

A Note on the Pedagogies about Comprehensive Learning: An Empirical Study in Teaching Finance Courses

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Abstract

This paper is an empirical study to examine the effectiveness of different pedagogies in knowledge perception. The study uses data from 562 students during the period from 2012 to 2016 that measures students' performance in the Finance courses aligned with the commonly implemented pedagogies in teaching. The results from the empirical tests verify the theme proposed by Richard L. Gregory (a prominent British neuropsychologist) that learning is achieved through a process of analogizing and aligning the new information with available and stored knowledge in the brain, and the continuous efforts to discover and solve the problems in learning bring about this effectiveness. The study provides a detailed assessment for different pedagogies in teaching that offers reflections on effectiveness for teaching and learning.

Keywords: Pedagogy, Education Research, and Finance

1. Introduction

The effectiveness of teaching on students' comprehension and learning is truly a combination of the efforts between students and instructor. When students are unable to keep up their learning efforts with the class – i.e. a lack of effort towards learning beyond class attendance and inability to review and prepare for the course materials in a timely manner and to complete the assigned homework independently and responsibly – the lecture or class discussion may bring very little to them. This paper is an empirical study to examine the effectiveness of some commonly implemented pedagogies in teaching that formulate a comprehensive approach intended to achieve learning effectiveness, to stimulate students' learning efforts and to improve the learning outcomes.

Scientific evidence shows that visual perception is more than ninety percent of the total bandwidth perceived by the brain encoded into memory, while less than ten percent is sensory nerve signals¹. Without students' conscious effort to perceive and comprehend the information delivered in the course, what is taught in the classroom might never approach the students effectively. Thus, the application of the current understanding of perception to the various pedagogies in learning and teaching is the theme of this study.

This paper starts with the literature by Richard L. Gregory, a prominent British neuropsychologist, known for his work in perception, as a basis for providing insight on the pedagogies discussed in the paper. This study reviews and tests the learning outcomes when the instructor used *pop quizzes, projects and simulation assignments*, as well as an *e-learning software package provided by textbook publishers* to improve students' learning outcomes. The study is based on the data of 562 students from different classes over the period from 2012 to 2016. Could pop quizzes adequately stimulate students' timely preparation for class materials? Does e-learning software packages offered along with textbooks improve students' learning outcomes? Do projects and simulation assignments that are designed to enhance and broaden students' learning interests beyond classroom produce intended or expected results? With empirical data as the objective measure for different pedagogies' learning outcomes, the study searches for answers and believes this paper raises interesting points that may be helpful as a reference as educators continue to strive for comprehensive learning and teaching effectiveness.

¹ Gregory, R. L. (1997). Knowledge in perception and illusion. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 352(1358), 1121–1127.

2. Literature Review: Knowledge in Perception and Illusion by Richard L. Gregory

Richard L. Gregory shows in his article, *Knowledge in Perception and Illusion* (1997), that we do not see what the eyes see while we see what the brain sees. He wrote “*Philosophy and science have traditionally separated intelligence from perception, vision being seen as a passive window on the world and intelligence as active problem-solving*” while “*...vision, requires intelligent problem-solving based on knowledge*”. He believes learning is a process that combines two senses of intelligence: potential intelligence and kinetic intelligence. Learning is a process that recognizes new information through actively aligning and analogizing this new information with the available and stored answers in the brain. “*The notion is that stored-from-the-past potential intelligence of knowledge is selected and applied to solve current perceptual problems by active processing of Kinetic intelligence.*” “*The more available knowledge, the less processing is required; however, Kinetic intelligence is needed for building useful knowledge, by learning through discovery and testing.*”²

Richard L. Gregory indicates in his study that learning is a self-initiated process. Obtaining new information is accomplished through a process of analogizing and aligning the knowledge available and stored in the brain. Comprehensive learning is achieved by continuously assessing the information that is approaching and solving the problem in the process. An effective pedagogy facilitates the purpose of learning adequately and improves the learning outcomes generated.

3- Data, Variables, and Models

This paper is an empirical study to examine the effectiveness of learning with the pedagogies developed and implemented for Managerial Finance courses that optimize the learning outcomes. The course of Managerial Finance I used in the study is an introductory required course for all Business majors including the students with options of Accounting, Finance, Marketing, Management, and International Business; while Managerial Finance II is a required course for the students in the upper level Business major with Finance option only. The study examines the learning outcomes when the instructor used some commonly implemented pedagogies, such as pop quizzes, projects and simulation assignments that are closely related to the contents covered in the courses, as well as an e-learning software

² The sentences were extracted from page 1121, Gregory, R. L. (1997). Knowledge in perception and illusion. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 352(1358), 1121–1127.

package provided by the publisher of textbook to improve students' learning outcomes. Given similar pedagogies implemented for the two courses, Managerial Finance I and Managerial Finance II, the study also contrasts the learning outcomes generated between the students of the two courses. The following explains the details of the database, the variables and the models designed for the study.

3.1 Data

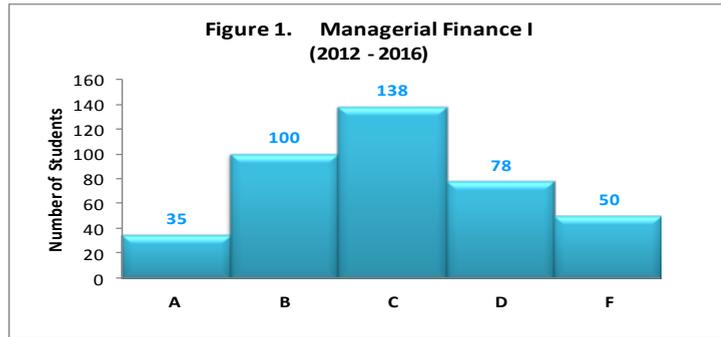
Two sets of data tested in the study are related to the two courses explained above. Data set one is based upon 17 sessions of the Managerial Finance I class over the period from 2012 to 2016, and 401 students (observations) are included in the test³. Most students who were attending Managerial Finance I were sophomores or juniors in the university. Data set two is based upon 5 sessions of Managerial Finance II over the same period of 2012 – 2016 while 161 students (observations) are included⁴. The students included in the data set are juniors or seniors. Managerial Finance II was offered once a year during that time period, while Managerial Finance I was offered throughout the year, including fall, spring, and summer semesters.

According to the overall grades received at the end of the semester, the students who are included in the first data set, the Managerial Finance I class, can be distributed as follows:

Grade Received	Number of Students	% of the Total
A	35	8.73%
B	100	24.94%
C	138	34.41%
D	78	19.45%
F	50	12.47%
Total	401	100%

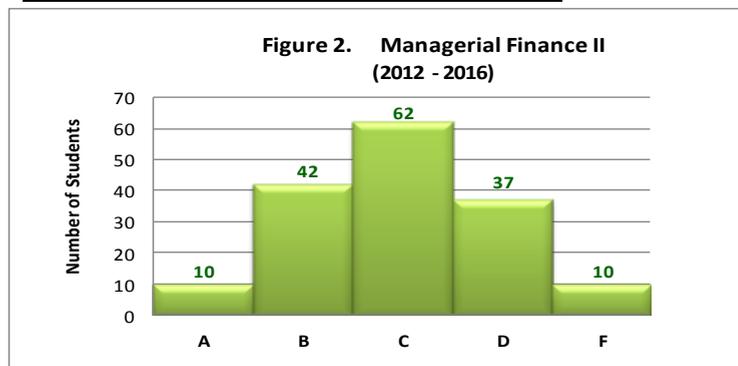
³ The data covers the period from Spring 2012 to Fall 2016 and the course was offered every semester including summer sessions. The observations in the data include all the students who attended and completed the classes at the end of the semester, excluding the students who dropped the classes during the semester.

⁴ The data covers the period from Spring 2012 to Fall 2016 and the observations in the database include all the students who attended and completed the classes, excluding the students who dropped the class during the semester, and/or who did not complete the course at the end of the semester.



According to the overall grade received at the end of the semester, the students who are included in the second data set, the Managerial Finance II class, have the following distribution:

Grade Received	Number of Students	% of the Total
A	10	6.21%
B	42	26.09%
C	62	38.51%
D	37	22.98%
F	10	6.21%
Total	161	100%



The distributions of the overall grades (A to F) between the two courses, Managerial Finance I and Managerial Finance II, are quite similar with grade C accounting for the highest frequency (34.41% and 38.51% respectively). The frequency for grade B is higher than the frequency of the grade D (24.94% and 19.45% for Managerial Finance I while 26.09% and 22.98% for Managerial Finance II), and the number of the students who failed

the course is larger than the number of the students who received A (50 receiving an F and 35 receiving an A, or 12.47% and 8.73%, respectively) for Managerial Finance I, while the numbers are even (10, or 6.21% of the class total) for Managerial Finance II.

3.2 The Variables Designed for the Test

The two courses have been implemented with similar pedagogical approaches that are commonly used in teaching. The variables included in the model reflect the measure of students' performance across different categories through the semester, including scores from final exams, midterms, pop quizzes (and its variation), project assignments and homework assignments from the textbook and the e-learning software package. The explanations of the variables are listed below:

Exams: Two midterm exams and one final exam are scheduled for Managerial Finance I while one midterm and one final exam are given for Managerial Finance II. Final exams are comprehensive while midterms focus on assigned chapters. The test scores carry 50% weight of the overall grade of the course for Managerial Finance I; while the test scores carry 60% weight of the overall grade of the course for Managerial Finance II. The variable *Exams* is a weighted average of multiple exams and is designed as a proxy to measure the learning outcomes.

Quizzes: The variable *Quizzes* is an average of the pop quiz scores for the entire semester multiplied by the weight of the quiz score with respect of the overall course grade formulation. In a given semester, an average of 8 pop quizzes are given throughout the semester (weekly, excluding the first weeks of class and those with midterm or final exams). Quizzes are designed to check the students' understanding of the learning in a timely fashion, and usually are one-page of multiple choice questions and/or conceptual problem solving lasting 5 to 10 minutes to complete. If students remain diligent regarding coursework, the expectation and bar for the pop quizzes is such that students should do well.

Measurement for Continuous Learning Efforts (MCLE): The *MCLE* variable is the variation of the quiz scores calculated by the standard deviation of the quiz scores divided by the mean of the quiz scores through the semester. Thus, a smaller *MCLE* value, in general, reflects a more consistent performance, indicating that the student has kept up his/her learning steadily through the semester.

Project Assignments: Students receive multiple project assignments and mini case analyses during the semester. The assignment intends to connect the textbook contents

with real business practices (beyond the classroom) to improve the students' problem solving abilities, often exercising independent comprehension of information learned. This variable is measured by the average score of the project assignments weighted by the project assignments' contribution in the overall grade of the course. This measurement is a positive contributor to learning outcomes.

Connect: *Connect* is an e-learning software package provided with the textbook by the publisher (McGraw Hill). Every student is required to sign up a *Connect* account at the beginning of the semester. The homework questions/problems for each chapter are assigned through *Connect* with a due date to complete the assignment. Before the due date, students are granted unlimited attempts to work through the *Connect* homework questions to replace and improve their score. Therefore, timelier completion of the *Connect* homework assignments is expected to result in higher scores on *Connect*. Furthermore, students receive explanations and/or tips for learning if they have difficulties in working out the problems that is built in the software. Thus, *Connect* supplements students' coursework efficiently with a personalized learning style. The *Connect* variable is calculated by the total score of the homework, including all the chapters, multiplied by the weight of *Connect* assignment scores in the overall grade, and is also expected to be a positive contributor to learning outcomes.

3.3 Test Models

Three linear regression models were designed to interpret the learning outcomes. Each model reflects a selected pedagogy and measures its contribution to the learning outcomes. They are explained as follows:

Model 1 was designed to measure the contribution of timely and consistent effort towards learning, and is defined as

$$\text{Exams} = \alpha + \beta_1 \text{Quizzes} + \beta_2 \text{MCLE} + \varepsilon \quad (1)$$

where *MCLE* is a measure of the variation of the quiz scores as it is explained above.

We expect timely and consistent learning effort contributes positively to the effectiveness of the learning outcomes.

Model 2 is a measure of the effectiveness of the *Connect* e-learning software package form of consistent chapter-by-chapter homework assignments to supplement the textbook material, by the publisher (McGraw Hill). Working on the homework assignment

independently and consistently reflects a process of obtaining new information through analyzing and aligning the knowledge available and stored in the brain, and we expect the model will reveal a positive contribution to the learning outcome. The model is defined as

$$\text{Exams} = \alpha + \beta_1 \text{Connect} + \varepsilon \quad (2)$$

Model 3 is a comprehensive measure of students' learning efforts *beyond the classroom*, which includes the homework assignment based on the textbook through *Connect* and the project and simulation assignments aimed to connect the textbook contents with real business practices to improve students' problem solving. The model is defined as

$$\text{Exams} = \alpha + \beta_1 \text{Connect} + \beta_2 \text{Project Assignments} + \varepsilon \quad (3)$$

The study expects that the test results will reflect whether the various pedagogies implemented in the course improve students' learning outcomes. This will provide evidence to support Richard L. Gregory's theme of knowledge in perception: learning is a process to combine two senses of intelligences: potential intelligence and kinetic intelligence, whereby "...stored-from-the-past potential intelligence of knowledge is selected and applied to solve current perceptual problems by active processing of Kinetic intelligence"⁵. An effective pedagogy facilitates the combination of the two intelligences and thus optimizes the learning outcomes generated.

⁵ The sentences were extracted from page 1121, Gregory, R. L. (1997). Knowledge in perception and illusion. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 352(1358), 1121–1127.

4. Empirical Results

Table 1 below reports the results from Model (1) that tested if the pop quizzes stimulate students' learning effort to review the class material timely and thus improve the learning outcomes.

Table 1: Learning Outcomes vs. Timely and Consistent Learning Efforts

<u>Panel A: Managerial Finance I (Observations = 401)</u>			
α Value)	β_1	β_2	F-value (P- Value)
Variable	(Adjusted R ²)	Quizzes	MCLE
Coefficient	48.0582	4.9985	-14.8297
T-Value	16.3271	13.3809	-6.6438
P-Value	(3.97E-62)	(5.61E-34)	(1.007E-10)
	(0.5061)		
<u>Panel B: Managerial Finance II (Observations = 161)</u>			
α Value)	β_1	β_2	F-value (P- Value)
Variable	(Adjusted R ²)	Quizzes	MCLE
Coefficient	37.1498	0.5857	-13.2285
T-Value	8.6612	1.322	-3.8868
P-Value	26.0888 (1.62 E10)	(0.188)	(0.00014)
	(5.162E-15)		
	(0.2387)		
Model: $Exams = \alpha + \beta_1 Quizzes + \beta_2 MCLE + \varepsilon$			

The results reported in Table 1 show a positive relationship between the *Quizzes* and *Exams*, and additionally, a negative relationship between *MCLE* (measure of the variation of quiz scores) and *Exams*. The coefficient for *Quizzes* is positive and statistically significant for Managerial Finance I class while it is positive but not statistically significant for Managerial Finance II class. The results indicate timely quizzes catch up students' learning efforts and timely review does contribute to the learning outcome. Moreover, the coefficient for *MCLE*, which measures the variation of quiz score (i.e. a larger *MCLE* indicates more variation in quiz scores), is negative for *Exams* in both class, and is statistically significant in both classes, indicating steady and consistent learning efforts improve the learning outcomes. The test results show the model in both classes is statistically significant. The adjusted R² indicates the *quiz scores* and *the variation of quiz*

scores contribute to the variability in learning outcomes by 50% for the course of Managerial Finance I, whereas for the Managerial Finance II course, the value is 24%.

Table 2 shows the empirical testing results of Model (2) which examines the relationship between the learning outcomes and the completion and scores of *Connect* homework assignments:

Table 2: Learning Outcomes vs. Completion of Homework Assignment at the Text Book

Panel A: Managerial Finance I (Observations = 401)

Variable	α F-value (P-Value) (R Square)	β_1 Connect	
Coefficient	23.9596	4.9985	
T-Value	20.0468	0.668	
P-Value	50.974 (4.46E-12) (0.1133)	(2.41 E-62)	(4.46 E-12)

Panel B: Managerial Finance II (Observations = 161)

Variable	α value (P-Value) (R-Square)	β_1 Connect	F-
Coefficient	25.9064	0.6777	
T-Value	11.0893	4.8619	
P-Value	23.6383 (2.77 E-06) (0.1294)	(1.573E-06)	(2.77 E-06)

$$\text{Model 2: Exams} = \alpha + \beta_1 \text{ Connect} + \varepsilon$$

The regression results reported in Table 2 reveals a positive and statistically significant relationship between the score earned in *Connect* and the performance of the exams. Note, a higher score in *Connect* reflects a timely and consistent completion of homework assignments for every chapter, which ultimately leads to an improved performance on the exams. As expected, the results in Table 2 show a significantly positive relationship between *Connect* and *Exams* for both courses. The R^2 indicates how students' completion of *Connect* homework contributes to their exam scores, with an R^2 of 11.33% for the Managerial Finance I class and 12.94% for the Managerial Finance II class.

Finally, Table 3 shows the results from Model (3) which examines the impact of the pedagogy that incorporates the overall students' learning efforts beyond the classroom to

the exams as a measure of learning outcomes. Effort beyond the classroom included the completion of homework questions through *Connect* and the project assignments and mini-case analyses that bridge the textbook with real business practices and thus improve the students' abilities for problem solving. It is reported as follows:

Table 3: Learning Outcomes vs. Overall Student Learning Efforts beyond Classroom

Panel A: Managerial Finance I (Observations = 401)

	α	β_1	β_2	F-
value (P-Value)				
Variable		Connect	Projects	
	(Adjusted R ²)			
Coefficient	4.8522	0.4261	26.6641	
T-Value	1.5599	4.4296	6.5985	
49.9748 (4.333 E-20)				
P-Value	(0.11658)	(1.22 E-05)	(1.32	E-10)
(0.1967)				

Panel B: Managerial Finance II (Observations = 161)

	α	β_1	β_2	F-
value				
Variable		Connect	Projects	
	(Adjusted R ²)			
Coefficient	8.7853	0.2719	2.9823	
T-Value	2.6788	1.9807	6.7231	
37.7049 (4.097 E14)				
P-Value	(0.00817)	(0.04935)	(3.07	E-10)
(0.3145)				

$$\text{Model: Exams} = \alpha + \beta_1 \text{ Connect} + \beta_2 \text{ Project Assignments} + \varepsilon$$

The results in Table 3 are interesting and affirm the propositions of *Knowledge in Perception and Illusion* by Richard L. Gregory. Both coefficients for *Connect* and *Project Assignments* are positive and statistically significant for both classes, Managerial Finance I and Managerial Finance II, indicating that the learning efforts beyond the classroom do produce and contribute significantly to the learning outcomes – namely, *Connect* homework that links to the textbook and projects that connect to the textbook contents through real business cases. Moreover, the results show a higher degree of significance for the coefficient of *Project Assignment* to the learning outcomes than that of the coefficient of *Connect* for both courses, asserting learning with active problem-solving may be more effective. The results support the theme of the study proposed by Richard L. Gregory well. Learning is a consistent process that recognizes new information by actively aligning and analogizing the knowledge confronted and with that obtained, and an effective pedagogy facilitates and promotes this learning process.

5. Conclusion

This paper is an empirical study to examine the effectiveness of different pedagogies in teaching that intends to promote knowledge in perception. In more detail, the study tries to explain whether the commonly used pedagogies in teaching do in fact stimulate students' learning efforts and improve their learning outcomes. The study is based upon the work of Richard L. Gregory in knowledge of perception. Richard L. Gregory believes that learning is a self-initiated process, and obtaining new information is a process of aligning and analogizing the knowledge already available and stored in the brain. Learning is achieved by continuous effort to assess information, unlocking discoveries and solutions to presented problems and questions.

The empirical study of this paper uses the data of 562 students during the period of 2012 to 2016 for two Finance courses, Managerial Finance I and Managerial Finance II. The data – various measurements of students' performance in the courses – in the study tested commonly used pedagogies implemented in teaching. The test results support the theme of the study and our anticipated expectation. It shows pop quizzes are an effective approach to motivate students' timely reviewing for what they are learning. The significant negative relationship between variation in pop quiz scores throughout the class and the resultant exam scores further points out that learning requires steady and consistent effort. The e-learning software package, *Connect*, provided with the textbook allows students to supplement their course work through the semester, and the results in the study show that consistent studying on *Connect* assignments more adequately equips students to perform better on exams. Learning beyond the classroom through projects and case analysis assignments that bridge textbook contents with real business practices enhance learning because it actively analogizes and aligns the knowledge available and stored in the brain, and thus improves students' abilities to discover and solve real-world problems in learning.

Timely and consistent learning efforts with active problem-solving results in effective learning. Teaching effectiveness should explore and improve the pedagogies that achieve effectiveness of knowledge in perceptions.

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