Fall 2008

Approaches to learning in a classroom environment: observational & experiential

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APPROACHES TO LEARNING IN A CLASSROOM ENVIRONMENT:

OBSERVATIONAL & EXPERIENTIAL

by

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A THESIS

Presented to the Faculty of the Graduate School of the

MISSOURI UNIVERSITY OF SCIENCE AND TECHNOLOGY

In Partial Fulfillment of the Requirements for the Degree

MASTER OF SCIENCE IN ENGINEERING MANAGEMENT

2008

Approved by

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PUBLICATION THESIS OPTION

This thesis consists of the following two articles that have been submitted or intended to submit for publication as follows:

Pages 3-23 were submitted to the FRONTIERS IN EDUCATION CONFERENCE 2007, Milwaukee, Wisconsin.

Pages 24-59 are intended for submission to JOURNAL OF ENGINEERING EDUCATION.

ABSTRACT

Accreditation Board for Engineering and Technology (ABET) has established a set of criteria that requires engineering graduates to be able to effectively communicate, work in teams with ethics and professionalism understanding the contemporary issues. There are different approaches for teaching and learning these skills, two of which are discussed in this thesis. The intention of this research is to understand the impact of observational and experiential learning on team and individual performance.

The first paper assesses the team performance based on the type of facilitation provided to different teams. The paper hypothesizes that the team exposed to facilitation using the virtual facilitator would show better performance and decision-making skills based on the theory of observational learning by Albert Bandura. Data collection occurred at a University in the state of Missouri where both undergraduate and graduate students participated in simulation games that were designed to assess the performance of different teams.

The second paper deals with the concept of experiential learning in a classroom-based environment. It assesses the performance of students based on their own autonomous motivation and their instructor's autonomy support to learn management concepts using experiential learning. Data was collected using surveys in both undergraduate and graduate level classes that were taught using the same approach of learning.

ACKNOWLEDGMENTS

With this thesis I am accomplishing another dream, another hope and another epitome of self-evolution and thoughtfulness. Retrospection of the past makes me liable to thank many people who have helped shape my life and dreams and supported me with the best of their efforts. I take this moment to thank a few and acknowledge many others in my thoughts who contributed significantly to this wonderful journey.

First and foremost, I would like to thank my grandparents Jaspal Singh and Joginder Kaur, and my parents Kanwar Jit Singh and Davinder Kaur, who provided me encouragement and support on the decisions I made and the career I chose. I would also like to thank my younger brother Bir Kanwar Singh without whose sacrifice, patience, and understanding my long night studies would not have been possible. The last two and a half years in Rolla would not have been successful without the wonderful support of my fiancée Amardeep Kaur, who helped me focus on my goals and priorities while walking with me through the thick of things. I appreciate her efforts and am thankful to her.

In addition, I am really thankful to my advisor Dr. Ray A. Luechtefeld for his immense support and the knowledge imparted by him, which not just helped in my thesis but also in my evolution to a better thought process and an able perspective to see things differently. I am also thankful to Dr. Steve E. Watkins for his guidance over the writing of my first paper and Dr. Elizabeth A. Cudney for serving on my committee.

Finally, I would like to thank the Missouri University of Science & Technology for supporting me as a research assistant and the president of the student government body, both of which facets were important for my evolution.

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INTRODUCTION

The 2007-2008 Accreditation Board for Engineering and Technology (ABET) criteria emphasizes the importance of learning “soft skills” by engineering students along with the ability to apply scientific and mathematical skills to solve engineering problems which is the part of a traditional classroom. Moreover, global competition, customer focus, knowledge explosion, and the development of third world countries has driven corporate organizations to seek students with not just the technical ability but with critical thinking ability and creative skills. Companies require employees to drive issues autonomously and make informed decisions while understanding the perspectives of others.

With the building revolution to the approaches to learning in higher education, there are a number of key ideas that emerge which challenge the nature of the traditional class based coursework. The purpose of this thesis is to study two such learning techniques called Observational and Experiential Learning.

The first part of this thesis considers a study of students’ learning behavior when exposed to the computationally intelligent “virtual facilitator” which is based on Albert Bandura’s theory of Observational Learning. This theory states that skills can be developed through observation of expert “others” engaged in practice. This paper aims at showing that beneficial team behaviors such as constructive controversy can be triggered by observing a model or an expert (virtual facilitator) thus increasing the performance of the team. The result of the analysis supports the theory that the students who are exposed to the questions (interventions) posed by the virtual facilitator asked more questions thus indicating the possibility of observational learning.

The second part of this thesis studies the effects of an instructor's autonomy support on the motivation and performance of the students using the concepts of experiential based learning and self-determination theory. This paper investigates the quality of students to autonomously behave in an organization based class environment with the instructor acting as the "senior manager" of the organization and the students playing different roles to keep the organizational work flowing. Experiential based learning of this type (the "classroom as organization") began more than 20 years ago when it was first used to teach students the concepts of organizational behavior. In the second paper we study the behavior of students in a class which uses similar idea to teach management concepts at both graduate and undergraduate level. The paper hypothesizes that the students who are more autonomously oriented towards taking this course would have a better performance in the course.

PAPER - 1

EXPERT SYSTEM FOR TEAM FACILITATION USING OBSERVATIONAL LEARNING

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ABSTRACT

While ABET criteria require that engineering graduates be able to "function on multidisciplinary teams" and "communicate effectively", the need for effective team skills goes far deeper. One solution is the use of a computationally intelligent "virtual facilitator" that contains a subset of the expert knowledge of a skilled facilitator. The "virtual facilitator" models behaviors of an expert facilitator to engineering student teams as they are working together. Albert Bandura's theory of observational learning suggests that skills can be developed through observation of expert "others" engaged in practice. Preliminary research indicates that students can increase beneficial team behaviors (such as inquiry) through observation and imitation of an expert system.

This paper is an extension of a 2005 Frontiers In Education (FIE) Work-In-Progress presentation that documented an expert facilitator system. In this study the system is used as part of an hour-long team exercise for engineering students. This study looks at student interactions during the exercise. Measures include analysis of team conversations for instances of imitation of the expert system, as well as a comparison of differences in team performance. The potential for an easily disseminated method to help engineering students learn effective team skills is discussed.

1. INTRODUCTION

The development of communication skills is necessary preparation for effective engineering team work. Teams with a high degree of openness and interdependence exhibit enhanced quality of decision making [1]. ABET requirements for accrediting Engineering Programs 2007 – 2008 state, “Engineering programs must demonstrate that their students attain: an ability to function on multi-disciplinary teams…...and....an ability to communicate effectively…..” [2]. While many faculty and institutions work to make team skills a part of the technical repertoire of the students, the portability of this knowledge is limited as it is difficult to share between institutions.

History attests to the catastrophic consequences of team dysfunctions and neglect of group dynamics. For example the space shuttle Challenger and Columbia tragedies can be attributed to failures in team skills [3]-[5]. The Columbia Accident Investigation Board found that “the hole in the wing of the shuttle was produced not simply by debris, but by holes in organizational decision-making. Furthermore, the factors that produce the holes in organizational decision-making are not unique to today’s NASA or limited to the shuttle program, but are generic vulnerabilities that have contributed to other failures and tragedies across other complex industrial settings" [6].

Such conflicts and team dysfunctions are related to difficulties of team members sharing their perspectives and making tradeoffs [7], [8]. Since engineering teams are often multi-disciplinary, the complex set of problems that engineers face need to combine the expertise of different disciplines. Also, to make the project successful they need to collaborate with others in a team who may have different perspectives and technical objectives. The quality of decision-making in these contexts is enhanced by increasing openness and interdependence, and diminished when team members regulate or ignore certain information [1], [9].

While engineering institutions regularly give students projects involving technical knowledge, all too often students are put in project teams where they are expected to work together successfully without sufficient support in interpersonal and team skills. Mere placement in teams does not guarantee the learning of these skills [8]. This can be improved in engineering education through activities specifically designed to nurture team skills [8], [10].

One solution is the use of a computationally intelligent "virtual facilitator" that contains a subset of the expert knowledge of a skilled facilitator. The "virtual facilitator" models the behaviors of an expert facilitator to engineering student teams as they are working together.

Automated facilitation tools may provide a simplified model for conversational interventions, which students can imitate [8]. Albert Bandura's theory of social (or observational) learning suggests that skills can be developed through observation of expert "others" engaged in practice. Bandura's theory has received a strong support in research on this area. This paper describes the virtual facilitator tool and presents findings from its use by several student groups [8].

1.1. ALBERT BANDURA'S THEORY OF SOCIAL LEARNING

Given that team skills produce highly beneficial results, the question arises 'How does someone learn to improve communication skills?' One possibility is that team skills could be learned in a fashion similar to other skills. The theoretical basis for this study is provided by Bandura's theory of social learning.

Albert Bandura suggested that individuals learn many skills through a process of modeling, in which behaviors are observed and imitated within a social context [11]-[14].

There are four steps involved in this process:

1. Attention – The first step is paying attention to the actions of another person modeling a behavior [11]-[14].
2. Retention – The second step involves retaining or remembering what one paid attention to. Imagery and language have a significant part to play in this because an individual stores what he has seen the model doing in the form of mental images or verbal descriptions. When stored in this form, he can later recall the image or description, so that he can reproduce it in his own behavior [11]-[14].
3. Reproduction – The ability to reproduce what has been observed and retained results in a more effective learning process. Reproduction is significant because the ability to

imitate a behavior improves with practice. People's abilities improve even by just imagining themselves performing a behavior [11]-[14]. For example, Many athletes rehearse their performance in their own minds prior to the actual event.

4. Motivation – The final step for learning comes from seeing the model as useful based on its outcomes [3]. If outcomes are perceived as valuable a person will be more likely to pay attention to that behavior because it has personal relevance [6], [15].

Bandura's theory thus predicts that "individuals in contact with models that produce useful outcomes will pay attention to their behaviors and are more likely to produce similar behavior" [11]-[14].

2. PROJECT OVERVIEW

2.1. THE VIRTUAL FACILITATOR – AN EXPERT DIALOGIC SYSTEM

Much learning occurs through the presence of real-life models but with the advancing technology as well as written and audiovisual means of communication, there can be increasing use of audiovisual and computational models that create imitable behavior [11]. Verbal instructions that describe the correct responses and their sequencing comprise one of the widely prevalent means of providing symbolic models [11].

Abstract theoretical concepts of leadership, management, teamwork, facilitation and communication can be connected to real experience through these 'symbolic models' [16]. Model-based activities that enhance such experiences offer valuable opportunities for learning concepts such as group facilitation.

2.1.1. FACILITATION FOR EFFECTIVE TEAM COMMUNICATION

Group facilitation is a process “in which a person who is acceptable to all members of the group, substantively neutral, and has no decision – making authority, intervenes to help a group improve the way it identifies and solves problems and makes decisions, in order to increase the group’s effectiveness” [16].

Researchers in team learning and group development have described “recipes for action” in interventions used for group facilitation [8], [17]. Recipes in this context refer to “relatively simple statements or questions that are triggered by particular words or phrases” [8].

While the literature on team learning and group development acknowledges the existence of “recipes for action” as a platform for mastering intervention skills, previous research on approaches to individual therapy have accounted for a “far richer set of these recipes” [8], [18]. For example, interventions used by experts in organizational facilitation can also be found in the behaviors used in therapy to help individuals surface information [8]. Research conducted with more than 100 virtual teams working in chat space found that teams exposed to these types of interventions performed significantly better than teams that were not exposed [8], [19].

An increase in team performance has been associated with facilitation [20]. Facilitation encompasses several goals, for example, helping team members to manage conflict effectively and share knowledge and expertise. These goals are achieved by facilitators through an observable process of intervening with questions and comments into group dialogue [11]. Outcomes such as conflict resolution and increased efficacy are expected to be some outcomes of observational/social learning.

Expert facilitation promotes greater shared understanding by:

1. Assisting team members unearth and test negative evaluations of others in the team.
2. Helping team members to reach conclusions and make their emotional reactions explicit, on the basis of their reasoning and data they have.
3. Encouraging everyone in the team to collaborate on team decisions.

Analysis of previous work in this area indicated that teams exposed to interventions exhibited significantly ($p<0.05$) higher levels of "constructive controversy" , a set of behaviors associated with the ability to manage conflict effectively, which is widely associated with improved team performance [22], [23]. Constructive controversy within a team involves the open-minded sharing of alternative perspectives in order to achieve a cooperative (win-win) solution that accrues benefit to the entire team.

2.1.2. VIRTUAL FACILITATOR AS EXPERT SYSTEM

The virtual facilitator is a responsive software system that functions similar to a chat space over the internet. It has a dialogue box that lists the names of the team members participating. As with a typical chat tool, conversations appear in the dialogue box. However, it also has a space where system-generated interventions into the team's conversation appear. The software includes the option of turning these interventions on or off as desired.

The software also has the ability to save the conversations between the team members and generate a transcript listing the detailed timings of the conversations and showing the interventions in a different font and color.

The virtual facilitator automatically “listens” to a team conversation (with the use of notebook computers equipped with microphones and wirelessly interconnected) and then generates a transcription of the conversation (using commercially available speech-recognition systems). Figure 1 illustrates the system [8].

When using the system, students participating in a team discussion wear a headset fitted with a microphone that is plugged into a notebook computer [8]. Commercially available speech recognition software converts each individual’s spoken words into text [8]. The Expert Dialogic System connects each individual notebook computer with the others wirelessly and knits together each individual’s text into a transcription of the group conversation [8].

The virtual facilitator’s main function is to help the group increase its effectiveness by improving its communication skills [17]. It achieves this by intervening in the conversations that occur between team members.

Interventions are triggered by particular words or phrases in the team conversation. These responses (interventions) are based on rules built into the software.

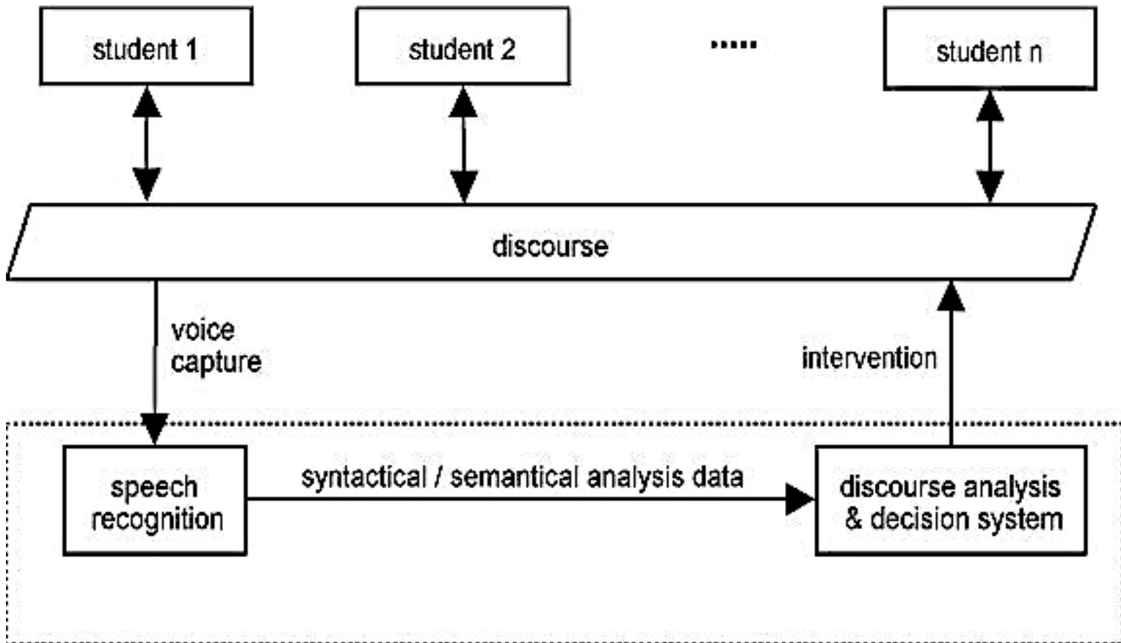

FIGURE 1: Student Team Interaction Using The Expert Dialogic System

The rules currently in use are based on the work of Chris Argyris [21], [24]-[26]. They are designed to foster the surfacing of information involved in the dialogues between team members [8].

The rules are stated in terms of IF-THEN relationships [8]. See Table 1 for the rules currently used.

It has been shown that teams exposed to these specific interventions exhibit a greater degree of beneficial team behaviors, such as constructive controversy [23].

Situation	Indicators (IF)	Questions (THEN ASK)
Deletion - Clearly and Obviously	-ly ending or "it was clear to me"	What leads you to see it that way? Can you give specific examples?
Deletion - Comparisons	-er, -est, more/less, most/least, etc.	Better (faster, etc.) than what? How, specifically, do you see it this way?
Deletion - Can't, Impossible, and Unable	can't, impossible, unable, no one can	What prevents you from doing so? (Does anyone see things differently?)
Deletion - Advocacy without illustration	"should, must, expect, encourage"	What leads you to see it that way?
Distortion - Forcing or Making	"I had to, you made me, you bore me"	What experience had you had that leads you to believe X? What was done that makes you Y?

TABLE 1: Examples of IF-THEN Rules

Through the process of observing, the virtual facilitator generates inquiries into the team's conversation. It is hypothesized that students can increase level of beneficial team behaviors, such as inquiry. Two specific hypotheses are tested in this research.

1. Students exposed to questions posed by the virtual facilitator (the treatment group) will ask more questions than those not exposed to it (the control group).

2. Students exposed to questions posed by the virtual facilitator (treatment group) will exhibit higher performance on a team decision-making exercise than those not exposed to it (control group).

3. EXERCISE DESCRIPTION

Teams in this research worked through one of two decision making exercises. The exercises involve team decision-making and information sharing as part of mock engineering and managerial design scenarios.

3.1. DESCRIPTION OF SIMULATION GAMES

Brief descriptions of the simulation games are given below.

Solar Car Team – The goal of this game was to make choices of solar car components that would maximize the number of miles the car would be able to travel. Each team consisted of four members representing one department each. The Mechanical Engineering Department had to suggest the type of motor to be used from the list of choices, the Electrical Engineering Department suggested types of batteries, and the Frame Design Department suggested the type of frame and solar cell. Finally, the Cost Management Department was charged with ensuring that the car did not exceed the budget.

Budget Balancing Team – Students participating in this game were given the task of balancing the budget of a fictional company to maximize profit. Each team had four roles, with one member playing each role. The team consisted of the Union Representative whose goal was to protect regular employee interests by limiting layoffs.

The Director of Personnel on the other hand had to retain not only employees but also managers from different departments. The Director of Development and the Director of Finance had to retain employees, their own department's managers and also had to make sure that they had funds for projects.

These two simulation games were conducted with students from four senior/graduate level courses at the Missouri University of Science & Technology. These courses were chosen because the advisors of these courses agreed to allow access for one hour to conduct the simulation games. Table 2 below shows the list of courses and other details.

Course Name	Number of Students	Type of Simulation Game
Project Management	8	Solar Car
Business Logistics & Systems Analysis	16	Budget Balancing
Organizational Psychology	4	Budget Balancing
Psychology of Leadership	4	Budget Balancing

TABLE 2: Courses Involved In The Research

The games were conducted as a virtual team, which meant that members communicated over the internet in a chat-space using the virtual facilitator.

Each team member was asked to balance personal goals (e.g., retaining as many employees as possible) with group goals (e.g., maximizing profitability). The exercises simulate real-life scenarios in which personal goals must be weighed against group needs.

Team members were asked to use mathematical, communication, and critical thinking skills to solve problems in such a way that each member could meet a basic level of individual role interests while maximizing team performance. Different team members achieved higher or lower individual goals depending on their ability to communicate and influence others in the team. Teams were required to reach a consensus agreement.

3.2. SETTINGS AND TREATMENTS

Immediately after entering the laboratory the students were assigned randomly to computer systems. These systems were arranged to have similar kinds of departmental representatives sitting together (e.g., for the solar car team simulation game the Mechanical Engineering Department members from each team were juxtaposed). Each team member was given a profile sheet which illustrated his or her own specific roles in the team. Also, a common sheet which described the team's goals and the other departments on the team was given to each student.

The participants of the Solar Car and the Budget Balancing games were given forty and thirty minutes respectively to make the first decision. Later an additional ten minutes were given for improving and making the second decision. At the end of each decision a particular team member was asked to bring the team's decision sheet and their results were calculated on the spreadsheets that were prepared for each game. After the game the conversations were saved and compared.

Students were divided into two groups:

1. The first group (the "treatment group") received facilitation by the virtual facilitator (expert system) throughout the exercise.
2. The second group (the "control group") was not exposed to facilitation by the expert system.

4. RESULTS

The conversations between the team members were saved and were later evaluated for results of the three hypotheses.

1. Number of inquiries during the conversation of each team (see Table 3) - A paired comparison T-Test was performed to evaluate whether there was a significant difference in the means of the average number of questions asked by the treatment and the control groups. The test was based on the assumption that the two groups have a normally distributed population.
2. Quantitative performance of the teams based on the decisions made by each (see Table 4) – A comparison on the basis of the team performance was made. Team performance was measured by evaluating which team reached a greater number of miles/day (Solar Car simulation game) and which team made more profit (Budget Balancing simulation game), without violating the rules and by reaching a consensus.

Type of Simulation Game	Type of Group - Team #	Number of questions asked	Difference (treatment - control)
Solar Car (Project Management)	Treatment - Team 1	83	10
	Control - Team 2	73	
Business Budgeting (Business Logistics & System Analysis)	Treatment - Team 1	37	11
	Control - Team 2	26	
Business Budgeting (Psychology)	Treatment - Team 1	26	5
	Control - Team 2	21	

TABLE 3: Results - Number Of Questions Asked

Type of Simulation Game	Type of Group - Team #	Decision Reached
Solar Car (Project Management)	Treatment - Team 1	346.9 miles/day
	Control - Team 2	352.4 miles/day
Business Budgeting (Business Logistics & System Analysis)	Treatment - Team 1	Loss - $11,950
	Control - Team 2	Loss - $17,000
	Treatment - Team 1	Loss - $11,200
	Control - Team 2	Profit - $5000
Business Budgeting (Psychology)	Treatment - Team 1	Loss - $10,000
	Control - Team 2	No Consensus Reached

TABLE 4: Results – Quantitative Performance

3. Conversations were coded based on the degree of constructive controversy behaviors [23]. If a positive connotation behavior was reflected it was coded “+1” and a negative connotation behavior received a “-1”. Table 5 shows a brief description of the behavior. Table 6 shows the level of constructive controversy for each team.

The results of the hypotheses are:

1. Hypothesis 1 is supported, with $p = 0.02286$ (≤ 0.05). There is strong evidence that students exposed to questions posed by the virtual facilitator asked more questions than those not exposed to it.
2. Hypothesis 2 was not supported. There was no significant result on whether students exposed to questions posed by the virtual facilitator exhibited higher performance on a team decision-making exercise than those not exposed to it.
3. Hypothesis 3 is not supported, with $p = 0.19971$ (≥ 0.05). There is not strong evidence to indicate that students exposed to questions posed by the virtual facilitator showed a higher level of constructive controversy.

Positive Connotation	**Negative Connotation**
Contributes Ideas & Opinions	Emphasizes win-lose competition
Emphasizes mutual goals	Criticizes and disagrees with others
Asks others for proof, facts, and rationale	Criticizes others as persons

TABLE- 5: Types of Behaviors

Type of Simulation Game	Type of Group - Team #	Constructive Controversy Level	Difference (treatment-control)
Solar Car (Project Management)	Treatment - Team 1	69	60
	Control - Team 2	9	
Business Budgeting (Business Logistics & System Analysis)	Treatment - Team 1	64	25
	Control - Team 2	39	
	Treatment - Team 1	42	-20
	Control - Team 2	62	
Business Budgeting (Psychology)	Treatment - Team 1	34	2
	Control - Team 2	32	

TABLE 6: Results – Constructive Controversy Level

5. DISCUSSION

Earlier work showed that student team performance could be significantly improved ($p < 0.05$) by applying a set of basic interventions, which have now been embedded in the proof-of-concept virtual facilitator [19]. This work investigated the effect of manually typing the interventions triggered by these rules into a chat room used by student teams as they worked on a team problem-solving exercise in cyberspace. The results indicated that interjecting these interventions into team conversations significantly improved team performance by around a half-sigma [19].

The previous results were obtained with a much larger sample size. Because the deviation of performance and constructive controversy results was quite large, it is understandable that the results of this research would not show statistically significant effects.

6. CONCLUSIONS

As an investigation of Bandura's Observational Learning theory, this study tested the effect of inquiry on the team members. Results supported one of our hypotheses. These results have two implications.

The expert dialogic system increased beneficial team behaviors. The virtual facilitator does appear to modify behavior by increasing the frequency of inquiry. While not conclusive, this indicates the possibility of observational learning. This implies that learning inquiry is like many other human behaviors and can occur through observational learning.

These results suggest that additional research is necessary to further study the effects of an expert dialogic system on team behavior and performance. Some avenues to explore include:

1. Using the virtual facilitator during face to face "spoken" team meetings by converting the conversations between the team members into written scripts for evaluation.
2. Further developing intervention rules by adding more complex rules or by adding rules from other experts.
3. Incorporating emotional components of communication between team members. The system has the capability to incorporate recognition of words and phrases with emotional attributes and to inquire accordingly into the discussion.

7. ACKNOWLEDGMENT

We gratefully acknowledge support of this research through NSF Award No. EEC - 0644917.

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PAPER - 2

EXPERIENTIAL LEARNING: THE EFFECTS OF INSTRUCTOR'S AUTONOMY SUPPORT ON STUDENTS' PERFORMANCE & MOTIVATION

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ABSTRACT

This paper studies and compares the effects of instructor's autonomy support on the motivation and performance of the students in graduate and undergraduate level courses. The course called *EXperience-Based* learning or XB considered for this study is designed to provide autonomy support to students by the instructor (called the "senior manager") to help them create their own "process and learning" environment, in a "classroom as organization" structure. Based on the concept of Self-Determination Theory the paper hypothesizes that (a) masters level (graduate) students as compared to bachelors level (undergraduate) students will show relatively higher perceived competence and interest/enjoyment and lower grade-focused performance goals which further relates to how students perform in the class, (b) greater perceived autonomy support tends to increase autonomous self regulation, perceived competence, and interest/enjoyment amongst students, and (c) students' performance in the course directly relates to their autonomous behavior and their perceived autonomy support towards their instructor.

1. INTRODUCTION

Learning in the traditional sense means completion of the homework assignments and exams by the students in a typical classroom setting. This method of learning involves one way transfer of information and often creates a “swim or sink” competitive environment [1]. In a typical classroom setting, students follow their instructor and rely on him to set the rules for the class. The instructor makes decision on what is right or wrong in an environment which is organized around the lecture hall, with students busy following what is laid down by their teacher.

1.1. CLASSROOM AS ORGANIZATION

The Classroom as Organization on the other hand provides the students with an autonomous setting and support needed to create their own process and learning environment. With its beginning more than 12 years ago where it was first used to teach college students theories of organization behavior, the classroom as organization has found applications in various academic fields including engineering and management. It is a form of simulation role play that can teach concepts and skills through reflection on action. EXperience-Based learning, or XB, is one such course being taught both at bachelors and masters level in a mid-western engineering university.

Contrary to a typical class format where students passively listen to lectures and take exams, the senior manager (instructor) in this course lets the students run the organization by delegating responsibilities to the participants. The class creates an organization and the students are distributed to form different departments to run this organization. For example, the *Responsibility department* consists of a staffing, planning and control team. The *staffing team* takes care of the employment of the organizational members (students) in different departments and makes sure that the skill sets of the team and their members match. The weekly agenda is prepared by the *Planning team* and the *Control team* keeps a check on the performance of and evaluations by the students. Students enact a *self-directed learning process* to learn the concepts of management and organizational behavior as a product of the autonomous class environment. The goal of the students is not winning or competing with others but to develop the concept of managing and organizing their department and see how its function ties into the whole. Expressing their opinions and discussing conflicts with other students in the organizations helps "facilitate self-determination" [2], [3].

1.2. SELF-DETERMINATION THEORY

Self-Determination Theory advocates that an important measure of motivated behavior is the degree to which it is *autonomous* rather than *controlled* [1]. Autonomous behaviors are voluntary behaviors that are performed out of interest or personal preferences [1]. They are the product of *intrinsic motivation* [1]. For example, if a student attributes his/her interest to internal factors that they can be controlled through, for example, efforts put in, the behavior is intrinsically motivated. In contrast, if the behavior is necessary to accommodate to the environment, it is said to be externally or *extrinsically* motivated. For example, if the student's interest is dependent on his/her grade, then the behavior is extrinsically motivated. Thus, extrinsic motivators, often result in *controlled behavior* to undertake and sustain the probable circumstance or event such as the "offer of a reward" [1].

Intrinsic and extrinsic motivation can thus be distinguished from each other on the basis of the rewards associated with the activity [4]. A behavior is extrinsically motivated when the individual focuses more on the goal, rather than on the process of doing the activity well [4]. Intrinsically motivated behavior on the other hand is associated with feeling of competence and *self-determination* [4]. Though the competition found in a typical class environment might seem to foster involvement and generate excitement it is in reality a special form of extrinsic activity with rewards associated with winning (or beating the other person or other team) [4]. This form of competition measures students' effectiveness by competing with others [4].

Based on Self-Determination Theory, researchers have argued that pursuing extrinsically motivated content tends to be associated with poorer mental health while intrinsic goal pursuits promotes people's natural growth tendencies [6], [7]. Studies indicate that because the pursuit of intrinsic goals promotes satisfaction of one's psychological needs for autonomy, competence, and relatedness, it has positive effects on the mental heath and well being of a person [5]-[7]. On the other hand, the pursuit of extrinsic goals is aimed at external indicators of worth, which result in excessive social comparisons and unstable self-esteem, both of which are negatively associated with well being [7]-[9].

1.3. BEHAVIORAL ORIENTATION AND SOCIAL SUPPORT

1.3.1. CAUSALITY ORIENTATION

The *degree of self-determination* and its source of initiation & regulation is characterized by ***causality orientation***, which is a relatively enduring aspect of one's behavior [10]. Causality orientation can further be divided into three types of orientations that explain the autonomous, controlled or impersonal behavior of a person.

Autonomy orientation explains the behavioral tendency of an individual to be autonomous across domains and his/her orientation towards the autonomy supportive aspect of the environment [1]. Autonomy orientation is seen to positively correlate with ego-development, self-esteem, and self-actualization and with personality integration [1], [10], [11]. An individual with a relatively higher autonomy orientation tends to display greater self-initiation and seeks interest in the activities which are interesting and challenging while taking responsibility of his/her actions [10]-[15].

The *controlled orientation* describes the behavioral tendency of an individual to be controlled and his/her orientation towards controlling inputs such as rewards, deadlines, structures, ego-involvements, and the directives of others [1], [10]-[15]. The controlled orientation has a positive correlation with public self-consciousness and negatively impacts the well being of an individual [1], [7], [10]. An individual higher on the controlled orientation tends to be dependent upon rewards or other controls and is more receptive to what people want rather than what they want from themselves [10]-[15].

The third category called the *impersonal orientation* describes one's behavioral tendency to be unmotivated and his/her orientation towards the aspects of the environment that promote incompetence [1]. This orientation is positively correlated with social anxiety, depression, and self-derogation [1], [10]. This individual cannot cope up with demands or changes and tends to believe that he/she is incapable of attaining the desired outcome and that success is largely a matter of luck or fate [10]-[15].

In the present paper we focus on the autonomy and controlled orientations of the students.

1.3.2. AUTONOMY SUPPORT

Studies done by Grolnick & Ryan on "social contexts and internalization" show that an interpersonal context, referred to as *autonomy support*, is important to promote internalization and self-determination [2], [16]. Self-determination theory proposes that the extent to which an individual is autonomous versus controlled is influenced by the *autonomy support* [1].

An autonomy supportive individual while in the position of authority (e.g., instructor) would consider other's (e.g., students') perspective, acknowledge their feelings and concerns, and provides them with pertinent information and opportunities to make informed choices [1]. This would minimize the pressure and demand from others to perform in a particular way and would encourage initiation [17]. For example, an autonomy supportive instructor would provide the students with necessary information encouraging them to use this information to solve the problem in their own way [1]. On the other hand, a controlling person in authority would pressure others to work or behave in their perceived correct way either through coercive or seductive techniques that generally include implicit or explicit rewards or punishments [1]. For example, a controlling instructor would expect the students to follow his/her method of solving the problem to score well on the class tests [1].

Autonomously supportive social events that provide moderate structures and contain involved others are optimal for encouraging, self-determined engagement, and promoting development. This is because such events lead to the satisfaction of the basic needs of a person by facilitating his/her expressions. Studies show that this environment will not only promote effective behavior but will also help in the development of the inner resources required for the adaptive self-regulation. In contrast, controlling events that are unstructured or over-structured or which do not facilitate involvement of significant others run the risk of undermining self-determination and impairing development by restraining the satisfaction of the basic needs [17].

Research supports that autonomy supportive class environments are associated with higher levels of intrinsic motivation than controlling classrooms [1], [18]. Further, autonomy supportive social events, relative to controlling, are associated with greater “conceptual learning”, more creativity, and more positive affect in regular and special education settings [1], [3], [19]-[21].

1.3.3. LEARNING SELF-REGULATION

Learning self-regulation considers the reasons why people learn in a particular setting and why they are engaged in learning related behaviors. Self-determination theory differentiates a motivation on the degree to which it has been internalized and integrated with one self. On the continuum from least integrated to fully internalized these regulations are external, introjected, identified, and integrated. External and introjected regulations are considered forms of extrinsic motivations whereas identified and integrated form the intrinsic motivation. Learning self-regulation puts these regulations under two "super" categories, controlled and autonomous and assesses the extent to which an individual is autonomous versus controlled in performing particular behaviors under certain circumstances [14], [16], [22]-[24]. This approach was developed by Ryan and Connell (1989) and then adapted by Williams and Deci (1996) as the learning self-regulation questionnaire to study the level of learning in universities [1], [14], [25].

1.3.4. PERCEIVED COMPETENCE

Self-determination theorizes the feeling or perception of *competence* to be one of the fundamental psychological needs. Competence is perceived to be important in facilitating people's goal attainment and providing them with a sense of satisfaction from engaging in a particular activity in which they feel effective. Analysis and usage of perceived competence is done along with perceived autonomy to predict behavioral change, effective performance, and internalization of ambient values [25], [26].

1.3.5. INTEREST AND ENJOYMENT

Interest & Enjoyment is considered to a be measure of intrinsic motivation. A person with a higher level of interest and enjoyment for a particular field has a higher intrinsic motivation to excel in that field. Further, it can also be said that the intrinsically motivated activities are those in which people would not indulge for rewards but for their own interest and enjoyment.

1.3.6. GRADE AND LEARNING ORIENTATION

Views of the students about their educational experience are either oriented towards their learning experiences called the *Learning Orientation (LO)* or their attempts to obtain the best grades called the *Grade Orientation (GO)* [27]. Students with a learning orientation consider the classroom environment as a context where they would learn new information and ideas that are both personally and professionally significant [27], [28]. Students with a grade orientation, on the other hand, consider college as a crucible where the tests and grades are considered necessary evils on the way of getting a degree or certification in a profession [27], [28].

Regardless of the orientation, students show greater learning in a highly student centered class, learning and grade orientation together contribute to the perception of the students towards the instructor, themselves and the way they interact with their instructor [27], [29], [30]. Further, studies show that students with lesser academic skills are believed to be under more pressure to obtain “better grades”, thus making them more grade oriented [27], [31]. Higher learning oriented students choose a college or a course based on the curriculum it follows whereas students with a higher grade orientation tend to be more concerned with their success at the college or in a course [27], [32].

2. THE PRESENT STUDY

The present study used an undergraduate and a graduate level course to collect data for research. In this study, we hypothesize the following:

1. Students who take the course for relatively autonomous reasons and perceive their instructor to be more autonomously supportive would tend to have greater perceived competence, autonomous self-regulation, interest enjoyment for learning the course, and lesser grade orientation. This is because students who take this course for autonomous reasons realize the benefits of this course and its environment as compared to the student who does not have an autonomous motivation to take the course. These students who realize the importance of this course if given the autonomy (by the instructor) to decide what to learn and how to learn,would show an increased interest and enjoyment for the course and thus would feel competent about the course material. Further, with a higher intrinsic motivation to learn the course, they would have a lower grade orientation. Thus, we predict that the instructor's autonomy support acts a *moderating factor* in this process as depicted in Figure 1.

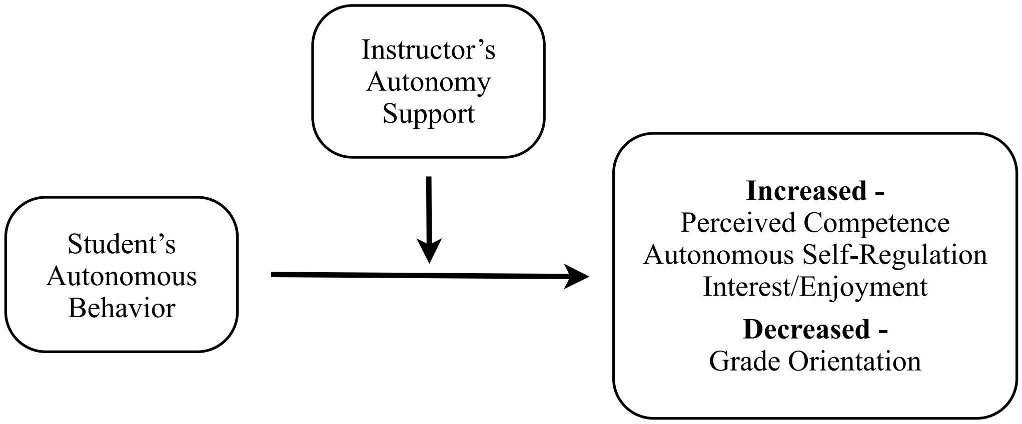

FIGURE 1: Instructor's Autonomy Support As Moderating Variable

2. Students' performance in this course is predicted to be directly related to their autonomous behavior with their perceived autonomy support (towards their instructor) acting as a *mediating factor* in the process. The students with higher autonomous motivations (behavior) for the course would see their instructor's autonomy support as a method to learn more from the environment Whereas the students who like to follow the traditional pattern of the class would feel uncomfortable with the same environment. Thus, we predict that the students who are comfortable with the class environment would be encouraged to see their instructor as autonomy supportive and therefore, would have better performance in the class as compared to others. This is depicted in Figure 2.

FIGURE 2: Perceived Autonomy Support As Mediating Variable

A study (Black and Deci) similar to the present one revealed that the instructor's autonomy support in a chemistry course predicted significant increase in student's autonomous regulation, their perceived competence and their interest in the course, thus increasing their performance in the course. We expect that the support to the present hypotheses would extend the results of Black and Deci.

3. METHOD

Participants are the students of a mid-western university taking courses in management at the graduate and undergraduate level. They attend this course as a standard class course under the same professor. The students are randomly assigned to different departments where they apply the concepts taught in the class to accomplish the tasks of their department. The organization is led by the senior manager (instructor) who helps facilitate problem solving, surfaces difficult issues, and encourages active engagement with the material.

The students in both the classes were asked to fill out two surveys pre & post course at the start and end of the semester. They were informed that the participation in this research was voluntary and if they chose not to participate, their grades would not be affected in any way. Also, the instructor will not have access to the responses and names of the students who chose to participate. Of 48 students, 23 students filled either one or more surveys. The number of males and females in each course is shown in Table 1 (refer to Appendix B, Table 1 for details). The first survey was requested in the first month of the course and asked about the students' feelings towards a typical course. Students were asked to complete the second survey in the last one and a half month, and it dealt with students' reactions towards XB.

Course	**Session**	**Males**	**Females**
314	Fall, 2007	10	4
313	Spring, 2008	3	2
314	Spring, 2008	4	0

TABLE 1: Number of Males & Females

4. MEASURES

The surveys contained the following measures:

4.1. THE GENERAL CAUSALITY ORIENTATION SCALE (GCOS)

There are three types of orientations including autonomy, controlled and impersonal. Each is theorized to exist within an individual up to some degree [10]-[15]. These orientations are considered to be the "relative enduring aspects of personality" [10]-[15]. The scale known as the General Causality Orientation Scale, measures these three motivational orientations within an individual [10]-[15]. The measure has three sub-scales to it, based on the three types of orientations.

The scale consists of 12 hypothetical vignettes, each describing a typical social or achievement oriented situation (for example, planning an event or interacting with a colleague) and is followed by three types of responses - autonomous, controlled, and impersonal. Respondents (students) are asked to indicate, how true a response is for them on a 7-point Likert scale [1], [10]-[15]. Thus, the score of each sub-scale is calculated by summing the item corresponding to each scale. The scale has been analyzed by Deci and Ryan to be reliable, with Cronbach alphas of about 0.75 and a test-retest coefficient of 0.74 over two months, and to correlate as expected with a variety of theoretically related constructs [10]-[15].

4.2. PERCEIVED AUTONOMY SUPPORT: THE LEARNING CLIMATE QUESTIONNAIRE (LCQ)

The Learning Climate Questionnaire as adapted by Williams and Deci (1996) from the Health-Care Climate Questionnaire is used for this study [1], [24], [25]. This scale concerns the degree to which the target individual (student) perceives people in authority (instructor) to be autonomy supportive [1], [25], [33], [34]. This 15-item scale asks the students to respond to the questions on a 7-point Likert scale and thus measures the degree to which instructors are perceived to be autonomously supportive.

For the present study, the pre-course survey asks the students about their *perceived autonomy support* towards their instructor in a typical course as compared to the post-course survey where students answer questions in regards of their perception of the XB course instructor. Comparisons are made among the responses of graduate and undergraduate level students towards a typical course and XB.

4.3. THE LEARNING SELF-REGULATION QUESTIONNAIRE (LSRQ)

The Learning Self-Regulation Questionnaire (SRQ) was adapted from the original SRQ designed for elementary students and the subsequent version adapted for students studying organic chemistry [1], [14]. The questionnaire asks why the respondent (student) performs a particular behavior (or a class of behavior) and then provides several possible pre-selected reasons to represent different styles of regulations and motivations [14], [16], [22]-[24]. The questionnaire is divided into analyzing two regulations, which are measured as autonomous sub-scale and controlled sub-scale.

The pre-course survey asks questions about a typical course whereas the post-course survey deals with the questions on the XB course. Students rate how true each of the 12 reasons are for them to engage in a particular behavior while studying the course, using the 7-point Likert scale. Five of the reasons are intrinsic, thus being considered autonomous (e.g., "I will participate actively in the XB course because a solid understanding of management concepts is important for my intellectual growth"). Seven are external and were thus considered controlled (e.g., "The reason that I will work to expand my knowledge in this subject is because a good grade in the course will look positive on my record") [14], [16], [22]-[24]. Sub-scale scores are the sum of the items on each scale.

4.4. THE PERCEIVED COMPETENCE SCALE (PCS)

The Perceived Competence Scale is designed for specific behavior or domain being studied [25], [26]. This scale assesses participant's feelings of competence towards the course they are taking [25], [26]. This scale was used to analyze students' responses (both graduate and undergraduate) towards a typical course as compared to XB. This scale is a 5-item measure adapted from Williams and Deci (1996) [1], [25]. The score is the sum of student's rating on the truth of each felt-competence item [1].

4.5. THE INTEREST/ENJOYMENT (I/E) MEASURE

Similar to PCS, the Interest/Enjoyment Measure was also adapted from Williams and Deci (1996) [1], [25]. Further, this measure was also taken by all the students twice in the pre and post course to assess their reactions towards a typical course and XB respectively. The scale asks the students to rate the truth of seven items (e.g., "This course was fun to do") on a 7-point Likert scale, the sum of which is the total score.

4.6. THE GRADE ORIENTATION SCALE (GOS)

The Grade Orientation Scale is a part of the 32-item Learning Orientation and Grade Orientation (LOGO II) scale which assesses how students perceive their education [27], [28]. The scale for the present study is a 16-item scale taken from a study conducted by Bell and which is a 16-item scale [27]. It measures the extent to which students are focused more on grades than on learning [1].

The respondents use a 5-point Likert scale to rate each of the 16 items, 8 of which reflect *Learning Orientation* and the other 8 reflect *Grade Orientation* of the students [27]. Unlike the above two scales, this scale does not concentrate on a typical course or XB but it intends to analyze the difference in grade orientation of the students (graduate vs. undergraduate) in the beginning and end of the course.

4.7. PERFORMANCE IN THE COURSE

Ordinal ranking of the performance of the students was received from the instructor. The ranking was performed on a scale from 1 through 10 with 1 being the best and 10 being the worst. Ranking was based on the student's placement in the distribution of the scores in the class.

5. RESULTS

The survey responses from the students over the two semesters were analyzed and evaluated for result of the two hypotheses.

1. Students who take the course for relatively autonomous reasons and perceive their instructor to be more autonomously supportive would tend to have greater perceived competence, autonomous self-regulation, interest enjoyment for learning the course, and lesser grade orientation.

    To analysis to prove the moderating factor hypothesis regression analysis was performed on the following relationships for graduate and undergraduate students separately:

    1. Relation of students' autonomous behavior with the outcomes.
    2. Relation of instructors' autonomy support with the outcomes.
    3. Relation of the product of students' autonomous behavior and their perceived autonomy support towards their instructor with the outcomes.

    The relation of the product with the outcomes if significant will prove that students' autonomy support acts as a moderating variable to influence the outcomes.

    The regression performed on the relation of graduate students' autonomous behavior, their autonomy support and the product with the outcomes is depicted in Figure 3 and Figure 4. Consider Appendix B, Figure 1 - Figure 4 for details.

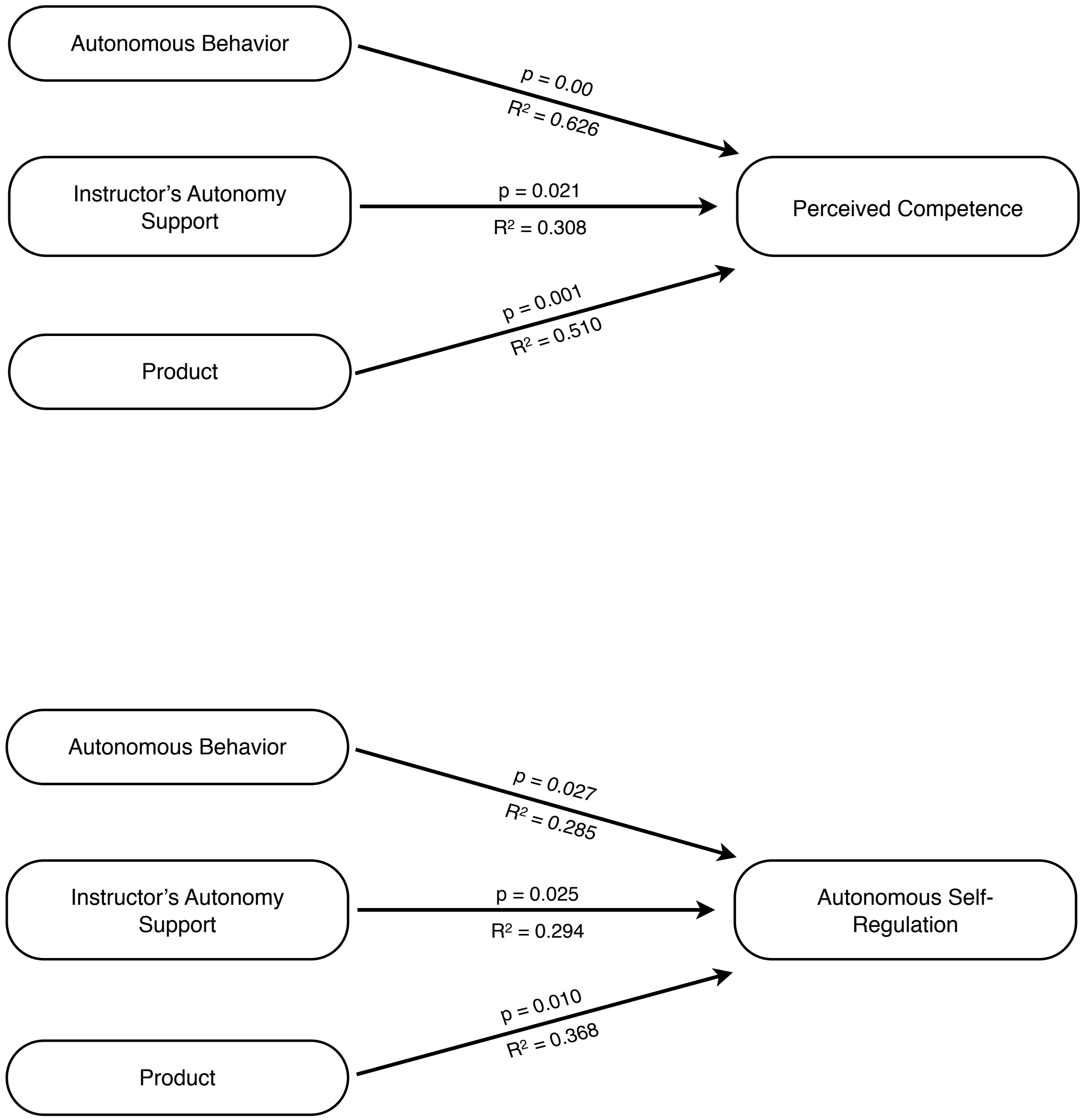

FIGURE 3: Relation with Perceived Competence & Interest/Enjoyment for Graduate Students

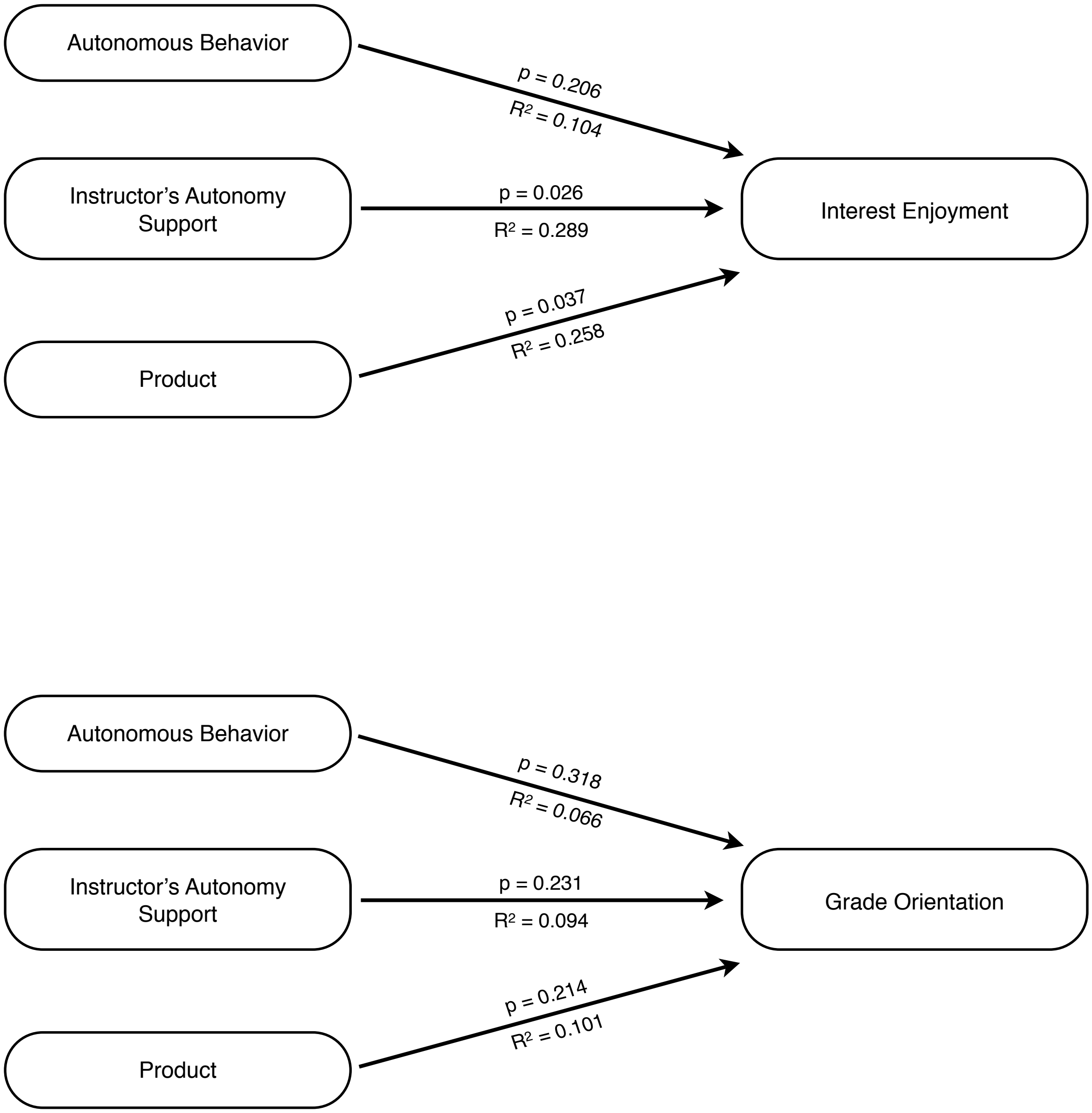

FIGURE 4: Relation with Interest/Enjoyment & Grade Orientation
for Graduate Students

The significance of relation between the product of students' autonomous behavior and their perceived autonomy support and the outcomes show that the instructor's autonomy support acts as a moderating variable to influence perceived competence, autonomous self-regulation and interest/enjoyment of the graduate students.

Similar analysis was performed for the undergraduate students. Figures 5 and Figure 6 depict the relations and their significance. The analysis shows that the instructor's autonomy support does not act as a moderating variable to influence any of the outcomes. Consider Appendix B, Figure 5 - Figure 8 for details.

Further, the means of student responses on different behaviors were computed for the graduate and undergraduate students for pre and post course surveys. Independent sample t-test was used for finding the means. The results are given in Table 2.

Comparing autonomous behaviors of the graduates and undergraduates depicts that the graduate students are more autonomously oriented towards the course during both pre and post the course as compared to the undergraduates. The significance of the mean comparison is 0.1615 and 0.1355, respectively, for pre and post course data. Consider Appendix B, Figure 9 and Figure 10 for details.

Comparing the perceived autonomy support of the students towards their instructor at the graduate and undergraduate level shows that the graduate students consider their instructor more autonomously supportive. The significance of the mean comparison is 0.0005. Consider Appendix B, Figure 11 for details.

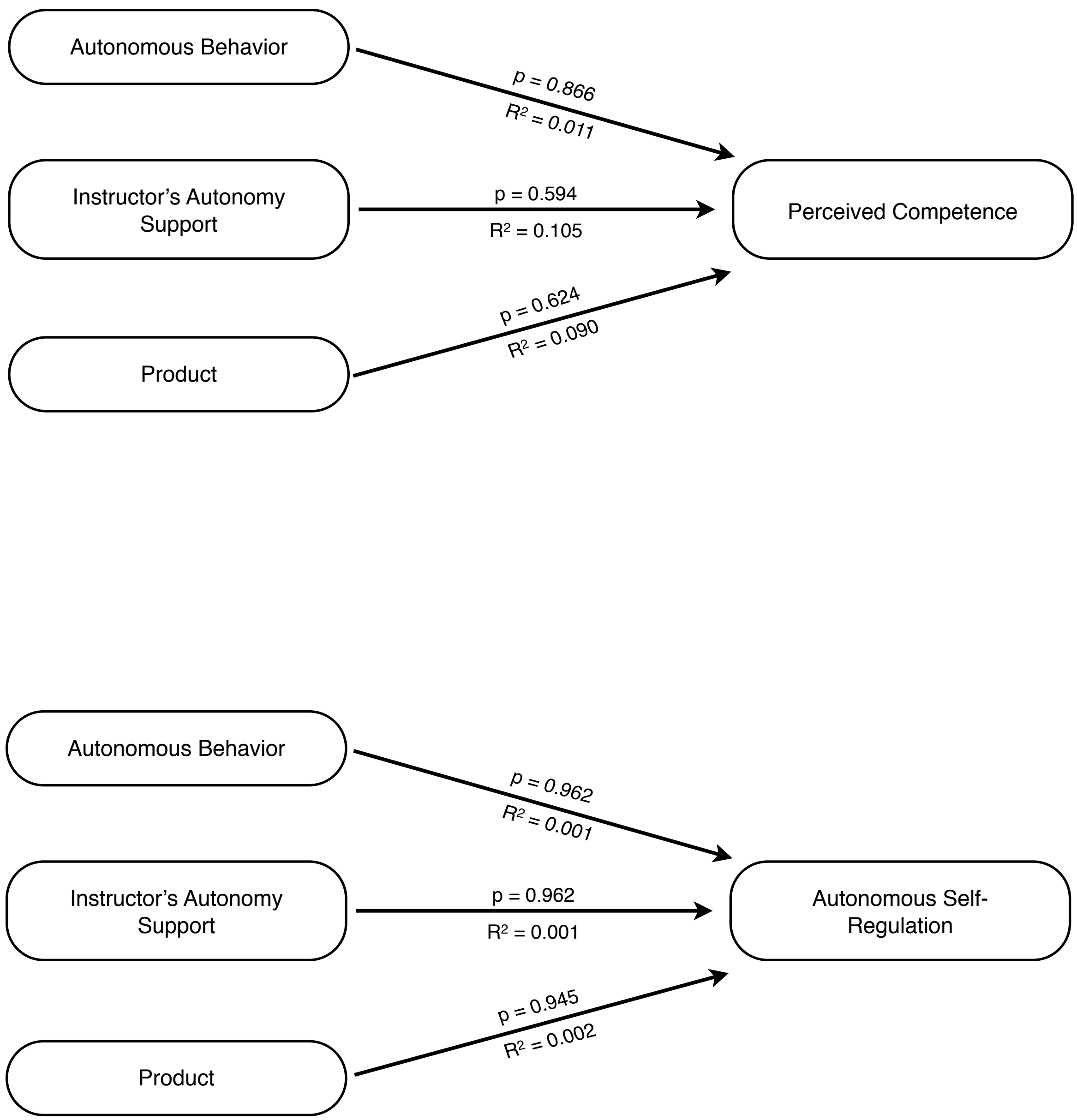

FIGURE 5: Relation with Perceived Competence & Interest/Enjoyment
for Undergraduate Students

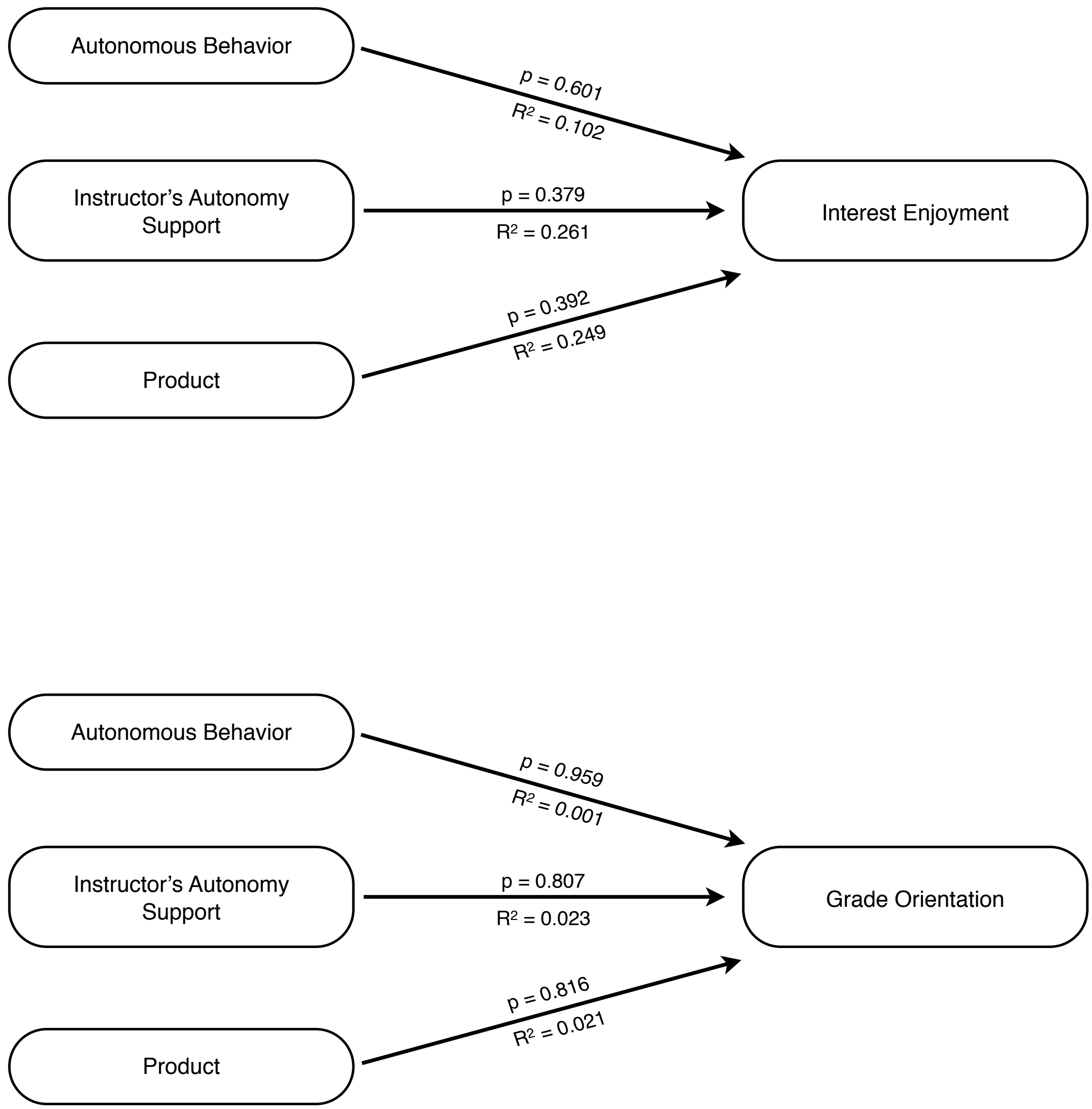

FIGURE 6: Relation with Interest/Enjoyment & Grade Orientation for Undergraduate Students

Behavior	Pre/Post	Graduates	Undergraduates	Significance
Autonomous Behavior	Pre-Course	75.4286	69.6667	0.1615
	Post-Course	73.23	68.03	0.1355
Perceived Autonomy Support	Post-Course	6.03	4.09	0.0005
Perceived Competence	Post-Course	6.13	5.75	0.225
Autonomous Self-Regulation	Post-Course	5.8941	4.68	0.07
Interest/Enjoyment	Post-Course	5.5653	3.458	0.0004
Grade Orientation	Post-Course	26.6	21.2941	0.15

TABLE 2: Mean Comparisons Using t-Test

Comparison of perceived competence, autonomous self-regulation, and interest/enjoyment for the graduates and undergraduates shows that the graduate students have higher traits than the undergraduates in all the three behaviors. The significance of comparison is 0.225, 0.07, and 0.0004, respectively, for perceived competence, autonomous self-regulation and interest/enjoyment. Consider Appendix B, Figure 12 for details.

A comparison of the grade orientation of the graduates and undergraduates shows that the graduates are less grade oriented than the undergraduates. The significance of the mean comparison is 0.15. Consider Appendix B, Figure 12 for details.

The above results indicate that there is no significant difference between the autonomous behaviors of graduate and undergraduate students ($p>0.05$). The difference in perceived autonomy support for graduates and undergraduates is significant ($p<0.05$). Further, the data does not show a significant increase in perceived competence and autonomous self-regulation ($p>0.05$) for graduate students as compared to undergraduates. However, there is a significant increase in the level of interest/enjoyment for the graduate students ($p<0.05$). Grade orientation for graduate and undergraduate students does not show a significant difference ($p>0.05$).

Therefore, the results show that graduate students show a higher perceived autonomy support towards the instructor. Thus their interet/enjoyment increases significantly as compared to the undergraduate by the end of the course.

2. Students' performance in this course is predicted to be directly related to their autonomous behavior with their perceived autonomy support (towards their instructor) acting as a *mediating factor* in the process.

   Regression analysis was used to test this hypothesis. The analysis required for testing mediating hypothesis involves the following steps [35], [36] -

   1. Showing significant relation between the predictor variable (student's autonomous behavior) and mediating variable (perceived autonomy support) using regression analysis. Consider Appendix B, Figure 13 for details.

2. Showing significant relation between the mediating variable (perceived autonomy support) and criterion variable (student's performance in the course) using regression analysis. Consider Appendix B, Figure 14 for details.
3. Showing less than significant relation between the predictor variable (students' autonomous behavior) and criterion variable (student's performance in the course) using regression analysis. Consider Appendix B, Figure 15 for details.

The values of *p-value* and R^2 (coefficient of determination) for each analysis is shown in the Figure 7.

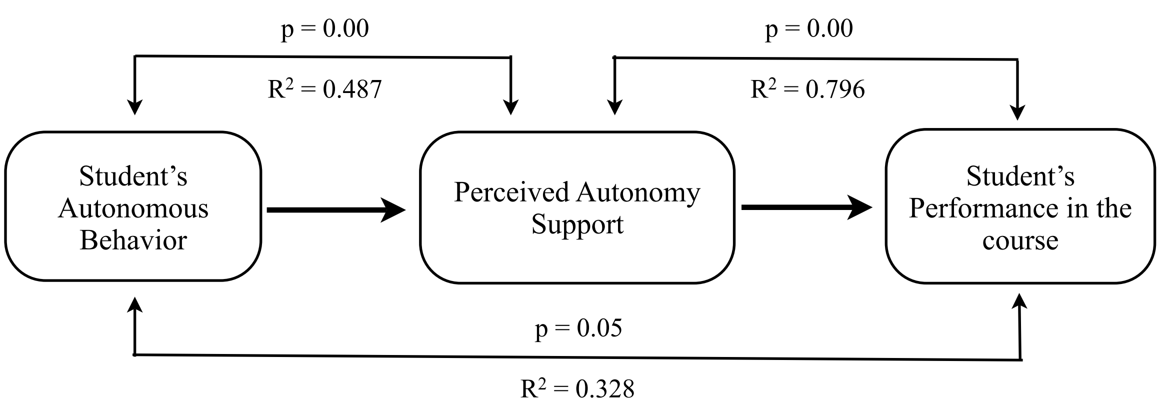

FIGURE 7: Relation Significance Using Regression Analysis

The calculations performed for the steps in the analysis indicate that there is a significant relation between students' autonomous behavior and perceived autonomy support and between perceived autonomy support and students' performance in the course. Also, there is less than significant relation between students' autonomous behavior and students' performance in the course. Thus, we can state that perceived autonomy support of the students towards their instructors acts as a *mediating factor* in relating their autonomous behavior to their performance in the course.

6. DISCUSSION

There are some important differences in the present study and the research of Black & Deci:

1. The course content of organic chemistry is considered to be orthogonal to instructor's style of teaching, whereas the course content of XB is considered to be conceptually related to the construct of instructor's autonomy support [1].
2. Some students dread organic chemistry, whereas management students typically want to learn management skills, so there might be considerably less variability in the relative autonomy of students in the present study (both graduate and undergraduate) [1].
3. There is a considerable difference in the number of students who took the survey. A total of 137 students took both the pre and post course survey in the organic chemistry class as compared to a total of 23 students who either completed the first or the second survey.

4. The perceived autonomy support towards the instructors is consistent with all the students under six to eight different instructors in the organic chemistry course whereas there a significant difference in the reaction of students at graduate and undergraduate level.

Thus, the present study offers an opportunity to explore the reaction of students at the graduate and undergraduate level and why they differ on the basis of autonomous behavior and perceived autonomy support.

The cause of difference in reactions of the graduate and undergraduate students towards the course and the instructor can be divided into three tiers related to students' autonomous behavior, perceived autonomy support, and their trust in their instructor. We consider these in turn.

First, understanding the relationship of students' autonomous behavior to their perceived competence, autonomous self-regulation, interest/enjoyment, and grade orientation is important. Regression analysis was performed to determine the significance of students' autonomous behavior being related to perceived competence, autonomous self-regulation, interest/enjoyment, and grade orientation. Figure 8 illustrates these relationships.

1. Students' autonomous behavior is significantly related to their perceived competence and grade orientation towards the course ($p<0.05$). (Appendix B, Figure 16 and 19).
2. Students' autonomous behavior is not significantly related to autonomous self-regulation and their interest/enjoyment ($p>0.05$). (Appendix B, Figure 17 and 18).

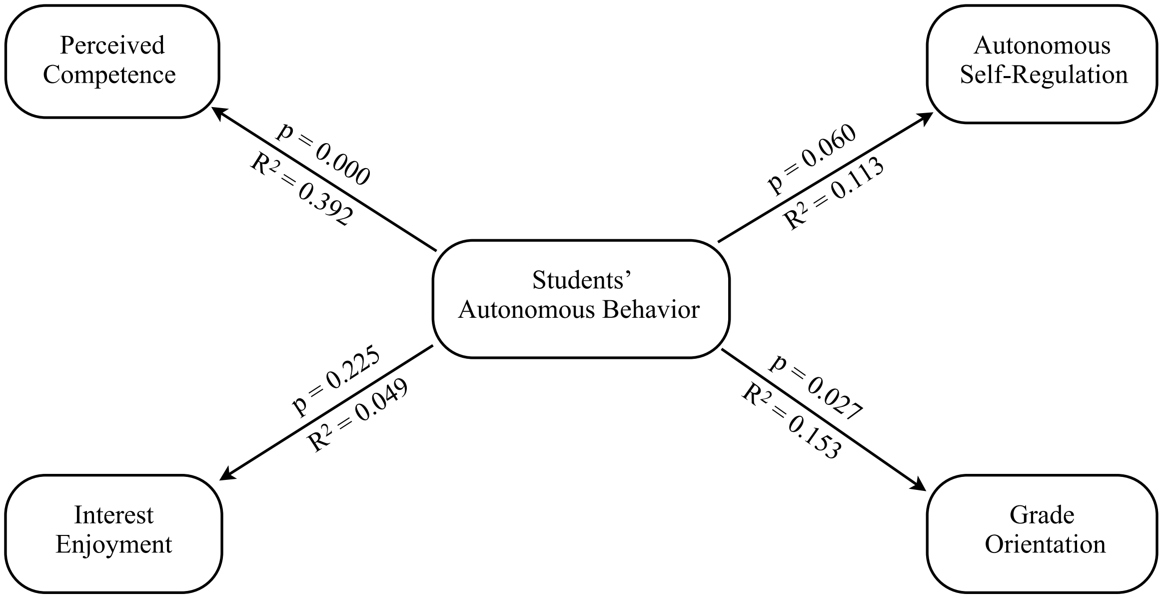

FIGURE 8: Relationship Significance with Autonomous Behavior

Thus, the data confirms that the students' level of autonomy would relate to their increased perceived competence and lower grade orientation.

Second, understanding the relationship of students' perceived autonomy support with perceived competence, autonomous self-regulation, interest/enjoyment, and grade orientation is also important.

Regression analysis performed on the data (Figure 9) shows that the students' perceived autonomy support is significantly related to perceived competence, autonomous self-regulation, interest/enjoyment, and grade orientation ($p<0.05$). (Appendix B, Figures 20-23). The results relating autonomous behavior and perceived autonomy support to adjustment variables are consistent with the findings of the Black and Deci , as well as Williams and Deci [1], [25].

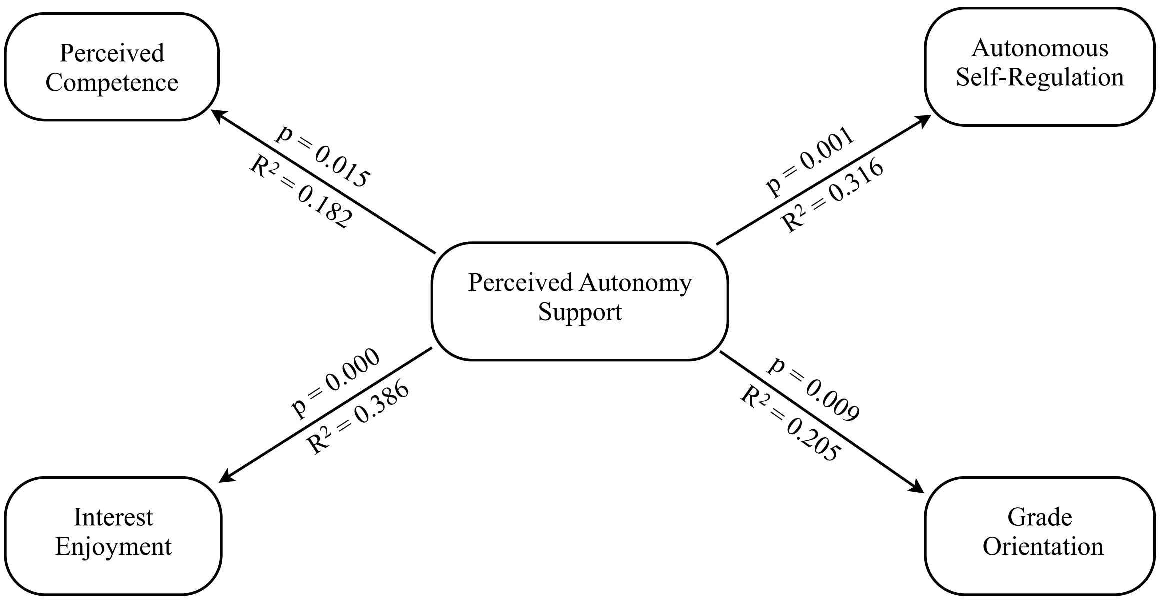

FIGURE 9: Relationship Significance with Perceived Autonomy Support

Third, the level of trust and ability to share feelings may be driving differences between the graduates and undergraduates. Calculating the average scores given to the questions 8 and 15 from the Learning Climate Questionnaire (Table 3) which ask about the level of trust and ability to share feelings with the instructor shows that undergraduates feel less trust and higher inability to share feelings with the instructor as compared to the graduate students. Consider Table 2 in Appendix B for details on more responses.

No	Question	314 (Graduate)	313 (Undergraduate)
8	I feel a lot of *trust* in the instructor	5.6	3.2
15	I feel able to *share my feelings* with my instructor	6.2	3.4

TABLE 3: Responses to Trust and Ability to Share Feelings

7. CONCLUSION

As an investigation of the concept of experiential based learning, this study tested the effect of instructor's autonomy support on students' performance and motivation. The results that were found have the following implications.

Master level students as compared to bachelor level students show higher autonomous self-regulation and interest/enjoyment. While not conclusive, there is higher perceived competence and lower grade orientation. Data indicates that students' performance in the course directly relates to their autonomous behavior and their perceived autonomy support towards their instructor.

Further, the above results suggest that additional research is necessary to further study the effects of students' autonomous behavior and instructor's autonomy support on perceived competence and grade orientation. Some avenues to explore include:

1. Using experiential based learning to teach other engineering courses and study the effect of this approach in comparison to those taught in traditional ways.
2. Using the data to study the root cause of difference in behavior of the students at graduate and undergraduate levels.
3. Studying the effect of students' previous work experience on their reactions in the class would be beneficial, as students with work experience tend to react better to ambiguity created in the classroom.

In light of these results and suggested future work, it appears that shifting towards providing more autonomy support for students' autonomy and active learning may hold promising results for enhancing students' achievement and psychological development [1]. The present data falls short of providing more conclusive results on certain aspects. However, the study's findings on supporting students' autonomy which facilitates the learning and adjustment of the students in the class would likely be helpful in other college-level engineering courses.

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FUTURE WORK

The research performed to study the two types of learning behaviors of students shows that these approaches have promising effects on the students and their learning behaviors and motivations. This piece of work is significant platform to further study the behaviors of students and the variables that effect these behaviors. Paper 1 shows that students learn the beneficial behavior of inquiry and, though not conclusive, Observational Learning seems to take place. Paper 2 demonstrates that the graduate students perceive their instructor as more autonomy supportive and have a higher trust in their instructor as compared to the undergraduates. Also, the level of Interest/Enjoyment towards the class is higher amongst the graduate students than the undergraduates.

With the present findings there were certain limitations that both the studies had. These limitations for the two papers are listed below -

Paper 1:

1. The number of students who participated in the simulation games or the number of teams included in the study were not sufficient.
2. Students were extrinsically motivated to become a part of this study. These motivations were either the reward of grades or attendance.
3. The simulation exercises used for this study took longer to make decisions than the time that was given to the teams.

Paper 2:

1. The number of students who took the survey were not sufficient.
2. The data does not consider individual responses of recipients on pre and post survey for comparison.
3. The state and trait of individual students was not studied i.e., the survey did not ask questions based on the State Trait Anxiety Inventory (STAI).

4. Students' experience can be studied and associated with the reaction of the students towards the class and the instructor.

While conducting these research studies we realized the following and thus would want make some recommendations for any future research that is done based on this work:

1. Students should be involved voluntarily to participate in the simulation exercises rather than motivating them with the reward of extra points or attendance. This would ensure their initial interest in the exercises.
2. The virtual facilitator should be used as a tool where the students can talk to other members of their team and the conversation is intervened by the facilitator based on their oral rather than written conversations.
3. More intervention rules should be added to the pool of rules. This pool can be enhanced by adding the rules based on Marshall Rosenberg's work of Non-Violent Communication.
4. Diversity based on ethnicity, gender and academic level (for example, sophomore, junior, senior etc) should be assured when making teams for the exercises.
5. Survey responses only of individual who take both pre and post course survey for the XB course should be accepted. This helps in getting more accurate data.
6. Pre-course data should be collected in the first month of the semester and the post-course data should be collected in the last one and a half month.

Based on the above recommendations we feel that there is scope for further research. The approach to observational learning can be studied in more detail based on the interventions provided by Marshall Rosenberg's work. With higher number of students participating in the exercises and the teams becoming more diverse would lead to better data and understanding of the reaction of students to the virtual facilitator.

Other engineering courses which use experiential learning to teach students should be considered for this research also. Studying the reaction of students based on any prior experience they have in the corporate world would give a better understanding of students' reactions to ambiguity they find in XB. Further, we believe that it is necessary to consider the data of only those students who fill both the pre and post course surveys. This would help to measure the difference in the level of change in behaviors that they would have during the course more accurately.

We also believe that the findings of this research should not only be limited to the simulation exercises or the XB course but can be extended to other fields of education also. These approaches will also be effective in teaching concepts of physics or engineering as they were effective in teaching management concepts.

APPENDIX A.

PAPER-2 SURVEY QUESTIONNAIRE

1. Pre-Course (Typical Course) Survey

1.1. General Perspective on Situations

Please use the following scale to rate your responses –

1	2	3	4	5	6	7
very unlikely			moderately likely			very likely

1. You have been offered a new position in a company where you have worked for some time. The first question that is likely to come to mind is:

   (a) What if I can't live up to the new responsibility?
   (b) Will I make more at this position?
   (c) I wonder if the new work will be interesting.

2. You have a school-age daughter. On parents' night the teacher tells you that your daughter is doing poorly and doesn't seem involved in the work. You are likely to:

   (a) Talk it over with your daughter to understand further what the problem is.
   (b) Scold her and hope she does better.
   (c) Make sure she does the assignments, because she should be working harder.

3. You had a job interview several weeks ago. In the mail you received a form letter, which states that the position has been filled. It is likely that you might think:

   (a) It's not what you know, but who you know.
   (b) I'm probably not good enough for the job.
   (c) Somehow they didn't see my qualifications as matching their needs.

4. You are a plant supervisor and have been charged with the task of allotting coffee breaks to three workers who cannot all break at once. You would likely handle this by:

   (a) Telling the three workers the situation and having them work with you on the schedule.
   (b) Simply assigning times that each can break to avoid any problems.
   (c) Find out from someone in authority what to do or do what was done in the past.

5. A close (same-sex) friend of yours has been moody lately, and a couple of times has become very angry with you over "nothing." You might:

   (a) Share your observations with him/her and try to find out what is going on for him/her.
   (b) Ignore it because there's not much you can do about it anyway.
   (c) Tell him/her that you're willing to spend time together if and only if he/she makes more effort to control him/herself.

6. You have just received the results of a test you took, and you discovered that you did very poorly. Your initial reaction is likely to be:

   (a) "I can't do anything right," and feel sad.
   (b) "I wonder how it is I did so poorly," and feel disappointed.
   (c) "That stupid test doesn't show anything," and feel angry.

7. You have been invited to a large party where you know very few people. As you look forward to the evening, you would likely expect that:

   (a) You'll try to fit in with whatever is happening in order to have a good time and not look bad.
   (b) You'll find some people with whom you can relate.
   (c) You'll probably feel somewhat isolated and unnoticed.

8. You are asked to plan a picnic for yourself and your fellow employees. Your style for approaching this project could most likely be characterized as:

   (a) Take charge: that is, you would make most of the major decisions yourself.
   (b) Follow precedent: you're not really up to the task so you'd do it the way it's been done before.
   (c) Seek participation: get inputs from others who want to make them before you make the final plans.

9. Recently a position opened up at your place of work that could have meant a promotion for you. However, a person you work with was offered the job rather than you. In evaluating the situation, you're likely to think:

   (a) You didn't really expect the job; you frequently get passed over.
   (b) The other person probably "did the right things" politically to get the job.
   (c) You would probably take a look at factors in your own performance that led you to be passed over.

10. You are embarking on a new career. The most important consideration is likely to be:

    (a) Whether you can do the work without getting in over your head.
    (b) How interested you are in that kind of work.
    (c) Whether there are good possibilities for advancement.

11. A woman who works for you has generally done an adequate job. However, for the past two weeks her work has not been up to par and she appears to be less actively interested in her work. Your reaction is likely to be:

    (a) Tell her that her work is below what is expected and that she should start working harder.
    (b) Ask her about the problem and let her know you are available to help work it out.
    (c) It's hard to know what to do to get her straightened out.

12. Your company has promoted you to a position in a city far from your present location. As you think about the move you would probably:

    (a) Feel interested in the new challenge and a little nervous at the same time.
    (b) Feel excited about the higher status and salary that is involved.
    (c) Feel stressed and anxious about the upcoming changes.

1.2. Perceived Autonomy Support

This questionnaire contains items that are related to your experience with your instructor **in a typical class**. Instructors have different styles in dealing with students, and we would like to know more about how you have felt about your encounters with your instructor in other courses. Your responses are confidential. Please be honest and candid. Please use the following scale to rate your responses -

1	2	3	4	5	6	7
strongly disagree			neutral			strongly agree

1. I feel that my instructor provides me choices and options.
2. I feel understood by my instructor.
3. I am able to be open with my instructor during class.
4. My instructor conveyed confidence in my ability to do well in the course.
5. I feel that my instructor accepts me.
6. My instructor made sure I really understood the goals of the course and what I need to do.
7. My instructor encouraged me to ask questions.
8. I feel a lot of trust in my instructor.
9. My instructor answers my questions fully and carefully.
10. My instructor listens to how I would like to do things.
11. My instructor handles people's emotions very well.
12. I feel that my instructor cares about me as a person.
13. I don't feel very good about the way my instructor talks to me.
14. My instructor tries to understand how I see things before suggesting a new way to do things.
15. I feel able to share my feelings with my instructor.

1.3. Learning in a Typical Course

<u>Please use the following scale to indicate how true each reason is for you</u>:

1	2	3	4	5	6	7
not at all true			somewhat true			very true

1. I will participate actively in a typical course:

   (a) Because I feel like its a good way to improve my understanding of the material.
   (b) Because others might think badly of me if I didn't.
   (c) Because I would feel proud of myself if I did well in the course.
   (d) Because a solid understanding of the material is important to my intellectual growth.

2. I am likely to follow my instructor's suggestions for studying for a typical course:

   (e) Because I would get a bad grade if I didn't do what he/she suggests.
   (f) Because I am worried that I am not going to perform well in the course.
   (g) Because it's easier to follow his/her suggestions than come up with my own study strategies.
   (h) Because he/she seems to have insight about how best to learn the material.

3. The reason that I will work to expand my knowledge of the subject is:

   (i) Because its interesting to learn more about the material of the course.
   (j) Because it's a challenge to really understand how to solve the course problems.
   (k) Because a good grade in the course will look positive on my record.
   (l) Because I want others to see that I am intelligent.

1.4. Perceptions on Learning

Please respond to each of the following items in terms of how true it is for you with respect to your learning **in a typical course**. Use the scale:

1	2	3	4	5	6	7
not at all true			somewhat true			very true

1. I feel confident in my ability to learn the material of the course.
2. I am capable of learning the material in this course.
3. I am able to achieve my goals in this course.
4. I feel able to meet the challenge of performing well in this course.

1.5. Interest /Enjoyment Measure in a Typical Course

For each of the following statements, please indicate how true it is for you using the following scale:

1	2	3	4	5	6	7
not at all true			somewhat true			very true

1. I enjoy doing a typical course very much.
2. A typical course is fun to do.
3. I think a typical course is a boring course.
4. A typical course does not hold my attention at all.
5. I would describe a typical course as very interesting.
6. I think a typical course is quite enjoyable.
7. While I am doing a typical course, I think about how much I enjoy it.

2. Post-Course (XB) Survey

2.1. General Perspective on Situations

Please use the following scale to rate your responses –

1	2	3	4	5	6	7
very unlikely			moderately likely			very likely

1. You have been offered a new position in a company where you have worked for some time. The first question that is likely to come to mind is:

   (a) What if I can't live up to the new responsibility?
   (b) Will I make more at this position?
   (c) I wonder if the new work will be interesting.

2. You have a school-age daughter. On parents' night the teacher tells you that your daughter is doing poorly and doesn't seem involved in the work. You are likely to:

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5. A close (same-sex) friend of yours has been moody lately, and a couple of times has become very angry with you over "nothing." You might:

   (a) Share your observations with him/her and try to find out what is going on for him/her.
   (b) Ignore it because there's not much you can do about it anyway.
   (c) Tell him/her that you're willing to spend time together if and only if he/she makes more effort to control him/herself.

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   (c) "That stupid test doesn't show anything," and feel angry.

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   (b) Follow precedent: you're not really up to the task so you'd do it the way it's been done before.
   (c) Seek participation: get inputs from others who want to make them before you make the final plans.

9. Recently a position opened up at your place of work that could have meant a promotion for you. However, a person you work with was offered the job rather than you. In evaluating the situation, you're likely to think:

   (a) You didn't really expect the job; you frequently get passed over.
   (b) The other person probably "did the right things" politically to get the job.
   (c) You would probably take a look at factors in your own performance that led you to be passed over.

10. You are embarking on a new career. The most important consideration is likely to be:

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    (c) Whether there are good possibilities for advancement.

11. A woman who works for you has generally done an adequate job. However, for the past two weeks her work has not been up to par and she appears to be less actively interested in her work. Your reaction is likely to be:

    (a) Tell her that her work is below what is expected and that she should start working harder.
    (b) Ask her about the problem and let her know you are available to help work it out.
    (c) It's hard to know what to do to get her straightened out.

12. Your company has promoted you to a position in a city far from your present location. As you think about the move you would probably:

    (a) Feel interested in the new challenge and a little nervous at the same time.
    (b) Feel excited about the higher status and salary that is involved.
    (c) Feel stressed and anxious about the upcoming changes.

2.2. Perceived Autonomy Support

This questionnaire contains items that are related to your experience with your instructor **in XB**. Instructors have different styles in dealing with students, and we would like to know more about how you have felt about your encounters with your instructor in other courses. Your responses are confidential. Please be honest and candid.
Please use the following scale to rate your responses -

1	2	3	4	5	6	7
strongly disagree			neutral			strongly agree

1. I feel that my instructor provides me choices and options.
2. I feel understood by my instructor.
3. I am able to be open with my instructor during class.
4. My instructor conveyed confidence in my ability to do well in the course.
5. I feel that my instructor accepts me.
6. My instructor made sure I really understood the goals of the course and what I need to do.
7. My instructor encouraged me to ask questions.
8. I feel a lot of trust in my instructor.
9. My instructor answers my questions fully and carefully.
10. My instructor listens to how I would like to do things.
11. My instructor handles people's emotions very well.
12. I feel that my instructor cares about me as a person.
13. I don't feel very good about the way my instructor talks to me.
14. My instructor tries to understand how I see things before suggesting a new way to do things.
15. I feel able to share my feelings with my instructor.

2.3. Learning in XB

Please use the following scale to indicate how true each reason is for you:

1	2	3	4	5	6	7
not at all true			somewhat true			very true

1. I will participate actively in XB:

   (a) Because I feel like its a good way to improve my understanding of the material.
   (b) Because others might think badly of me if I didn’t.
   (c) Because I would feel proud of myself if I did well in the course.
   (d) Because a solid understanding of the material is important to my intellectual growth.

2. I am likely to follow my instructor’s suggestions for studying for XB:

   (e) Because I would get a bad grade if I didn’t do what he/she suggests.
   (f) Because I am worried that I am not going to perform well in the course.
   (g) Because it’s easier to follow his/her suggestions than come up with my own study strategies.
   (h) Because he/she seems to have insight about how best to learn the material.

3. The reason that I will work to expand my knowledge of the subject is:

   (i) Because its interesting to learn more about the material of the course.
   (j) Because it’s a challenge to really understand how to solve the course problems.
   (k) Because a good grade in the course will look positive on my record.
   (l) Because I want others to see that I am intelligent.

2.4. Perceptions on Learning

Please respond to each of the following items in terms of how true it is for you with respect to your learning in XB. Use the scale:

1	2	3	4	5	6	7
not at all true			somewhat true			very true

1. I feel confident in my ability to learn the material of the course.
2. I am capable of learning the material in this course.
3. I am able to achieve my goals in this course.
4. I feel able to meet the challenge of performing well in this course.

2.5. Interest /Enjoyment Measure in XB

For each of the following statements, please indicate how true it is for you using the following scale:

1	2	3	4	5	6	7
not at all true			somewhat true			very true

1. I enjoy doing XB very much.
2. XB is fun to do.
3. I think XB is a boring course.
4. XB does not hold my attention at all.
5. I would describe XB as very interesting.
6. I think XB is quite enjoyable.
7. While I am doing XB, I think about how much I enjoy it.

APPENDIX B.

PAPER-2 REFERENCE TABLES & FIGURES

Student ID	Course	Session	Gender
PRE-314F07-1	314	Fall, 2007	M
PRE-314F07-2			F
PRE-314F07-3			M
PRE-314F07-4			M
PRE-314F07-5			M
PRE-314F07-6			F
POST-314F07-2			F
POST-314F07-4			M
POST-314F07-6			M
POST-314F07-8			F
POST-314F07-9			M
POST-314F07-10			M
POST-314F07-11			M
POST-314F07-12			M
PRE-313S08-1	313	Spring, 2008	F
PRE-313S08-2			M
PRE-313S08-3			F
POST-313S08-4			M
POST-313S08-5			M
PRE-314S08-1	314	Spring, 2008	M
POST-314S08-1			M
POST-314S08-3			M
POST-314S08-4			M

TABLE 1: Number of Males & Females in the course

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.791[a]	.626	.601	.62944

a. Predictors: (Constant), GCOS: Autonomous Orientation

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	9.947	1	9.947	25.106	.000[a]
	Residual	5.943	15	.396		
	Total	15.890	16			

a. Predictors: (Constant), GCOS: Autonomous Orientation

b. Dependent Variable: Perceived Competence for Learning

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.555[a]	.308	.261	.85645

a. Predictors: (Constant), Learning Climate Questionnaire

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	4.887	1	4.887	6.663	.021[a]
	Residual	11.003	15	.734		
	Total	15.890	16			

a. Predictors: (Constant), Learning Climate Questionnaire

b. Dependent Variable: Perceived Competence for Learning

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.714[a]	.510	.478	.72016

a. Predictors: (Constant), AB*PAS

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	8.110	1	8.110	15.637	.001[a]
	Residual	7.780	15	.519		
	Total	15.890	16			

a. Predictors: (Constant), AB*PAS

b. Dependent Variable: Perceived Competence for Learning

FIGURE 1: Relation with Perceived Competence for Graduate Students

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.534[a]	.285	.237	.73367

a. Predictors: (Constant), GCOS: Autonomous Orientation

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	3.215	1	3.215	5.973	.027[a]
	Residual	8.074	15	.538		
	Total	11.289	16			

a. Predictors: (Constant), GCOS: Autonomous Orientation

b. Dependent Variable: LSRQ: Autonomous Regulation

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.542[a]	.294	.247	.72889

a. Predictors: (Constant), Learning Climate Questionnaire

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	3.320	1	3.320	6.249	.025[a]
	Residual	7.969	15	.531		
	Total	11.289	16			

a. Predictors: (Constant), Learning Climate Questionnaire

b. Dependent Variable: LSRQ: Autonomous Regulation

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.606[a]	.368	.325	.68991

a. Predictors: (Constant), AB*PAS

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	4.150	1	4.150	8.718	.010[a]
	Residual	7.140	15	.476		
	Total	11.289	16			

a. Predictors: (Constant), AB*PAS

b. Dependent Variable: LSRQ: Autonomous Regulation

FIGURE 2: Relation with Autonomous Self-Regulation for Graduate Students

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.323[a]	.104	.045	.79752

a. Predictors: (Constant), GCOS: Autonomous Orientation

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1.112	1	1.112	1.749	.206[a]
	Residual	9.541	15	.636		
	Total	10.653	16			

a. Predictors: (Constant), GCOS: Autonomous Orientation

b. Dependent Variable: Interest Enjoyment Measure

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.537[a]	.289	.241	.71077

a. Predictors: (Constant), Learning Climate Questionnaire

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	3.075	1	3.075	6.087	.026[a]
	Residual	7.578	15	.505		
	Total	10.653	16			

a. Predictors: (Constant), Learning Climate Questionnaire

b. Dependent Variable: Interest Enjoyment Measure

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.508[a]	.258	.209	.72574

a. Predictors: (Constant), AB*PAS

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2.753	1	2.753	5.226	.037[a]
	Residual	7.900	15	.527		
	Total	10.653	16			

a. Predictors: (Constant), AB*PAS

b. Dependent Variable: Interest Enjoyment Measure

FIGURE 3: Relation with Interest/Enjoyment for Graduate Students

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.258[a]	.066	.004	4.50108

a. Predictors: (Constant), GCOS: Autonomous Orientation

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	21.634	1	21.634	1.068	.318[a]
	Residual	303.896	15	20.260		
	Total	325.529	16			

a. Predictors: (Constant), GCOS: Autonomous Orientation

b. Dependent Variable: Grade Orientation

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.307[a]	.094	.034	4.43386

a. Predictors: (Constant), Learning Climate Questionnaire

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	30.642	1	30.642	1.559	.231[a]
	Residual	294.887	15	19.659		
	Total	325.529	16			

a. Predictors: (Constant), Learning Climate Questionnaire

b. Dependent Variable: Grade Orientation

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.318[a]	.101	.041	4.41721

a. Predictors: (Constant), AB*PAS

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	32.853	1	32.853	1.684	.214[a]
	Residual	292.676	15	19.512		
	Total	325.529	16			

a. Predictors: (Constant), AB*PAS

b. Dependent Variable: Grade Orientation

FIGURE 4: Relation with Grade Orientation for Graduate Students

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.105[a]	.011	-.319	1.01497

a. Predictors: (Constant), GCOS: Autonomous Orientation

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	.034	1	.034	.033	.866[a]
	Residual	3.091	3	1.030		
	Total	3.125	4			

a. Predictors: (Constant), GCOS: Autonomous Orientation

b. Dependent Variable: Perceived Competence for Learning

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.324[a]	.105	-.193	.96543

a. Predictors: (Constant), Learning Climate Questionnaire

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	.329	1	.329	.353	.594[a]
	Residual	2.796	3	.932		
	Total	3.125	4			

a. Predictors: (Constant), Learning Climate Questionnaire

b. Dependent Variable: Perceived Competence for Learning

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.300[a]	.090	-.213	.97359

a. Predictors: (Constant), AB*PAS

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	.281	1	.281	.297	.624[a]
	Residual	2.844	3	.948		
	Total	3.125	4			

a. Predictors: (Constant), AB*PAS

b. Dependent Variable: Perceived Competence for Learning

FIGURE 5: Relation with Perceived Competence for Undergraduate Students

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.030[a]	.001	-.332	1.20611

a. Predictors: (Constant), GCOS: Autonomous Orientation

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	.004	1	.004	.003	.962[a]
	Residual	4.364	3	1.455		
	Total	4.368	4			

a. Predictors: (Constant), GCOS: Autonomous Orientation

b. Dependent Variable: LSRQ: Autonomous Regulation

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.030[a]	.001	-.332	1.20611

a. Predictors: (Constant), Learning Climate Questionnaire

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	.004	1	.004	.003	.962[a]
	Residual	4.364	3	1.455		
	Total	4.368	4			

a. Predictors: (Constant), Learning Climate Questionnaire

b. Dependent Variable: LSRQ: Autonomous Regulation

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.043[a]	.002	-.331	1.20552

a. Predictors: (Constant), AB*PAS

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	.008	1	.008	.006	.945[a]
	Residual	4.360	3	1.453		
	Total	4.368	4			

a. Predictors: (Constant), AB*PAS

b. Dependent Variable: LSRQ: Autonomous Regulation

FIGURE 6: Relation with Autonomous Self-Regulation for Undergraduate Students

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.319[a]	.102	-.198	.16785

a. Predictors: (Constant), GCOS: Autonomous Orientation

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	.010	1	.010	.339	.601[a]
	Residual	.085	3	.028		
	Total	.094	4			

a. Predictors: (Constant), GCOS: Autonomous Orientation

b. Dependent Variable: Interest Enjoyment Measure

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.511[a]	.261	.015	.15223

a. Predictors: (Constant), Learning Climate Questionnaire

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	.025	1	.025	1.060	.379[a]
	Residual	.070	3	.023		
	Total	.094	4			

a. Predictors: (Constant), Learning Climate Questionnaire

b. Dependent Variable: Interest Enjoyment Measure

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.499[a]	.249	-.002	.15348

a. Predictors: (Constant), AB*PAS

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	.023	1	.023	.994	.392[a]
	Residual	.071	3	.024		
	Total	.094	4			

a. Predictors: (Constant), AB*PAS

b. Dependent Variable: Interest Enjoyment Measure

FIGURE 7: Relation with Interest/Enjoyment for Undergraduate Students

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.033[a]	.001	-.332	5.00401

a. Predictors: (Constant), GCOS: Autonomous Orientation

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	.080	1	.080	.003	.959[a]
	Residual	75.120	3	25.040		
	Total	75.200	4			

a. Predictors: (Constant), GCOS: Autonomous Orientation

b. Dependent Variable: Grade Orientation

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.152[a]	.023	-.302	4.94822

a. Predictors: (Constant), Learning Climate Questionnaire

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1.745	1	1.745	.071	.807[a]
	Residual	73.455	3	24.485		
	Total	75.200	4			

a. Predictors: (Constant), Learning Climate Questionnaire

b. Dependent Variable: Grade Orientation

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.145[a]	.021	-.305	4.95369

a. Predictors: (Constant), AB*PAS

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1.583	1	1.583	.064	.816[a]
	Residual	73.617	3	24.539		
	Total	75.200	4			

a. Predictors: (Constant), AB*PAS

b. Dependent Variable: Grade Orientation

FIGURE 8: Relation with Grade Orientation for Undergraduate Students

Group Statistics

	Course	N	Mean	Std. Deviation	Std. Error Mean
GCOS: Autonomous Orientation	313	3	69.6667	9.29157	5.36449
	314	7	75.4286	7.41299	2.80185

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means		
		F	Sig.	t	df	Sig. (2-tailed)
GCOS: Autonomous Orientation	Equal variances assumed	.139	.719	-1.054	8	.323
	Equal variances not assumed			-.952	3.162	.408

Independent Samples Test

		t-test for Equality of Means			
				95% Confidence Interval of the Difference	
		Mean Difference	Std. Error Difference	Lower	Upper
GCOS: Autonomous Orientation	Equal variances assumed	-5.76190	5.46842	-18.37211	6.84830
	Equal variances not assumed	-5.76190	6.05212	-24.47739	12.95358

FIGURE 9: Pre-Course Mean Comparison of Autonomous Behavior

Group Statistics

	Course	N	Mean	Std. Deviation	Std. Error Mean
GCOS: Autonomous Orientation	313	5	68.6000	6.73053	3.00998
	314	17	73.2353	8.34063	2.02290

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means		
		F	Sig.	t	df	Sig. (2-tailed)
GCOS: Autonomous Orientation	Equal variances assumed	.402	.533	-1.133	20	.271
	Equal variances not assumed			-1.278	8.020	.237

Independent Samples Test

		t-test for Equality of Means			
				95% Confidence Interval of the Difference	
		Mean Difference	Std. Error Difference	Lower	Upper
GCOS: Autonomous Orientation	Equal variances assumed	-4.63529	4.09258	-13.17227	3.90168
	Equal variances not assumed	-4.63529	3.62659	-12.99453	3.72394

FIGURE 10: Post-Course Mean Comparison of Autonomous Behavior

Group Statistics

	Course	N	Mean	Std. Deviation	Std. Error Mean
Learning Climate Questionnaire	313	5	4.0900	1.08995	.48744
	314	17	6.0282	.88479	.21459

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means		
		F	Sig.	t	df	Sig. (2-tailed)
Learning Climate Questionnaire	Equal variances assumed	.005	.943	-4.099	20	.001
	Equal variances not assumed			-3.639	5.648	.012

Independent Samples Test

		t-test for Equality of Means			
				95% Confidence Interval of the Difference	
		Mean Difference	Std. Error Difference	Lower	Upper
Learning Climate Questionnaire	Equal variances assumed	-1.93824	.47286	-2.92460	-.95187
	Equal variances not assumed	-1.93824	.53259	-3.26139	-.61508

FIGURE 11: Post-Course Mean Comparison of Perceived Autonomy Support

Group Statistics

	Course	N	Mean	Std. Deviation	Std. Error Mean
Perceived Competence for Learning	313	5	5.7500	.88388	.39528
	314	17	6.1324	.99655	.24170
LSRQ: Autonomous Regulation	313	5	4.6800	1.04499	.46733
	314	17	5.8941	.83999	.20373
Interest Enjoyment Measure	313	5	3.4580	.15336	.06859
	314	17	4.5653	.81597	.19790
Grade Orientation	313	5	26.6000	4.33590	1.93907
	314	17	21.2941	4.51061	1.09398

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means		
		F	Sig.	t	df	Sig. (2-tailed)
Perceived Competence for Learning	Equal variances assumed	.865	.363	-.771	20	.450
	Equal variances not assumed			-.825	7.295	.435
LSRQ: Autonomous Regulation	Equal variances assumed	.863	.364	-2.697	20	.014
	Equal variances not assumed			-2.382	5.614	.058
Interest Enjoyment Measure	Equal variances assumed	14.791	.001	-2.969	20	.008

Independent Samples Test

		t-test for Equality of Means			
				95% Confidence Interval of the Difference	
		Mean Difference	Std. Error Difference	Lower	Upper
Perceived Competence for Learning	Equal variances assumed	-.38235	.49606	-1.41711	.65240
	Equal variances not assumed	-.38235	.46332	-1.46901	.70431
LSRQ: Autonomous Regulation	Equal variances assumed	-1.21412	.45014	-2.15309	-.27514
	Equal variances not assumed	-1.21412	.50981	-2.48266	.05442
Interest Enjoyment Measure	Equal variances assumed	-1.10729	.37293	-1.88522	-.32937

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means		
		F	Sig.	t	df	Sig. (2-tailed)
Interest Enjoyment Measure	Equal variances not assumed			-5.287	18.979	.000
Grade Orientation	Equal variances assumed	.001	.981	2.330	20	.030
	Equal variances not assumed			2.383	6.780	.050

Independent Samples Test

		t-test for Equality of Means			
				95% Confidence Interval of the Difference	
		Mean Difference	Std. Error Difference	Lower	Upper
Interest Enjoyment Measure	Equal variances not assumed	-1.10729	.20945	-1.54571	-.66888
Grade Orientation	Equal variances assumed	5.30588	2.27726	.55560	10.05616
	Equal variances not assumed	5.30588	2.22639	.00647	10.60529

FIGURE 12: Post-Course Mean Comparison

Variables Entered/Removed[b]

Model	Variables Entered	Variables Removed	Method
1	GCOS: Autonomous Orientation[a]	.	Enter

a. All requested variables entered.

b. Dependent Variable: Perceived Competence for Learning

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.698[a]	.487	.461	.70884

a. Predictors: (Constant), GCOS: Autonomous Orientation

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	9.530	1	9.530	18.967	.000[a]
	Residual	10.049	20	.502		
	Total	19.580	21			

a. Predictors: (Constant), GCOS: Autonomous Orientation

b. Dependent Variable: Perceived Competence for Learning

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.041	1.387		.030	.977
	GCOS: Autonomous Orientation	.083	.019	.698	4.355	.000

a. Dependent Variable: Perceived Competence for Learning

FIGURE 13: Relation Between Students' Autonomous Behavior and Students' Perceived Autonomy Support

Variables Entered/Removed[b]

Model	Variables Entered	Variables Removed	Method
1	Learning Climate Questionnaire[a]	.	Enter

a. All requested variables entered.

b. Dependent Variable: Grades (Ordinal Data)

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.892[a]	.796	.786	1.76224

a. Predictors: (Constant), Learning Climate Questionnaire

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	242.663	1	242.663	78.140	.000[a]
	Residual	62.110	20	3.105		
	Total	304.773	21			

a. Predictors: (Constant), Learning Climate Questionnaire

b. Dependent Variable: Grades (Ordinal Data)

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	21.756	1.786		12.179	.000

a. Dependent Variable: Grades (Ordinal Data)

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	Learning Climate Questionnaire	-2.763	.313	-.892	-8.840	.000

a. Dependent Variable: Grades (Ordinal Data)

FIGURE 14: Relation Between Students' Perceived Autonomy Support and Students' Performance in the Course

Variables Entered/Removed[b]

Model	Variables Entered	Variables Removed	Method
1	GCOS: Autonomous Orientation[a]	.	Enter

a. All requested variables entered.

b. Dependent Variable: Grades (Ordinal Data)

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.573[a]	.328	.295	3.19913

a. Predictors: (Constant), GCOS: Autonomous Orientation

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	100.084	1	100.084	9.779	.005[a]
	Residual	204.688	20	10.234		
	Total	304.773	21			

a. Predictors: (Constant), GCOS: Autonomous Orientation

b. Dependent Variable: Grades (Ordinal Data)

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	25.776	6.260		4.118	.001
	GCOS: Autonomous Orientation	-.270	.086	-.573	-3.127	.005

a. Dependent Variable: Grades (Ordinal Data)

FIGURE 15: Relation Between Students' Autonomous Behavior and Students' Performance in the Course

Variables Entered/Removed[b]

Model	Variables Entered	Variables Removed	Method
1	GCOS: Autonomous Orientation[a]	.	Enter

a. All requested variables entered.

b. Dependent Variable: Perceived Competence for Learning

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.626[a]	.392	.372	.70845

a. Predictors: (Constant), GCOS: Autonomous Orientation

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	9.722	1	9.722	19.371	.000[a]
	Residual	15.057	30	.502		
	Total	24.779	31			

a. Predictors: (Constant), GCOS: Autonomous Orientation

b. Dependent Variable: Perceived Competence for Learning

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.069	1.168		.916	.367
	GCOS: Autonomous Orientation	.070	.016	.626	4.401	.000

a. Dependent Variable: Perceived Competence for Learning

FIGURE 16: Relation Between Students' Autonomous Behavior & Perceived Competence

Variables Entered/Removed[b]

Model	Variables Entered	Variables Removed	Method
1	GCOS: Autonomous Orientation[a]	.	Enter

a. All requested variables entered.

b. Dependent Variable: LSRQ: Autonomous Regulation

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.336[a]	.113	.084	1.06799

a. Predictors: (Constant), GCOS: Autonomous Orientation

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	4.364	1	4.364	3.826	.060[a]
	Residual	34.218	30	1.141		
	Total	38.582	31			

a. Predictors: (Constant), GCOS: Autonomous Orientation

b. Dependent Variable: LSRQ: Autonomous Regulation

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	2.148	1.761		1.220	.232
	GCOS: Autonomous Orientation	.047	.024	.336	1.956	.060

a. Dependent Variable: LSRQ: Autonomous Regulation

FIGURE 17: Relation Between Students' Autonomous Behavior & Autonomous Self-Regulation

Variables Entered/Removed[b]

Model	Variables Entered	Variables Removed	Method
1	GCOS: Autonomous Orientation[a]	.	Enter

a. All requested variables entered.

b. Dependent Variable: Interest Enjoyment Measure

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.221[a]	.049	.017	.77014

a. Predictors: (Constant), GCOS: Autonomous Orientation

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	.910	1	.910	1.534	.225[a]
	Residual	17.793	30	.593		
	Total	18.703	31			

a. Predictors: (Constant), GCOS: Autonomous Orientation

b. Dependent Variable: Interest Enjoyment Measure

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	2.737	1.270		2.156	.039
	GCOS: Autonomous Orientation	.022	.017	.221	1.239	.225

a. Dependent Variable: Interest Enjoyment Measure

FIGURE 18: Relation Between Students' Autonomous Behavior & Interest/Enjoyment

Variables Entered/Removed[b]

Model	Variables Entered	Variables Removed	Method
1	GCOS: Autonomous Orientation[a]	.	Enter

a. All requested variables entered.

b. Dependent Variable: Grade Orientation

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.391[a]	.153	.125	5.06178

a. Predictors: (Constant), GCOS: Autonomous Orientation

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	138.853	1	138.853	5.419	.027[a]
	Residual	768.647	30	25.622		
	Total	907.500	31			

a. Predictors: (Constant), GCOS: Autonomous Orientation

b. Dependent Variable: Grade Orientation

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	42.188	8.344		5.056	.000
	GCOS: Autonomous Orientation	-.266	.114	-.391	-2.328	.027

a. Dependent Variable: Grade Orientation

FIGURE 19: Relation Between Students' Autonomous Behavior & Grade Orientation

Variables Entered/Removed[b]

Model	Variables Entered	Variables Removed	Method
1	Learning Climate Questionnaire[a]	.	Enter

a. All requested variables entered.

b. Dependent Variable: Perceived Competence for Learning

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.427[a]	.182	.155	.82182

a. Predictors: (Constant), Learning Climate Questionnaire

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	4.517	1	4.517	6.689	.015[a]
	Residual	20.262	30	.675		
	Total	24.779	31			

a. Predictors: (Constant), Learning Climate Questionnaire

b. Dependent Variable: Perceived Competence for Learning

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	4.520	.658		6.871	.000
	Learning Climate Questionnaire	.304	.117	.427	2.586	.015

a. Dependent Variable: Perceived Competence for Learning

FIGURE 20: Relation Between Perceived Autonomy Support & Perceived Competence

Variables Entered/Removed[b]

Model	Variables Entered	Variables Removed	Method
1	Learning Climate Questionnaire[a]	.	Enter

a. All requested variables entered.

b. Dependent Variable: LSRQ: Autonomous Regulation

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.562[a]	.316	.294	.93767

a. Predictors: (Constant), Learning Climate Questionnaire

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	12.205	1	12.205	13.882	.001[a]
	Residual	26.377	30	.879		
	Total	38.582	31			

a. Predictors: (Constant), Learning Climate Questionnaire

b. Dependent Variable: LSRQ: Autonomous Regulation

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	2.844	.751		3.788	.001
	Learning Climate Questionnaire	.499	.134	.562	3.726	.001

a. Dependent Variable: LSRQ: Autonomous Regulation

FIGURE 21: Relation Between Perceived Autonomy Support & Autonomous Self-Regulation

Variables Entered/Removed[b]

Model	Variables Entered	Variables Removed	Method
1	Learning Climate Questionnaire[a]	.	Enter

a. All requested variables entered.

b. Dependent Variable: Interest Enjoyment Measure

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.621[a]	.386	.365	.61893

a. Predictors: (Constant), Learning Climate Questionnaire

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	7.211	1	7.211	18.825	.000[a]
	Residual	11.492	30	.383		
	Total	18.703	31			

a. Predictors: (Constant), Learning Climate Questionnaire

b. Dependent Variable: Interest Enjoyment Measure

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	2.204	.495		4.448	.000
	Learning Climate Questionnaire	.384	.088	.621	4.339	.000

a. Dependent Variable: Interest Enjoyment Measure

FIGURE 22: Relation Between Perceived Autonomy Support & Interest/Enjoyment

Variables Entered/Removed[b]

Model	Variables Entered	Variables Removed	Method
1	Learning Climate Questionnaire[a]	.	Enter

a. All requested variables entered.

b. Dependent Variable: Grade Orientation

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.453[a]	.205	.179	4.90335

a. Predictors: (Constant), Learning Climate Questionnaire

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	186.215	1	186.215	7.745	.009[a]
	Residual	721.285	30	24.043		
	Total	907.500	31			

a. Predictors: (Constant), Learning Climate Questionnaire

b. Dependent Variable: Grade Orientation

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	33.530	3.925		8.542	.000
	Learning Climate Questionnaire	-1.950	.701	-.453	-2.783	.009

a. Dependent Variable: Grade Orientation

FIGURE 23: Relation Between Perceived Autonomy Support & Grade Orientation

No	Question	314 (Graduate)	313 (Undergraduate)
1	Provides choices and options	5.7	3.6
2	Feel understood by instructor	5.8	3.2
3	Able to open up with instructor	6.4	3
4	Instructor conveyed confidence	5.9	4.4
5	Instructor accepts me	5.7	5.6
6	Instructor made sure that I understood the goals	5.63	1.4
7	Instructor encouraged me to ask questions	6.3	6
8	I feel a lot of *Trust* in the instructor	5.6	3.2
9	Instructor answers my questions fully and carefully	5.2	4.2
10	Instructor listens to how I would like to do things	5.74	4.4
11	Instructor handles people's emotions very well	5.6	3.8
12	Instructor cares about me as a person	5.8	4.2
13	I don't feel very good about the way my instructor talks to me	2.4	3
14	My instructor tries to understand how I see things before suggestion a new way to do things.	4.6	4.4
15	I feel able to *share my feelings* with my instructor	6.2	3.4

TABLE 2: Responses to Learning Climate Questionnaire

VITA

Raj Kanwar Singh was born in Chandigarh, India on September 11, 1983. He completed his Bachelor of Technology in Mechanical Engineering at Punjab Technical University in Punjab, India in May 2006. Raj started his Master of Science program with the Engineering Management Department at Missouri University of Science & Technology in August, 2006. While a graduate student with the Engineering Management department, Raj served as the President of Graduate Student Body (Council of Graduate Students) of Missouri S&T and had an opportunity to co-op with Monsanto Company in St. Louis. Raj is proud to be a part of the Tau Beta Pi and the Engineering Management Society at Missouri University of Science & Technology.

With a penchant in Organizational Behavior and Group Dynamics, Raj worked under Dr. Ray Luechtefeld to write two papers, studying the learning behaviors of students in a class environment. He received his Master of Science Degree in December of 2008.