THE BIGGS AND MOORE MODEL IN E-LEARNING:
The role of motivation and collaboration as moderators

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ABSTRACT

The purpose of this paper is to report the findings of a research conducted to evaluate the effect of e-learning experience on students' perceived learning outcomes, and more specifically the role of motivation and collaboration as moderators between the e-learning experience and the learning outcome. The perceived learning outcome was measured with whether the students perceived to learn more in e-learning vis-à-vis traditional learning context.

The participants came from an undergraduate course at Tamk University of Applied Sciences in Tampere, Finland. The Biggs and Moore learning model indicates that the process variables (motivation and collaboration in this study) have a mediating role. It was found out in this study, however, that these process variables have a moderating role rather than mediating role.

Specific recommendations for the practitioners are provided, and implications for educators are discussed. Finally suggestions for further research on e-learning are provided.

Keywords: e-learning experience, Biggs and Moore learning model, learning outcomes, motivation, collaboration, moderating variables

INTRODUCTION

The digital revolution, networking and individualization has been called as the general purpose technologies (GPT) (Hanson, 2007). All of these technologies have all greatly contributed to the tremendous growth of e-learning. Thus many universities and higher education institutions have developed wide e-learning programs (Volery, 2000). In addition many governments deploy e-learning at all levels (Worldwidelearn, 2011).

A report by research firm Ambient Insight showed that electronic learning industry reached $27.1 billion in 2009 and predicts that this will nearly double by 2014 (Ambient Insight Research, 2009). Taking into account this growth, the crucial issue then is that how is e-learning, and the digital revolution changing the dynamics of teaching and learning (Janicki & Steinberg, 2003)? Furthermore the issue arises how to improve the learning outcomes of students (Gravoso, Pasa, & Mori, 2002).

This study about e-learning aims to improve our understanding about the dynamics of e-learning. The objective is to better understand the interrelationships in the Biggs and Moore (1993) model between presage, process and the perceived learning outcome variables in e-learning. This research is an extension of the previous work conducted by the researcher (Haverila, 2009).

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In the prior research it was demonstrated that students' e-learning experience positively correlated with the perceived learning outcome as measured with the perceived amount of learning of students.

Interestingly, however, it was also proven that the intermediate process variables in the Biggs and Moore model did not act as mediators between the presage and the outcome variables in spite of the fact that they did have an impact on the learning outcomes.

Therefore the plan in this research is to extend and broaden the earlier investigation to address an additional question regarding the possible moderating role of the specific process variables of motivation and collaboration in e-learning.

This moderating role of the motivation and collaboration variables between the e-learning experience and the learning outcome as measured with the perceived amount of learning is studied in an undergraduate course at Tamk University of Applied Sciences in Tampere, Finland.

The prior research has found out that there is shortage of research regarding the experience in e-learning (Sharpe, & Benfield, 2005) and thus this research is trying to fill this void. The course was students' first experience with e-learning. The investigation of the moderating role of the process variables collaboration and motivation will complement the 3P Biggs and Moore model of learning.

This research proceeds first with the theoretical discussion about the Biggs and Moore learning model and the research propositions. This is followed by the methodology of the research, descriptive details of the data, the preliminary data analysis, and the testing of the moderating role of the two process variables. Finally we present the discussion section with the summary of the findings, which are followed by conclusions, limitations and future research suggestions.

THE BIGGS AND MOORE MODEL OF LEARNING

The research question in this study is that do the learning process variables collaboration and motivation moderate the relationship of e-learning experience of students and the learning outcome as measured with the perceived amount of learning by students. The Biggs and Moore (1993) 3P model of learning is used as the theoretical framework. The 3 P's stand for Presage, Process and Product.

The "Presage" section contains pre-existing student variables, and contextual and situational issues.

In the "Process" section students' perceptions regarding their learning environment are evaluated. These perceptions affect students' choices of learning strategies and their implementation.

The "Product" part includes the perceived learning outcomes (in this study perceived amount of learning by students).

Consistently with prior research the Biggs and Moore model indicates that the prior learning experiences, perceptions of learning of students reinforce the learning outcomes of students (Gravoso et al., 2002).

Table 2 includes sample variables that can be used in learning model (Cybinski, & Selvanathan, 2005).

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Table: 1
The 3P Model of student learning

Presage	Process	Product
Student variables, intellectual capability (IC) and abilities, prior knowledge, subject area, teaching methods, personality, culture, home background, time constraints, course structure.	Student motivation behavior, and learning strategies.	Exam results, self-concept, grade point average, satisfaction.

The moderating role of the process variables motivation and collaboration in the Biggs and Moore (1993) framework is displayed in Figure: 1.
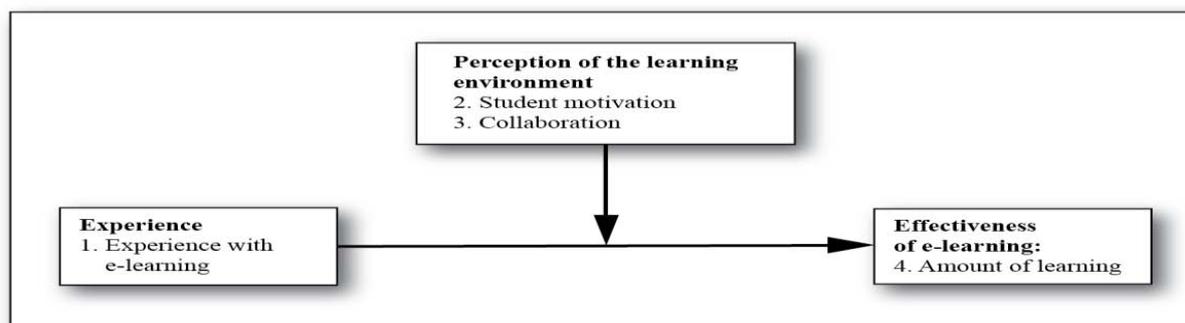
Figure: 1
The research model

Experience in e-learning has been used as an independent variable in prior research (Liaw, 2008). The previous research discovered a direct positive effect of the presage and process variables with the learning outcome. The research by Entwhistle, McCune, & Walker (2001) discovered that the meanings students' link to the learning concept is based on the cumulative effects of previous educational and other experience. The process variable included variables like collaboration, and motivation (Han, & Park, 2008; Kim, 2009). In this study their moderating role is investigated.

Some of the other research used traditional exams to measure overall learning effectiveness. In this study the students' perceived learning outcome (amount of learning) was used as a measure of learning effectiveness. Previous research has discovered that there is evidence that student performance does not provide a reliable indication of the quality of student learning (Cybinski, & Selvanathan 2005; Cleveland, & Bailey, 1994; Gal, & Garfield, 1997; Leidner, & Järvenpää, 1995), and also that the use of tests and grades may involve measures of short-term learning or may even be unrelated to the quality of instruction (Allen et al., 2004).

Therefore perceptions regarding the learning effectiveness were used to assess the learning outcome. Motivation and the need for collaboration in the e-learning mode are used to assess the moderating role of these intermediary variables between the learning experience and the learning outcome in the model.

The Biggs and Moore model does not suggest, however, a moderating role of these variables on the learning outcomes, but rather a mediating role. Since the previous research did not discover any mediating role to exist, this research wants to explore this possibility. On the basis of the previous the research propositions in this exploratory study are:

- ➢ **Proposition 1:** The students' motivation as a learning process variable moderates between the prior e-learning experience and the learning outcome (amount of learning) in the learning process.
- ➢ **Proposition 2:** The students' need for collaboration as a learning process variable moderates between the prior e-learning experience and the learning outcome (amount of learning) in the learning process.

METHODOLOGY OF THE RESEARCH

The Unit of The Study
The participants in this study were undergraduate students in the International Business program at TAMK University of Applied Sciences in Tampere, Finland. The course is typically taken during the Fall term of the second year of the undergraduate studies and is their first course in e-learning mode. The pedagogical elements of the course include weekly collaborative asynchronous discussions similarly to the Concord model (Tinker, 2001), trial exam and final exam.

Questionnaire and Data Collection
The language of the questionnaire as well as of the IB program is English. The questions are derived from the 3P model created by Biggs and Moore (1993). There are three categories of questions: Presage (experience 1 measure), Process (2 measures) and Product (1 measure). These categories, the specific wording of the questionnaire, and response scales are in Appendix. The presage variables include other items as well in the Biggs and Moore model, but the focus of this research was to study the effects of the experience only as a presage variable.The data collection was done with Internet based software tool called "Form Editor", which is frequently used for carrying various kinds of research and data gathering activities. The questionnaire is first created with the "Form Editor" software and then an E-Mail describing the nature of the study with an Internet link to the actual questionnaire was sent to the respondents.

Analytical Techniques
Two different types of analytical techniques were used to carry out the research. First, descriptive statistics, both means and frequency distributions, were presented. Second a stepwise regression method was used to discover significant correlations between the elements of the model, and more importantly to test the moderating effects of the variables. This is possible because stepwise regression is an approach to select a subset of effects for a regression model. The standard convention in statistics cannot be followed, because the significance level associated with the F-statistic, the "F Ratio, is not to be trusted as a real significance probability (JMP, 2009). Instead Mallow's Cp criterion for selecting a model was used. Mallows (1973) recommends choosing the model where Cp first approaches p (p is the number of x-variables+1).

DATA ANALYSIS

Descriptive Details
The research survey included questions about the general characteristics of the students (gender) and questions relating to students' perceptions regarding the presage, process and product (learning outcome) of learning (see Appendix). The questionnaire was pretested in the prior phase of the research project.

A seven point Likert type scale was used. The JMP 1-2-3 (version 8 for Mac) software program by SAS was used for statistical analysis. Out of all responses there were 35 male respondents and 23 female respondents. This reflects well the student population in the undergraduate IB program.

Preliminary Data Analysis

Table: 2 indicates the mean values and the standard deviations of all variables in this research.

Table: 2.
Means and standard deviations of the variables in the study

Category	Variable	Mean (Std. dev.)
Presage: Preconceptions	1. Experience	4.41 (1.40)
Process: Perceptions of learning environment	2. Motivation	5.26 (1.14)
	3. Collaboration	4.33 (1.46)
Product: Learning outcomes	4. Amount of learning	3.66 (1.57)

As the results in Table: 2 indicate the students have limited experience with e-learning. Students also indicated to have reasonably high level of motivation, and also somewhat agreed with the statement that collaboration helps with learning.

The electronic marketing course used collaborative technologies like forum discussions widely. Communication in collaborative learning environments is a challenge especially in the virtual learning environment (VLE) due to the lack of face-to-face contact. Finally the students perceived that e-learning somewhat decreased the amount of learning. The gender differences regarding the variables are shown in Table 3. As shown in Table 3, the differences between genders are not significant. Therefore we can conclude that both gender groups are similar regarding the variables of e-learning under scrutiny in this research. In case significant differences between genders would have emerged the model should have been separately tested with both genders for validity.

Table: 3
Mean responses and gender differences of the variables

	Male (SD)	Female (SD)	p-value
1. Experience	4.30 (1.55)	4.49 (1.31)	0.63
2. Motivation	5.57 (0.90)	5.09 (1.25)	0.12
3. Collaboration	4.00 (1.68)	4.54 (1.27)	0.17
4. Amount of learning	3.74 (1.60)	3.60 (1.58)	0.63

Moderating Role of the Process Variables Motivation and Collaboration

As indicated before the previous research has indicated (Haverila, 2010) that e-learning experience has a positive impact on the perceived e-learning effectiveness as measured with the perceived amount of learning by the students. No mediating impact by the process variables was discovered, however.

Therefore the aim of this research was to investigate if there is a moderating impact in play. This analysis was done using the stepwise regression analysis. A standard stepwise regression approach was used as described by Frazier, Tix, & Barron (2004). First the moderating role of the process variables (motivation and collaboration) was investigated independently and then jointly.

The results are presented in table 4. As regards to the research propositions it can be concluded that both propositions are supported. As indicated previously Mallows (1973) recommends choosing the model where Cp first approaches p (p is the number of x-variables+1). This is the case in all scenarios meaning that both process variables independently and jointly moderate the relationship between e-learning experience and the outcome of learning as measured by the perceived amount of learning by the students.

This is also evident from the Rsquare measure since the moderating variables double the variance explained. Rsquare values as such are quite low indicating that there are other independent variables in play in the learning model. The investigation, however, concentrated on the effects of experience and the possible moderating role of motivation and collaboration only.

Table: 4
The results of the stepwise regression analysis

Parameter	Mallows Cp	p	RSquare
Experience	5.747	2	0.062
Product term: Experience*Motivation	3	3	0.136
Parameter			
Experience	4.311	2	0.062
Product term: Experience*Collaboration	3	3	0.115
Parameter			
Experience	5.821	2	0.062
Product term: Experience*Motivation*Collaboration	3	3	0.138

DISCUSSION

This study concentrated on the effects of the learning process variables motivation and collaboration as moderators between the learning presage variable e-learning experience and the learning outcome variable as measured by the perceived amount of learning. Previous research discovered (Haverila, 2009) that the learning process variables mentioned do not have a mediating role in spite of the fact that they did appear to have an impact on the perceived learning outcomes.

The course took place at Tamk University of Applied Sciences in Tampere, Finland. More importantly the course was students' first experience with e-learning. The aim was to use the 3 P learning model as a theoretical framework (Biggs, & Moore 1996). As indicated the model includes "*presage*", "*process*", and "*product*" elements. The presage portion of the 3P model in this study included the "*e-learning experience*" variable. The moderating role of learning process variables in the Biggs and Moore 3P framework of learning was assessed with stepwise regression analysis, and the results indicate that both learning process variables motivation and collaboration were discovered to moderate the learning presage variable as measured with e-learning experience and learning outcome as measured with the perceived amount of learning. The moderating effect was discovered to happen independently and jointly with the variables motivation and collaboration.

The findings of the research are consistent with prior research in the sense that learner characteristics (in this study the experience with e-learning) have been discovered to have an impact on the learning outcomes. Liaw (2004) for example found out that learner characteristics like cognitive, social, and personal characteristics should be taken into account when designing the learning environment.

Consistently with this research Becker (1997) learnt that compatibility with the learning environment had significant, but modest correlation with learning outcomes. Liaw (2008) also discovered in another research project that learners' characteristics influence learners' perceived satisfaction and usefulness of learning. 174

He did not, however, assess the relationship between the e-learning experience and the learning effectiveness. Furthermore Gravoso et al. (2002) concluded that the students' prior learning experiences have an impact on the learning conceptions of students and incline the students to the use of a specific learning approach.

Finally the results are consistent with the reflective learning theory (Dewey, 1997) and experiential learning theory (Kolb, 1984), which designate that prior experience plays a crucial role in learning (Huang, 2002; Jonassen, 1994).

The moderating role of learning process variables, however, has been under lesser amount of scrutiny in pedagogical research. Hede (2002), however, developed a learning model, which he saw as useful in highlighting the complex nature of multimedia effects on learning. In his study the learning style acted as the independent variable, and learning as the dependent variable. The other elements in the model were visual input, auditory input, learner control, attention, working memory, motivation, cognitive engagement, intelligence, reflection, and long-term storage, each of which is either an intervening (mediating) or moderating variable or in some cases both.

Stonebraker and Hazeltine (2004) evaluated the effectiveness of a virtual-learning program in a Fortune 50 corporation, and considered participant perceptions of technology impacts, the moderating effects of demographics (age, gender, and prior technology experience), and the effectiveness of knowledge transfer. They did not, however, consider the moderating role of the learning process variables. Allen et al. (2004) also investigated the effects of several moderator variables and discovered that examination of several moderator variables generated solutions that only partly account for the variability. Most insightful explanation was found for the issue of course content as a moderator.

For example for foreign language instruction the use of virtual learning demonstrated superiority for that technology while in natural sciences that was not the case. In addition they did not discover any moderating impact for the use of synchronous interactive technologies. They did not address the issues of motivation and collaboration, however. The non-use of motivation's role as a moderator was, however, addressed as a shortcoming in their research.

As indicated this research confirms the fact that both collaboration and motivation moderate the relationship between e-learning experience and the learning outcome as measured by the perceived amount of learning. It is important to note that online collaboration may include many obstacles due to the lack of face-to-face communication and shared social context (Havard, Du, & Xu, 2008; Hishina, Okada, & Suzuki, 2005), and thus practitioners and developers of e-learning environments should carefully address and incorporate collaborative elements into the virtual learning environment by paying attention to the quality of discussions for example to the manner of responses, sizes of the group, and the discussion topics (Du, Zhang, Olinzock, & Adams, 2008).

In addition increasing motivation of the participants before, during and after the e-learning courses appears to be important as well.

This can be done for example by knowing the intended learner, preparing the learning environment, and providing a learning portal prior the learning experience, creating a conducive learning environment, giving legitimate feedback, and stimulating curiosity during the learning experience, and reinforcing learning, and measuring motivation to transfer effect of learning after the completed course (Smith, 2008).

CONCLUSIONS, LIMITATIONS AND FUTURE RESEARCH

While interesting results were found about the 3P e-learning model both in the prior research as well as in this research, the reader should be careful about extending the results of this research to other e-learning contexts beyond the current research setting. The future research activity should broaden the study of e-learning by concentrating on learning where multiple modes (e.g. mixed mode) are used. Also various types of technological software solutions for collaborative e-learning could be investigated (e.g. Wikis, Blogs). In other words does the use various e-learning tools moderate the presage and learning outcome relationship?

As indicated the students in this research were all undergraduate students experiencing their first e-learning course. Therefore it would be interesting to test and examine the moderating role of collaboration and motivation in the 3P learning framework when the undergraduate students have more experience with e-learning as well as with graduate students (Du et al., 2008). In addition the introduction of different countries with various cultural settings into the research framework would potentially increase the validity of the results of this research.

The moderating impact of collaboration for example might be very different in countries with high individualism score like United States or with low individualism score like South Korea and China in the Hofstede cultural dimensions framework (Hofstede, 2011) in comparison to Finland (culture that endorses individualism and student-centered learning).

In the first phase of this research, we focused on a particular aspect of e-learning: perceptions regarding preconceptions, experience, ability and interest ("*presage*") of students, perceptions of the learning environment ("*process*") and perceived effectiveness ("*product*") in an undergraduate setting. Later on the study was extended by incorporating e-learning experience into the 3P model. This research investigated the moderating role of collaboration and motivation. Future research should expand on this effort and test the results of this research in a larger scale and in different cultures. For example, are there variations in the 3P model of learning for Europe, North America, Asia, and Middle East where face-to-face interaction and social presence may vary? This could be answered for example by conducting of longitudinal research in multiple courses.

Educational institutions providing e-learning should assist students with limited prior experience by providing support for them. As indicated in the previous research (Haverila, 2009) this could be done for example by providing an initial face-to-face gathering with the purpose of explaining for students the basics of taking an e-learning course. This could happen for example by guiding students with the course access, how to use various learning tools and resources. In addition support and help functions should be provided (O'Neill, Singh, & O'Donoghue, 2004). Due to the fact that collaboration within the e-learning platform moderates the e-learning effectiveness as measured with the perceived amount of learning, the lack of experience with online communications may cause problems when using the collaboration tools within the virtual learning environment (Stokes, Cannavina, & Cannavina, 2004). The key principle of constructivism is that knowledge is constructed from positive experiences (Applefield, Huber, & Moallem, 2001). This principle is applicable also in e-learning, and thus the role of motivation and collaboration should be taken into account when planning for an effective virtual learning environment.   Also the addition of supplementary features to the e-learning environment should be done gradually by improving students' technical skills to match the requirements needed in e-learning (Pirani, 2004).

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APPENDIX: Questionnaire
1) Gender
a) Male
b) Female
2) Presage question: Experience
2) I have experience with e-learning
1...........2...........3...........4...........5...........6...........7
Completely disagree   Completely agree
3) Process questions
3) The collaboration with the fellow students contributed greatly towards learning.
1...........2...........3...........4...........5...........6...........7
Completely disagree   Completely agree
4) Motivational level
4) My motivational level is high
1...........2...........3...........4...........5...........6...........7
Completely disagree   Completely agree
5) Product questions: Learning outcomes
5) I learn more in an e-learning course than in a traditional course.
1...........2...........3...........4...........5...........6...........7
Completely disagree   Completely agree