributed to these students' instructors in order to collect information on the extent they used the Discovery Learning method as well as ascertaining the complexity level of learning intended to be achieved based on the criteria used for course evaluation (e.g. homework, project, and examination). Fourteen instructors of a total of nine courses and 34 classes participated in this study. The results indicated the higher the use of Discovery Learning during the course the lower the course grades were found to be. Also the higher the cognitive level of learning (e.g. analysis, synthesis and evaluation used by the instructor for the course, the lower the course grade was achieved by the students.

Key Words: Discovery Learning, Cognitive Level of Learning, Academic Success

INTRODUCTION

In the last few decades the approach to education is increasingly steering towards more student centered approach of which Discovery Learning is a part. The reason for this is it has been found to instil curiosity and motivation in students to analyze and make sense of the information they encounter (Castronova, 2002). This in return results in better knowledge retention (Balım, 2009).

While expository teaching is based on teachers (who are believed to be an expert on their subject) planning and presenting the information in a set timeframe, generally in an atmosphere where students are passive listeners (Terzi, Eryılmaz, Anadol & Kaya, 2009), Discovery Learning is where the teacher's role is more in the line of being a facilitator helping the students to discover information by deduction and construction (Kaufman, 1971). The main initiators of this approach to learning is Bruner (Denbo, 1994), John Dewy, Jean Piaget, and Lev Vygotsky based on their constructivist learning theories (Castronova, 2002) as well as Hilda Taba's curriculum based projects on Discovery Learning in the 1960's (Kaufman, 1971).

Light, Calkins and Cox (2009), in their book Learning and Teaching in Higher Education, state one of the most prominent and important challenges in teaching in higher education today to be the necessity for teachers to be aware of and accept that just presenting preplanned information to a passive audience is not enough to motivate students to independently "attain and construct their own knowledge during and after higher education" (p. 11). Graduates who will be the new generation of all types of professions need to know how to continuously learn and construct new knowledge by using their high level cognitive skills that they acquire during their higher education.

Although lower level skills in Cognitive Domain (Bloom, Engelhart, Furst, Hill, & Krathwohl, 1956) such as Knowledge, Comprehension and Application (renamed Remembering, Understanding and Applying by Anderson et al., 2000), skills in Affective Domain (Krathwohl, Bloom, & Masia, 1964) and skills in Pychomotor Domain (Dave, 1975; Harrow, 1972; Simpson, 1966) are important for education, higher level cognitive skills are preferred during higher education and beyond. These are Analysis (which involves comparing and contrasting), Synthesis (which involves creating, designing, hypothesizing, inventing and developing) and Evaluation (which inolves judging, recommending, critiquing and justifying) (Huit, 2011). These three cognitive

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levels were later renamed as Analyzing (which involves comparing and contrasting), Evaluation (which involves criticizing, defending, justifying and summarizing) and Creating (which involves combining, composing, designing, modifying and reorganizing) (Anderson et al., 2000).
Based on the examples given for each of the higher level Cognitive Domain skills (Application, Synthesis and Evaluation), it can be seen that acquiring these will not only help students enrolled in the Faculty of Education be successful in their studies, but when in employment whether they will be teachers, academicians or heads of departments, it will also enable them to compare and contrast information available for course content and/or curriculum, reflect with a critical eye teaching and/or learning processes and enable them to defend and/or justify their ideas to modify, reorganize or design a new course, curriculum or method of education. This in return will help them reach new horizons in the field of education nationally as well as globally. So, not only does higher education have to incorporate this higher level of education using a student centered approach such as Discovery Learning, it also needs to evaluate their practices to see whether it is actually leading to academic success.

Many studies on Discovery Learning versus Expository Teaching have conducted research incorporating a control and experimental group where the pretests have shown students pre-test achievement scores to have no significant difference and in the post-test have shown the Discovery Learning method to have a significant positive effect on the students' academic achievement. Examples of such studies conducted in three different parts of the world are one conducted on fifty-seven seventh grade students in İzmir, Turkey and based on a science course (Balım, 2009), a second on 48 High School students in Pakistan based on a mathematics course (Perveen, 2010), and the third on 160 undergraduate students in Texas, USA based on a biology course (Wilke & Straits, 2001).

There seems to be a consensus within the literature that the approach to education should be more about students discovering and constructing their own knowledge thus leading to the use of higher level cognitive skills, but how are the teachers actually faring? Is there a shift from the use of Expository Teaching to Discovery Learning? Are instructors evaluating the use of higher level cognitive skills? What are the factors that contribute towards the chosen method of teaching? According to Entwistle, McCune & Hounsel, 2002), it is the teachers' past experience (how they were taught as students) and beliefs that shape the method of teaching they choose to adopt. This may be an important factor to consider when choosing an educational approach or a teaching method for students enrolled in programs in the Faculty of Education as they will be the new generation of educators. It is therefore important to find out how the present situation stands.

THE STUDY

This study aims to find the relationship between the instructors' use of Discovery Learning versus Expository Teaching on the Cognitive Domain level of learning and on academic success of students enrolled in the Faculty of Education in Northern Cyprus.

Research questions

1. How is the use of Discovery Learning related to academic success?
2. How is student assessment of homework, project and examination based on Bloom's Taxonomy Cognitive Domain level of learning related to academic success?

Sample

The sample consisted of all except the first year students enrolled in the Faculty of Education in the Eastern Mediterranean University during the 2010 – 2011 academic year Fall semester. Out of the valid 829 cases the majority 465 (54%) were 4th year students followed by 244 (29%) 3rd year students and 138 (17%) 2nd year students. These students were in one of nine courses and 34 groups taught by a total of fourteen instructors.

Instruments

Three instruments were used for this study. The first was the Student Information Questionnaire which aimed to obtain information on the students' year of study, their student number, course and group number (in order to ascertain their instructor). The student number was necessary to be able to obtain their final course grades from the portal. The students were informed of this process and their permission was taken.

The second instrument was the Teaching-Learning Methods Instrument designed by the authors. The participant is requested to mark on the given scale the percentage that they use the Discovery Learning and Expository Teaching for each course they are teaching to the students participating in the study. This and the third instrument was given to the fourteen instructors teaching the 34 groups of 829 students.

The third instrument, Identifying the Level of Learning Questionnaire which was also designed by the authors with the aim of ascertaining the level of learning the instructor aims to assess their students under the following categories: the level of homework, project, examinations and based on the Cognitive Domain of Bloom's Taxonomy. The questionnaire begins with a brief description of the aim of the study and asks the participants to fill in the course code and group number of the students they are teaching. Following this, a table containing three main sections can be found for each category to be assessed eg. homework, project, examinations. The first column of the table contains the levels of the Cognitive Domain namely Knowledge, Comprehension, Application, Analysis, Synthesis and Evaluation, the second column gives a brief description of the corresponding Cognitive Domain levels and the final section incorporating five columns has the following headings: Never/hardly ever, Sometimes, Half of the time, Usually, Always/nearly always, and asks the participants to tick how often they give e.g. homework that covers each of the levels of the taxonomy.

ANALYSIS

The data collected from the instructors was entered alongside each corresponding students' student numbers, course codes and group numbers using SPSS (version 18). Data gathered from the Teaching-Learning Methods Instrument was entered as the percentage they were using the Discovery Learning method as the opposite percentage showed the use of the Expository Teaching method.

When analyzing the data collected from the Identifying Level of Learning Instrument, each level of the Cognitive Domain was given a value. As can be seen in Table 1 one for Knowledge, two for Comprehension, three for Application, four for Analysis, five for Synthesis and six for Evaluation. The frequency of use of each of the Cognitive Domain levels were also given values starting from one for 'Never/hardly ever used', two for 'Sometimes used', three for Used half of the time', four for 'Usually used' and five for 'Used always/nearly always'. The cells ticked by the instructors were multiplied by the points assigned for the corresponding vertical and horizontal headings as shown in Table 1 and the summation of these was plugged in for each evaluation criteria such as homework, project and examination separately. This was done for all 34 courses.

Table 1 Calculation table of points allocated for each criteria

Points Allocated for Each Level of Complexity	**Never/Hardly Ever Used (1)**	**Used Sometimes (2)**	**Used Half of the Time (3)**	**Usually Used (4)**	**Used Always /Nearly Always (5)**
Knowledge (1)	1 x 1	1 x 2	1 x 3	1 x 4	1 x 5
Comprehension (2)	2 x 1	2 x 2	2 x 3	2 x 4	2 x 5
Application (3)	3 x 1	3 x 2	3 x 3	3 x 4	3 x 5
Analysis (4)	4 x 1	4 x 2	4 x 3	4 x 4	4 x 5
Synthesis (5)	5 x 1	5 x 2	5 x 3	5 x 4	5 x 5
Evaluation (6)	6 x 1	6 x 2	6 x 3	6 x 4	6 x 5

The students' grades were obtained from the portal and coded as follows: F = 1; D- = 2; D = 3; D+ = 4; C- = 5; C = 6; C+ = 7; B- = 8; B = 9; B+ = 10; A- = 11; A = 12.

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FINDINGS

Using SPSS (version 18) Pearson product-moment correlation analysis amongst five variables the following correlation coefficients showing the extent of their relationship were found. These correlations can be found in Table 2.

Table 2: Correlations between Discovery Learning, Course Grade and Levels of Learning of Homework, Project, and Examination based on Bloom's Taxonomy Cognitive Domain

Variables	1	2	3	4	5
1. Discovery Learning	1.00				
2. Level of Homework	.255**	1.00			
3. Level of Project	-.479**	.076	1.00		
4. Level of Examination	-.013	.859**	.330**	1.00	
5. Course Grade	-.061	-.161**	-.033	-.064	1.00
Mean	29.34	62.93	83.93	64.21	8.73
Standard Deviation	24.46	13.37	17.41	19.78	1.89
N	829	517	609	829	829

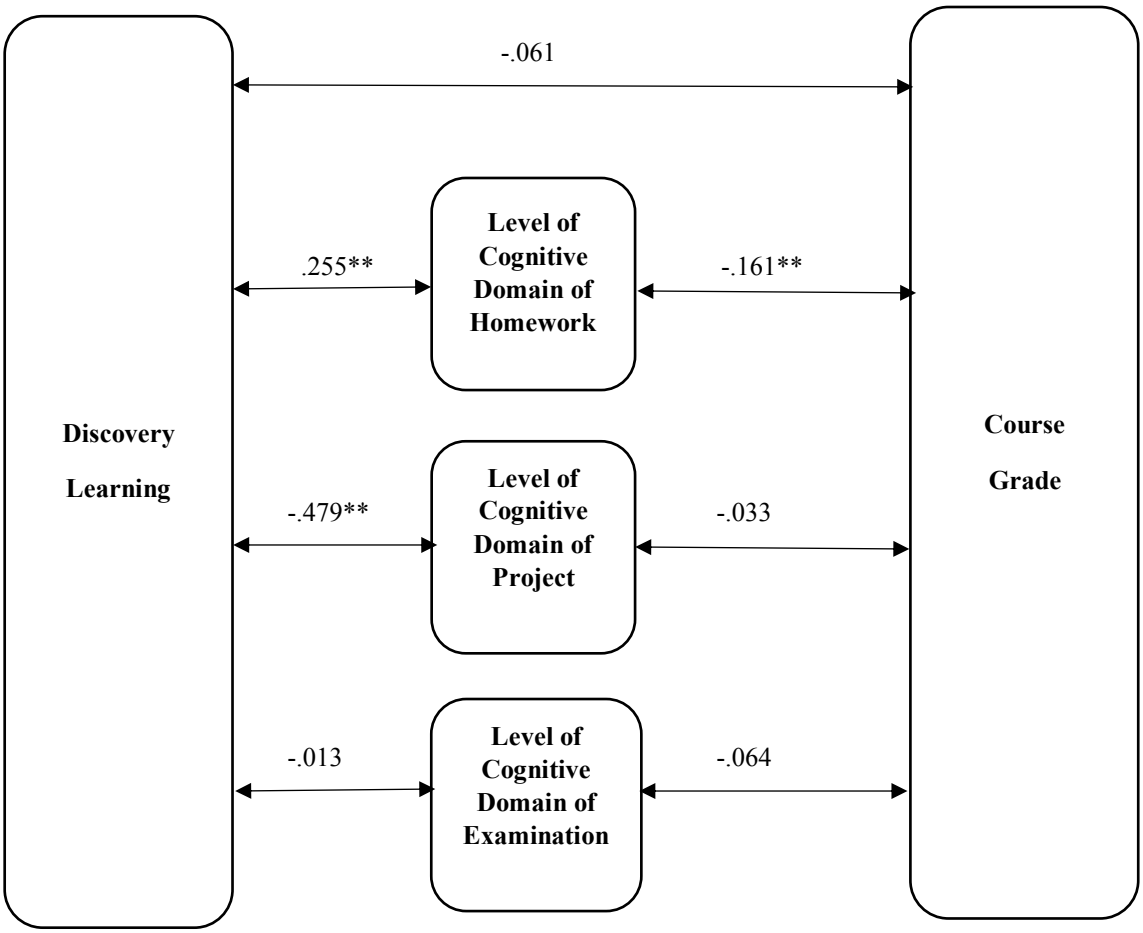

Figure 1 Relationship between Discovery Learning, Course Grade, Level of Learning of Homework, Project, and Examination based on Bloom's Taxonomy Cognitive Domain

Table 2 and Figure 1 show the correlations and relationships between Discovery Learning, Course Grade, Level of Learning of Homework, Project, and Examination based on Bloom's Taxonomy Cognitive Domain. It can be seen that out of the 829 valid cases all 829 of the students' evaluation criteria included examination, only 517 included homework and 609 included projects. The results show a positive significant relationship (r = .255)

between Discovery Learning and level of learning Homework based on Bloom's Taxonomy Cognitive Domain Level showing that the more the Instructor uses the Discovery Learning mode of education the higher the Cognitive Domain level of complexity the instructor aims at using when assigning homework. Although this may show that the Instructor believes this mode of education will enable students to accomplish higher cognitive levels when homework is assigned, the relationship between Cognitive Domain complexity level of homework and course grade shows a negative significant relationship (r = -.161) showing the student grades to be lower when homework is assigned at this higher complexity level and vice versa.

The correlation between the use of Discovery Learning and level project assignment on Bloom's Taxonomy Cognitive Domain levels shows a negative significant relationship (r = -.479) meaning the more the instructor uses Discovery Learning the lower the level of learning (based on the Cognitive Domain) is set for the project assignment. In addition to this an insignificant negative relationship is found between course grade and the level of learning of project assignment in the Cognitive Domain (r = -.033). Furthermore, the level of complexity of examinations based on the Cognitive Domain has a negative and insignificant relationship with both Discovery Learning and course grade (r = -.013 and -.064 respectively). As the latter has a p value close to .05 (p = .067) this may point out that students obtain lower course grades when a higher level of Cognitive Domain assessment is used.

There was no significant relationship between Discovery Learning and course grade only a small negative relationship (r = -.061 with a p value of .080) which may slightly indicate the higher the use of Discovery Learning the lower the course grade.

CONCLUSIONS AND DISCUSSIONS

The study's first aim was to find out whether the use of Discovery Learning has a relationship with the course grade. This study did not find any conclusive evidence showing any significant positive relationship but only an indication at the p = .080 level that as the use of Discovery Learning increases course grades drop and vice versa. This could be due to the students' prior educational experience and background cultures where they are used to having a teacher, who they believe to be an authority in their field, pass on the information in class. Also, the university entrance examinations in Turkey and North Cyprus are both based on a set curriculum and their evaluation is based on multiple choice questions. Therefore during the lengthy preparation for this examination, students may not have had the opportunity to gain experience or acquire the skills related to discovering their own learning and/or be able to succeed at answering questions involving analyzing, synthesizing and evaluation. It may take these students a little more time to adjust to this way of learning and prepare for the higher cognitive assessment levels. It is important to bear in mind, the majority of the sample consisted of 4th year students showing that they don't seem to have mastered these skills even towards the end of their studies at higher education. This result may also mean that the instructors are more ambitious when it comes to Discovery Learning and because their students are seen to be involved in what they are doing in class, the instructors' expectations of the students may become too high when setting complexity levels for assessment. Further studies can be made to ascertain the underlying problems.

When the first research question is looked at from the Expository Teaching perspective there seems to be a tendency pointing towards the higher the use of Expository Teaching the higher the course grade maybe showing that students are more accustomed to this method of teaching and know what to expect and how to study for this level of evaluation.

The study's second aim was to ascertain how the complexity levels based on the Cognitive Domain on homework, project and examinations affect course grade. The academic term assessments usually begin with homework and some quizzes generally just before the midterm examinations. After some of the material has been covered, a project may be given followed by a final examination. Looking at the correlations depicted in Figure 1 it can be seen that the instructor using more Discovery Learning in class gets more ambitious with the level of complexity when assigning homework but on seeing the homework mark results may realize the students are struggling to cope at this level and so may opt to lower the assessment levels for the project while continuing with Discovery Learning. Correlations between project level of complexity and course grade as well as Discovery Learning and examination level of complexity do not come up significant signalling an area that may need further research. Only a slight significant negative relationship between complexity of level of examinations and course grade was found. This may point to students struggling when instructors use higher cognitive domain levels in examinations.

Again, when the results are taken from the perspective of Expository Teaching, it can be seen that the higher the use of Expository Teaching method in class, the lower the assessment level of homework given is and the

students receive a higher course grade. So, in this case it seems the instructor using Expository Teaching gives out projects with complexity at the higher cognitive level after which the correlations between project level of complexity and course grade become insignificant. Again, further investigation is required.

As a result of these findings there may be a message to curriculum designers and instructors to determine the students'educational background and slowly introduce Discovery Learning from the first year of university. Where deemed necessary, instructors may be given in-house training to empower them to use this method more effectively and efficiently. Also when entering university, students' present cognitive domain level skills can also be determined and where necessary the upper cognitive domain skills such as comparing, contrasting (analysis), designing, developing (synthesis), criticizing and justifying (evaluation) can be incorporated within class time, again starting with year one, initially in homework and assignments. Extra class or tutorial time may be allocated for students to do rewrites after continuous feedback and encouragement from the instructors. This will take time, effort and practice for it to become a skill and may initially take time away from the actual subject matter being taught but hopefully the rewards of such activities will be reaped in later years. In order to allow for constant feedback for these skills to be assimilated by the student, preferably within the first year of university, curriculum designers and instructors need to also incorporate sufficient time for this to be able to happen within feasible class sizes.

Although there is a continuous rise in the number of new universities being established both in Turkey and North Cyprus, competition for students should not pressurize instructors to lower the level of cognitive complexity to allow for the average number of students to pass. Instead remedial strategies should be put into place to equip the students with the necessary skills so they can reach and pass their assignments and examinations at the required cognitive level for higher education.

More in depth research by way of interviews with instructors need to be conducted to ascertain their struggles with Discovery Learning whether it be training requirements for themselves or based on students' requirements due to prior different educational backgrounds. With these modifications this esteemed higher educational institution will hopefully be better armed and ready to effectively and efficiently prepare and equip the new generation of educators with the relevant skills to help educate the following generation to also be able to compete in all fields nationally and globally, facilitate better national economy and have a higher standard of living.

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