

# Influence of Learning Technologies on Learning Effectiveness

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## ABSTRACT

*Using various learning technologies aimed at making course delivery more effective has become increasingly more popular in higher education. Use of such technologies can assist students in understanding abstract and/or difficult concepts such as those covered in Operations Management (OM) course. While the use of technology is generally viewed favorably by instructors in terms of enhancing teaching effectiveness, less is known about students' perceptions of how such technologies influence their individual academic performance or career preparation. This study analyzes data from 186 undergraduate students enrolled in an OM course to examine the effectiveness of three pedagogical methods -- traditional, multimedia, and online methods – in contributing to their performance in the class. Their perceptions of career benefits from such learning experience are also investigated. The findings show that a more comprehensive or a hybrid approach that incorporates all the three pedagogical methods can indeed improve students' performance in the classroom. They also benefit the students in their career preparation.*

**Key words:** Career preparedness, Learning technology, Operations Management, Student performance.

## 1.0 Introduction

The advent of modern technology in learning delivery systems has significantly changed students' learning experience, and the way course delivery is structured. In essence, modern classrooms have moved away from traditional to more sophisticated methods (Proserpio & Gioia, 2007). However, effective sophisticated methods of learning must be based on sound instructional design that has similarities with traditional method learning process (Solimenoa, Mebaneb, Tomaia, & Francescatoa, 2008; Salas & Bowers, 2001). The traditional method involves heavy face to face communication, individual or group assessment, and comprehensive cognitive content of the subject matter (Prosser, K. Trigwell, 1999).

As information technology moderates most aspects of our lives, a medium of learning that is moderated by technology seems to be increasingly more popular as compared to the more traditional, face-to-face centric methods. Alavi (1994, p.159) stated that "Recent developments in computer hardware, software, and communication technologies create exciting new opportunities for the educational use of these technologies." The increasing interest in a non-traditional learning is also shown by the large number of students who register for online courses (Alavi, 1997).

Furthermore, classes that are taught via online or that made used of multimedia can be more cost effective and more favorably in terms of aiding student learning as compared to the more traditional teaching methods. This is particularly the case in disciplines or courses which students find them to be highly quantitative in nature or somewhat abstract, such as Operations Management (OM) and Supply Chain Management. In such environments, the use of multiple pedagogical methods (including multimedia and other technologies) may assist students to better relate to and understand the course content. However, while it is generally accepted that technology benefits and supports learning, it is unclear as to how students perceive the benefits from the use of such technology in their own learning experience.

In our curious attempt to examine how students perceive the benefits of new technology in the learning process, this study investigates the impact of traditional, multimedia and online learning on students' performance as well as on their perception of how the technology driven learning has helped their career preparedness.

This study has two primary objectives. First, we investigate how students perceive the impact of traditional, multimedia and online teaching on their individual academic performance. Second, we examine how students perceive: (1) the benefits of traditional and online learning methods, and (2) the impact of their individual academic performance on their future career.

The next section of this study discusses these objectives in detail along with the theoretical background and the development of hypotheses. Section three describes our research methods and data analysis, followed by section four that sets out the conclusion and discusses the implications of our findings.

## **2.0 Theoretical Background and Development of Hypotheses**

We examined three theories that provide the grounding for this study. The first theory is the self discrepancy theory, which indicates that individuals have perceptions and expectations of their environment (Higgins, 1987; 1999; Coetzer & Bushe, 2006) and consequently how they interact with their environments influence their performance. Also, according to this theory, if the learning environment meets individuals' expectations, the cognitive domains and the performance of the individual will increase. For the purpose of this study, we modeled the learning environment using three teaching dimensions, i.e., traditional, multimedia, and online.

The second theory, which is known as the self efficacy theory refers to a student's belief in his/her own ability to learn and/or to ultimately perform effectively (Kizilgunes *et al.*, 2009). Students possessing higher self efficacy have been shown to set higher goals and to perform better. Conversely, students with lower self efficacy have been shown to perform poorly or to even give up when faced with difficulties in their environment (Pajares, 1996).

In this study we used the self discrepancy and self efficacy theories to develop a total of six hypotheses. All the hypotheses are tested in regard to the identified teaching and learning environments, viz., traditional, multimedia and online. The goal of this research is to investigate how each of the three types of environment influences individual academic performance. In addition, we also test how students perceive the benefits of the traditional and online learning to develop a sense of self efficacy and to be more confident in their future career prospects. Since this reaseach aims to investigate the impact of technology on improving the effectiveness of learning delivery, we feel that the use of DeLone and McLean Information Systems (IS) Success Model is suitable to base our hypotheses. The DeLone and McLean Information Systems Success Model details how people interact with technology in their ongoing practice. By doing so they enact a structure of the system that shapes the emergent and situated use of the technology. Application of technology is not embedded in the system but it is done through human interactions. Hence, the users will shape the technology

structure based on their use of the technology. For this reason, technology will shape the process through human interactions (Orlikowski, 1992; 2000). In any type of learning method, interaction or communication is mandatory and the learning process will only occur through such human interactions. Once the users know that the interaction has given them a substantial impact, they will feel that the learning delivery is useful.

The concept of learning with the support of technology has similarity with the concept of end-user computing environment which was developed by Doll and Torzadeh (Delone & McLean, 1992). In the end-user computing environment, the authors explain that a decision maker (user) interacts directly with the software and the outcome of the activity depends on the his/her action. Benefit of the online learning system could be achieved through effective use of the system, and through the experience of users (Delone & McLean, 1992). Hence, it can be perceived that a non-traditional learning environment, such as an online learning system, is beneficial to the users or learners. The literature that forms the basis of the hypotheses to be tested in this study is discussed next.

### **2.1 Traditional learning (TRD) and Individual Performance (IP)**

Traditional learning is defined as the learning environment that necessitates face-to-face interactions that are set in the traditional class rooms. Though learning environment is gradually changing, the traditional learning is still considered to be the most powerful type of learning, and it pre-dominates all other types of learning simply because it facilitates discussions and explanations of issues that are difficult to explain in other non-traditional methods (Fortune, Shifflett, & Sibley, 2006). Furthermore, traditional learning increases a closeness between instructor and students and fosters a sense of 'team' and 'cohesiveness' among learners, which lead to powerful 'old school networks' that students carry as a powerful tool to advance their careers. Through this type of learning, social distance between instructor and students can be reduced (Hughes et al., 2003). The appropriate use of class time, a caring instructor, good class materials with interesting individual and group exercises coupled with healthy competition increase students' motivation (Wooten, 1998). Once a student's motivation and self efficacy increases, s/he should feel that the environment is comfortable which can result in positive behavioral changes (Bandura, 2002). Thus, individual performance and traditional learning is known to have a positive relationship. Hence, our first hypothesis for testing this relationship, i.e. to compare the traditional learning environment with that of online and multimedia is:

***H1: Traditional learning environment has a positive relationship with individual performance.***

### **2.2 Traditional learning and Individual Performance (mediated by Multimedia)**

Traditional learning environment that incorporates certain non-traditional technique and technology such as multimedia should benefit students and instructor, especially in teaching certain abstract and difficult to grasp concepts. For example, learning can be more interesting if the instructor can show the students a video highlighting different Operations Management (OM) concepts which they may face in the work place. Students' ability to learn vary significantly between experienced adult learners and fresh high school graduates with no real world experience. Those students with no or with limited real world work experience often struggle to envision some of these concepts. In this situation, multimedia plays a role to help instructor to draw parallels, and to help students to understand the subject matter better, thereby helping to increase their epistemological belief. Thus, our next hypothesis is:

***H2: Traditional learning, mediated by multimedia, positively influences individual performance.***

### **2.3 Online delivery and Individual Performance**

Modern day classrooms are increasingly witnessing usage of non-traditional teaching tools such as online course management systems like the WebCT as important aids in course delivery. In this way,

instructors can design a wholesome course delivery package consisting of various teaching techniques such as the traditional, multimedia, and also online methods (e.g., videos, and the WebCT) in delivering a single course offering. Some authors argue that these additional forms of communication (online learning) can burden students with information overload. However, this study argues that the flexibility that students have in deciding time, venue and content in online learning can overcome the seemingly burdensome information overload. Just as chatrooms and instant messengers have facilitated a borderless, barrierless social structure, online learning facilitates student-teacher interactions to overcome social barriers. In many cultures where 'speaking up' is frowned upon, and the students grew up usually 'listening' to the teacher, online course delivery can be advantageous as it facilitates discussions without the fear of 'loss of face'. This is especially true in case of introvert students who often feel threatened to engage in open discussions in a classroom setting and will feel more comfortable in an online learning environment, and will thus experience an increase in self efficacy. Therefore, online learning can benefit both introvert and extrovert students who can use the online chat rooms to communicate with other students or the instructor publicly. Thus:

***H3: Online learning has a positive relationship with individual performance.***

#### **2.4 Traditional learning and Career Benefits**

Communication that exists in the traditional learning environments is primarily dictated by the course content and/or the cognitive issues surrounding the course content. Communication with students regardless of the method of delivery can be very challenging as communication in the context of classroom is not just between instructor and students, but also among students (Quinney, 2005; Littlefield & Roberson, 2005; Weil & Rosen, 1997).

Communication in the context of 'learning' is the existence of dialogues between instructor and students that can take place either in a traditional face-to-face conversation or in a non-traditional setting such as online chats or an online proprietary virtual learning environment systems such as the WebCT or the Blackboard. The concept of communication is important for effective class management as the foundation of training depends upon how successful the communication is regardless of whether such a communication is facilitated by technology or it depends solely on face-to-face interactions (Salas & Bowers, 2001). In a traditional learning, the assumption is that communication is a fundamental element of learning process where an instructor communicates directly with his or her students in a teaching set up. Thus, the effectiveness or otherwise of the communication is believed to have a direct positive impact on class management. In a classroom setting that is conducive to more and more student participations and dialogues students would feel encouraged to share information and/or experiences between them which would then result in an enhanced self efficacy and/or an increased confidence in their preparedness for their future career. Additionally, this environment lets instructors share their work experience with students, or let students share their work experience with their class. The reciprocal communications that exist in this environment increases the students' knowledge in regard to real world experience as well as the their self efficacy related to their career. Thus:

***H4: Traditional learning environment has a positive relationship with students' career benefit.***

#### **2.5 Online course and Career Benefits**

Online course delivery facilitates tracking of student's progress in a more coordinated way, and at the same time allows him/her to understand his/her progress or otherwise 'at any time', 'anywhere' and 'at will'. Computer-based, online grading and tracking systems allow constant monitoring of student's progress and participation and allow the required 'transparency' in the grading system, and this an important aspect of learning in an online course delivery technique (Chickering & Gamson, 1987). Effective class management facilitated by online course delivery techniques could save valuable faculty time, which could be used to improve course materials, quizzes and tests through further reading and enhanced research. Thus, online course delivery systems often could help in enriching

the course content and delivery and could contribute to overall effectiveness of the faculty in managing his/her classroom. This situation has been found to increase users' efficacy and has thus benefited them (Gravill & Compeau, 2008). The users who continued to use the systems have indicated their satisfaction with them (Moore, 1972).

The use of the internet and other information technologies (IT) has redefined the way in which business is conducted in the real world. These online tools serve as an important training ground for carrying out similar tasks in an information technology intensive real world, and empower students with knowledge that is essential in carrying out day-to-day business processes and in achieving firm's goals in important areas such as customer service and innovation (Bhatt and Troutt, 2005). Another important aspect of adult learning is the explosion of online, e-learning training methodologies being adopted by large corporations. For corporations whose work force is scattered through out the world classroom training is often not viable for them costwise or at best becomes an extremely difficult logistical nightmare (should the enterprise be willing to spend millions of dollars in employee skill development). In such cases, learning has usually moved away from face-to-face course delivery to web-based techniques such as video conferences, netmeetings, e-learning, online classrooms, live meetings, and teleconferences with equal if not more end-user acceptance. Given this, students who are familiar and are already exposed to such learning methodologies feel more comfortable and are better positioned for success in their careers at a later point in time. Hence, incorporating such tools and experiences in course delivery earlier in their educational experience could therefore increase students' self efficacy as related to the practices that they will be subsequently engaged during their later career (Arbaugh & Benbunan-Finch, 2006). Thus:

***H5: Online learning environment has a positive relationship with students' career benefit.***

### **2.6 Individual Performance and Career Benefits**

Bandura (2002) indicates that performance accomplishments is the most influential factor that influences self efficacy and that an individual can build self efficacy from his/her previous experiences. Consider the example of an individual who has low self efficacy regarding usage of computer. As that person uses computer in a successful and repeated fashion, his/her self efficacy or confidence in using the computer increases. Similarly, a student who is successful in his/her academic performance may have adequate confidence and self efficacy in pursuing his/her later career. On the other hand, a student with poor academic performance may feel under-prepared and therefore will have less self efficacy when it comes to orchestrating their career success. Similarly, a top performing student is more likely to enter their career with a much higher level of self efficacy or confidence. Thus:

***H6: Individual performance has a positive relationship with students' career benefit.***

### **3.0 Research Methodology and Data Analysis**

The participants in this study were 186 senior and junior undergraduates at a university in midwest United States. All participants were business students and were enrolled in one of four possible sections of operations management course. The first step was to estimate the measurement model, followed by the second step which was to estimate the structural model. While the measurement model specifies the relationship of the observed measures, i.e. how the items and the constructs that are inter-correlated, the structural model specifies the path or the causal relationship based on the underlying theory (Bagozzi and Yi, 1988).

***Result for measurement model:*** Measurement model analysis was analyzed based on 'goodness of fit criteria' that evaluates how well the data fits the proposed model. Fit measure was assessed based on root mean square (RMR), goodness of fit index (GFI), non-normed fit index (NFI) and comparative fit index (CFI).

Table 1.0 shows the result of the measurement model for analysis of each dimension. As shown in the table all the values (for RMR, GFI, NFI, CFI) are above the accepted value, indicating that a good fit exists in the measurement model. Cronbach alpha is used for the reliability measurement. All values for Cronbach alpha are between 0.68 and 0.94. The value that is more than 0.60 is an acceptable value for reliability (Fisher, 1992; Nunnaly and Bernstein, 1994).

Table 1: Evaluation of goodness-of-fit and reliability criteria of all constructs

Construct	Items	RMR	GFI	NFI	CFI	Reliability (Cronbach's alpha)
Traditional teaching	5	0.036	0.988	0.956	0.996	0.68
Multimedia	4	0.009	0.982	0.996	0.997	0.94
Online	4	0.017	0.996	0.993	0.999	0.76
Individual Performance	3	0.031	0.994	0.971	0.995	0.70
Career Benefit	4	0.025	0.978	0.983	0.987	0.90
Recommended Values		< 0.05	> 0.90	> 0.90	> 0.90	> 0.60

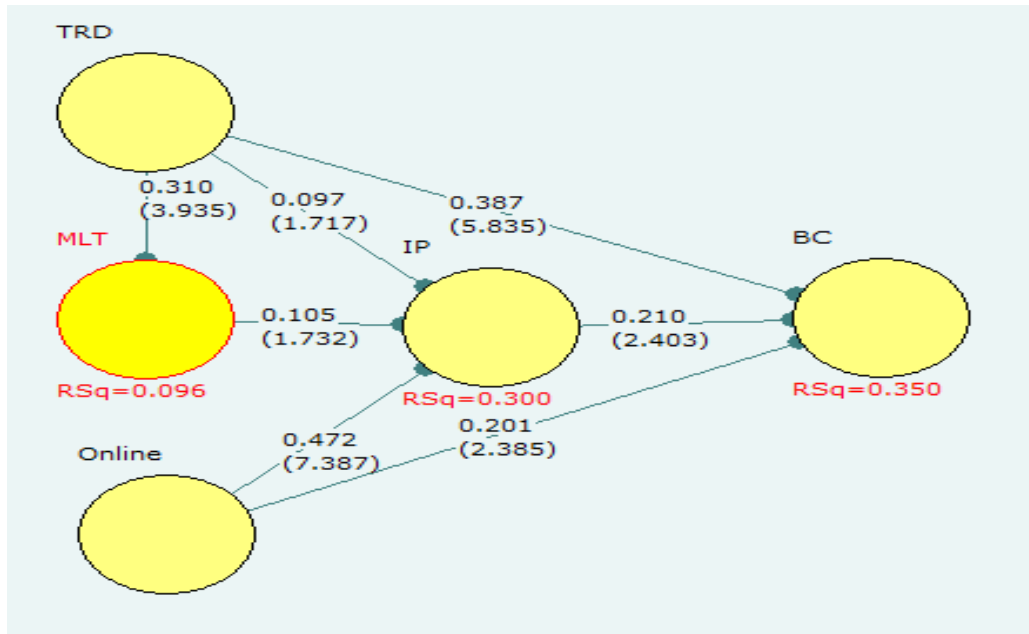
Discriminant validity was tested through pair wise comparison. The objective of discriminant validity is to measure the independence of the dimension of each construct (Bagozzi and Yi, 1988). Discriminant validity was tested using structural equation modelling. Pair-wise comparison follows three steps: 1) analysis of two dimensions in one construct was constructed in a correlated model, and the value of chi-square was recorded, 2) the two dimensions were tested in one single model, and the value of chi-square was recorded, and 3) the discriminant validity is supported if the difference between the two chi-square scores (step 1 and 2) is significant at  $p < 0.05$  (Bagozzi & Yi, 1988). Table 2 shows the result from the discriminant analysis; the difference between the chi-square value for the difference in the degrees of freedom is statistically significant at  $p < 0.01$ . This result indicates support for the existence of discriminant validity for the construct.

Table 2: Pair-wise Comparison Using Structural Equation Modelling (SEM)

Construct	Chi Square (d.f.)		
	Single Model	Correlated Model	Diff.
TRD - MLT	73(14)	26(13)	47(1)
TRD - OL	62 (14)	9(13)	53(1)
TRD - IP	42(14)	19(13)	21(1)
TRD - CB	56(14)	14(13)	42(1)
MLT - IP	337(20)	29(19)	16(1)
MLT - OL	215(20)	28(19)	187(1)
MLT - CB	442(20)	26(19)	416(1)
OL - IP	447(20)	27(19)	430(1)
OL - CB	175(20)	18(19)	157(1)

**Results for the structural equation modelling:** For testing the hypotheses, linear structural equation model, using PLS was used to test the structural relationships and the fit between the data and the model.

Figure 1 : Results of the path model : includes, R square, beta coefficient and T value.



This study examined path model analysis through beta coefficient, R square and T- statistics. Since the study has two dependent variables, the result for R squared values are 0.30 and 0.35. The third R square is the value for multimedia learning technology (MLT) which was not hypothesized for the purposes of this study. We created the path because we needed to examine the difference between the traditional learning and the one that is mediated by MLT. The acceptable value for R square is 0.30 and above, as this value indicates good model fit (Barclay et al., 1995). Other parameters that we used for model fit are beta coefficient and significance levels ( $p$ -values). Significance levels show whether the hypothesis is supported or not.

The PLS analysis results (Figure 1) show that all the hypotheses are supported, thus the proposed theoretical model is empirically supported. H1, positing the relationship between traditional teaching and individual performance, was found to be significant ( $\beta = .097$ ,  $p < .05$ ). H2 which examined the relationship between traditional teaching and individual performance as mediated by multimedia, was also found to be positively significant ( $\beta = 0.105$ ,  $p < .05$ ). H3 tested the relationship between online and individual performance, and the result was found to be significant ( $\beta = .472$ ,  $p < .001$ ). H4 tested the relationship between traditional teaching and career benefits which was found to be significant in the expected direction ( $\beta = .387$ ,  $p < .001$ ). H5 which tested the relationship between online and career benefits, was found to be significant ( $\beta = .472$ ,  $p < .001$ ). Finally, H6 which tested the relationship between individual performance and career benefit was also significant ( $\beta = .210$ ,  $p < .01$ ).

#### 4.0 Discussion and Implications

This study was designed to examine how students perceive technology use in course delivery and how it may influence their performance and perceptions on their career preparation. Specifically, we investigated how traditional, multimedia, and online teaching techniques influence students' individual performance and perceptions of their abilities to have successful careers later on. Data was used from a survey designed to measure these elements, whose respondents were from a student group belonging to a midwestern university.

The findings suggest that all three teaching methods remain influential in shaping student's performance and can benefit students in their future careers. The most interesting finding however was that the traditional classroom techniques showed the weakest relationship with individual performance. However, when the traditional (classroom, face-to-face) techniques were augmented by multimedia tools (i.e., videos), results tended to improve. Considering this, along with the strong relationship found between online methods and individual student performance suggest that a hybrid or blended delivery approach is perceived more favorably by the students. As such, educators are encouraged to incorporate a variety of methods into their instructional practices to improve student performance. This is likely of particular importance in subject matters like Operations Management, which are highly quantitative and often consist of higher level of abstraction especially in terms of their concepts, particularly for students lacking in work experience. In this environment, the use of methods such as videos, simulations, and games can make the materials not only more interesting and enjoyable, but most importantly, it goes a long way in fostering self efficacy and improved student's perception of their career preparedness.

The hybrid approach suggested by this study clearly indicates that a wholesome course design should not only consist of face-to-face classrooms, but should also leverage online resources such as chatrooms, netmeetings, live meetings, videoconferences and the use of online course management systems such as the WebCT. These resources produce at least two benefits for students. First, online resources allow student to access information in as large or small extent as the student feels is necessary at his/her own pace, and secondly the resources are available to them twenty four hours per day, seven days per week. These benefits will increase the student's self efficacy and confidence in their ability to perform well in the class as well as instill a sense of ownership over his/her performance. Again, the former is of significant benefit in courses such as Operations Management, Finance and Accounting which are more quantitative and abstract in nature and many students often find the materials more challenging than those of less quantitative courses. The latter can benefit virtually any discipline as students who feel more ownership and accountability towards the course can perform better in nearly any environment.

The traditional methods, online methods, and a student's individual performance in class have all been suggested to influence the student's perception of his or her career preparation. These findings reveal that while the popularity of online instruction is growing and herein shown to prepare students for their careers, the traditional teaching methods continue to play the most significant role in career preparation. Educators are therefore reminded of the importance of the classroom experience in preparing students for successful business careers, and are encouraged to create a diverse environment in terms of the resources and tools availed to students.



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