Results of a Study using the Motivation Strategies for Learning Questionnaire (MSLQ) in an Introductory Engineering Graphics Course

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Abstract – This paper will present data related to a study conducted at NC State University in the spring of 2008 that focused on student motivation in an introductory graphics course. This study conducted a motivation and learning assessment using the Motivated Strategies for Learning Questionnaire (MSLQ) Attitude Survey. The motivational portion of MSLQ focuses on six areas associated with student learning and motivation. These areas were intrinsic goal orientation, extrinsic goal orientation, task value, control of learning beliefs, self-efficacy learning performance, and test anxiety. Findings from the study included the identification of enduring motivational factors for learning graphics education. Insights into the strategic learning process of students in a graphics education course will be discussed. Also, areas of concern for future pedagogical development and course improvement will be highlighted.

Keywords: MSLQ, Introductory Graphics Course,

INTRODUCTION

Many motivational processes are responsive to individual properties associated with tasks, the classroom, or the context within student engagement [Wolters & Pintrich, 11]. Literature on student motivation identifies many beliefs and constructs, but control, competence, and self-regulated strategic learning remain chief among them [Shell & Husman, 9]. Internal pressures also serve as strong motivators in adult learners [Knowles, Holton, & Swanson, 4, pp. 64-66]. An attitude of self-determination resides at the nucleus of intrinsic motivation [Johari & Bradshaw, 5]. This self-determined attitude is primarily a result of feeling competent and/or independent. In adults, feelings of intellectual competence can be highly motivational when paired with internal pressures that serve as a driving force. Self-determination theory research has placed a large amount of attention on, not only intrinsic motivation, but also extrinsic motivation. Extrinsic motivation refers to "engaging in an activity to obtain an outcome separable from the activity itself" [Vansteenkiste, Timmermans, Lens, Soenens, & Van den Broeck, 10, pp. 388]. A study conducted by Bye, Pushkar, & Conway [2] at Concordia University identifies intrinsic motivation as a predictor of positive classroom effect, while self-improvement and personal growth were found to be highly valued in comparison with extrinsic goals, further distinguishing between intrinsic and extrinsic motivation.

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Student motivation possesses a value component involving students' goals and beliefs about the importance of a task or their personal interest in an application. Motivational value has been conceptualized through various approaches (e.g., learning vs. performance goals, intrinsic vs. extrinsic orientation, task value, and intrinsic interest); this motivational component effectively concerns students' motives for the completion of a task [Pintrich & De Groot, 8]. Beyond beliefs pertaining to importance and interest is self-efficacy. Students' perceived self-efficacy might influence the process by which he or she selects activities to participate in or complete. There are many circumstances where students assume and perform activities they deem themselves capable of successfully completing and avoid those they believe exceed their ability [Yang, 12]. This paper will examine the results of a study conducted at North Carolina State University that looked at the type of motivation exhibited by students taking an introductory engineering class.

MOTIVATED STRATEGIES FOR LEARNING QUESTIONNAIRE

The Motivated Strategies for Learning Questionnaire (MSLQ) is an instrument designed to evaluate "college students' motivational orientation and use of different learning strategies for a college course" [Pintrich, Smith, Garcia, and McKeachie, 8]. The broad cognitive analysis of motivation and learning strategy, paired with the social cognitive view of motivation and self-regulated learning, serves as the foundation of MSLQ. The MSLQ consists of two major sections: a motivation section and a learning strategies section. The motivation segment has 31 items that evaluate students' goals and value beliefs, students' beliefs about skills necessary to succeed, and test anxiety associated with a specific course [Duncan & McKeachie, 3]. Duncan & McKeachie further differentiate the learning strategy section of the MSLQ as identifying students' use of different cognitive and metacognitive strategies as well as student management of resources. The motivation section and the learning strategies section of the MSLQ include 81 items. Each item is rated using a 7-point Likert-type scale. The rating scale ranges from one (not at all true of me) to seven (very true of me).

Pintrich, Smith, Garcia, & McKeachie [8] describe the motivation scales of the MSLQ as vehicles to acquire information associated with value, expectancy, and affect. Value assists in exploring intrinsic and extrinsic goal orientation, expectancy targets beliefs about learning and self-efficacy, and affect gauges test anxiety. Learning strategies investigated through the motivation scales are drawn from a broad compilation of cognitive research representing cognitive processing and its affect on student learning [Lynch, 6].

Numerous MSLQ studies have been conducted that present evidence of internal consistency, reliability, and predictive validity of the instrument [Pintrich, Smith, Garcia, & McKeachie, 8; Artino, 1; Duncan & McKeachie, 3]. The MSLQ represents a method to accurately and holistically gage student motivation and self-regulated learning grounded by a theoretical basis. The MSLQ allows student learning researchers to move beyond traditional examinations of individual differences in learning styles to gain insight into the motivation and learning specifically occurring in a targeted college course. In this investigation, an introductory engineering graphics course was

selected to investigate intrinsic goal orientation, extrinsic goal orientation, task value, control of learning beliefs, self-efficacy learning performance, and test anxiety with the MSLQ Attitude Survey.

METHODOLOGY

This targeted investigation utilized the results of 31 motivational questions MSLQ Attitude Survey to examine six proposed null hypotheses concerning motivation and satisfaction of student learning. These null hypotheses were: 1) Ho: Student intrinsic goal orientation elements are independent components of motivation and learning. 2) Ho: Student extrinsic goal orientation elements are independent components of motivation and learning. 3) Ho: Student task value elements are independent components of motivation and learning. 4) Ho: Student controls of learning beliefs are independent components of motivation and learning. 5) Ho: Student self-efficacy and learning performance elements are independent components of motivation and learning. 6) Ho: Student test anxiety elements are independent components of motivation and learning.

These hypotheses guided the motivation and learning investigation utilizing the MSLQ Attitude Survey as the means for data acquisition. Specifically, the six hypotheses structure the investigation to identify enduring motivational factors for learning graphics in the introductory engineering graphics course at NC State University.

To better gauge indicators of student attitude and motivation, the MSLQ data analysis was shortened. As prescribed by Matthews [7] to solely measure motivation concerning goal orientation, extrinsic goal orientation, task value, control of learning beliefs, self-efficacy learning performance, and test anxiety, the MSLQ analysis was limited to 31 questions specifically targeted to student motivation. Additionally, Matthews identified the MSLQ item equivalent subsets to provide a targeted analysis of the six focal areas associated with student learning and motivation.

In the 10th week of the 2008 spring semester the course instructors administered the MSLQ instrument to student participants in the introductory engineering graphics course. The questionnaire took the participants approximately 15 minutes to complete. One hundred and sixty one students in seven separate sections of GC 120 (Foundations of Graphics) completed and returned the instrument. One of the 161 participants failed to complete items 24 and 29 of the targeted subgroup analysis, but the researchers decided to include this questionnaire in the completed group. The researchers gathered the completed instruments from the course instructors, entered the MSLQ data, tabulated the questionnaire results, analyzed the target items, and formed conclusions based on the six identified student learning and motivation areas.

RESULTS

The proposed hypotheses were evaluated using a one-sample calculation of variance. The test of independence tabulates MSLQ instrument items in their designated categories and computes a chi-square value. This procedure uses the critical value to evaluate the proportional value derived from the Chi-Square table. A significant p-value for

an item in a category demonstrates that it is independent of the other items and, therefore, has no relationship to the other items in its category or the category itself.

The identified MSLQ item equivalents to investigate intrinsic goal orientation were 1, 16, 22, and 24 (See Table 1). Within the item equivalents that measured intrinsic goal orientation, item 16 had the highest average, while item 24 had the lowest. As a group, the intrinsic goal orientation items averaged 4.68 on the seven-point scale. The sampling variance, reported in the data summations, was due to a statistical fluctuation in the responses on intrinsic goal orientation sub grouped items identified in the six student learning and motivation areas. Additionally, evaluation of the chi-square statistic and the proportional value associated with each item identified all four MSLQ items within their student learning and motivation area as significantly different from one another, given the predetermined alpha level of significance (0.05). Items 1, 16, 22, and 24 all had p-values smaller than 0.05, therefore the null hypothesis that intrinsic goal orientation elements are independent components of motivation and learning could not be rejected because there is evidence that the questions were independent of the category and each other by virtue of their significant p-values.

Table 1. MSLQ Intrinsic Goal Orientation

Item	Mean	Sample Var.	DF	Chi-Square	P-value
1 In a class like this, I prefer course material that really challenges me so I can learn new things.	4.56	1.523059	160	243.68944	<0.0001
16 In a class like this, I prefer course material that arouses my curiosity, even if it is difficult to learn.	5.26	2.1065218	160	337.0435	<0.0001
22 The most satisfying thing for me in this course is trying to understand the content as thoroughly as possible.	4.73	1.5344721	160	245.51553	<0.0001
24 When I have the opportunity in this class, I choose course assignments that I can learn from even if they don't guarantee a good grade.	4.18	1.6587657	159	263.74374	<0.0001
Overall	4.68				

The identified item equivalents to investigate extrinsic goal orientation were MSLQ items 7, 11, 13, and 30 (See Table 2). Within the item equivalents of extrinsic goal orientation, item 13 had the highest average, while item 30 had the lowest. As a group, the extrinsic goal orientation items averaged 5.35 on the seven-point scale. Additionally, reporting and evaluation of the chi-square statistic and the proportional value associated with each item identified three of the four items were significantly different from one another. Item 13 was found not to significantly differ within the subgroup. Items 7, 11, and 30 all had a p-value smaller than 0.05, therefore, the null hypothesis that stated

that extrinsic goal orientation elements are independent components of motivation and learning also failed to be rejected.

Table 2. MSLQ Extrinsic Goal Orientation

Item	Mean	Sample Var.	DF	Chi-Square	P-value
7 Getting a good grade in class is the most satisfying thing for me right now.	5.09	2.7048912	160	432.78262	<0.0001
11 The most important thing for me right now is improving my overall grade point average, so my main concern in this class is getting a good grade.	5.27	2.6998448	160	431.97516	<0.0001
13 If I can, I want to get better grades in this class than most of the other students.	6.19	1.1025621	160	176.40994	0.3551
30 I want to do well in this class because it is important to show my ability to my family, friends, employer, or others.	4.84	2.6319876	160	421.118	<0.0001
Overall	5.35				

The identified item equivalents to investigate task value were MSLQ items 4, 10, 17, 23, 26, and 27 (See Table 3). Within the item equivalents for task value, the six items provide participant averages relatively close to one another. As a group, the task value items averaged a 5.16 on the seven-point scale. The sampling variance again was due to a statistical fluctuation in participant responses on the task value sub grouped items. Likewise, reporting and evaluation of the chi-square statistic and the proportional value associated with each item identified all six of the MSLQ items within their student learning and motivation area as significantly different from each other. The p-values for items 4, 10, 17, 23, 26, and 27 were all lower than the established cut-off value of 0.05, therefore, the null hypothesis that stated that task value elements are independent components of motivation and learning could not be rejected.

Table 3. MSLQ Task Value

Item	Mean	Sample Var.	DF	Chi-Square	P-value
4 I think I will be able to use what I learn in this course in other courses.	5.02	2.2684007	160	362.9441	<0.0001
10 It is important for me to learn the course material in this class.	5.50	1.3015528	160	208.24844	0.0123
17 I am very interested in the content area of this course.	5.00	1.85	160	296	<0.0001
23 I think the course material is this class is useful for me to learn.	5.20	1.5639751	160	250.23602	<0.0001
26 I like the subject matter of this course.	5.26	1.9815217	160	317.0435	<0.0001
27 Understanding the subject matter of this course is very important to me.	5.00	1.8437111	160	294.99377	<0.0001
Overall	5.16				

The identified item equivalents that examined control of learning beliefs were MSLQ items 2, 9, 18, and 25 (See Table 4). Within the item equivalents of control of learning beliefs, item 18 had the highest average while item 25 had the lowest. As a group, the control of learning beliefs items averaged 5.62. The sampling variance was due to the variation in the participants' responses on control of learning beliefs sub grouped items identified within the six student learning and motivation areas. The reporting and evaluation of the chi-square statistic, and the proportional value associated with each item, identified three of the four MSLQ items within their student learning and motivation area as significantly different from one another, given the predetermined alpha level of significance (0.05). Item 18 was found not to differ within the response subgroup. Items 2, 9, and 25 had a p-value lower than the critical value of 0.05, therefore, again the results failed to reject the null hypothesis that control of learning beliefs is an independent component of motivation and learning.

Table 4. MSLQ Control of Learning Beliefs

Item	Mean	Sample Var.	DF	Chi-Square	P-value
2 If I study in appropriate ways, then I will be able to learn the material in this course.	5.84	1.3444875	160	215.11801	0.0048
9 It is my own fault if I don't learn the material in this course.	5.62	1.6602484	160	265.63974	<0.0001
18 If I try hard enough, then I will understand the course material.	6.04	1.0293478	160	164.69565	0.7663
25 If I don't understand the course material, it is because I didn't try hard enough.	4.96	2.104348	160	336.69565	<0.0001
Overall	5.62				

The identified item equivalents to investigate self-efficacy learning performance are MSLQ items 5, 6, 12, 15, 20, 21, 29 and 31 (See Table 5). Within the item equivalents of self-efficacy learning performance, the eight items present participant averages relatively close to one another. As a group, the self-efficacy learning performance items averaged a 5.47 on a seven-point scale. The sampling variance again is due to the statistical fluctuation in participant response on this sub group of items. Additionally, the evaluation of the chi-square statistic and the proportional value associated with each item identified six of the eight MSLQ items within their student learning and motivation area as significantly differing from one another based on the predetermined alpha level of significance (0.05). Items 20 and 21 were found not to significantly differ within the response subgroup; however, items 5, 6, 12, 15, 29 and 31 were lower than the critical p-value set at 0.05; therefore, it was not possible to reject the null hypothesis that self-efficacy and learning performance are independent components of motivation and learning.

Table 5. MSLQ Self-Efficacy Learning Performance

Item	Mean	Sample Var.	DF	Chi-Square	P-value
5 I believe I will receive an excellent grade in this class.	5.24	1.618944	160	259.03107	<0.0001
6 I'm certain I can understand the most difficult material presented in the readings for this course.	5.18	1.9986025	160	319.7764	<0.0001
12 I'm confident I can learn the basic concepts taught in this course.	5.47	2.4132764	160	386.12424	<0.0001
15 I'm confident I can understand the most complex material presented by the instructor in this course.	5.48	1.6388199	160	262.21118	<0.0001
20 I'm confident I can do an excellent job on the assignments and test in this course.	5.60	1.0672361	160	170.75777	0.5317
21 I expect to do well in this course.	5.69	1.2029504	160	192.47205	0.0815
29 I'm certain I can master the skills being taught in this course.	5.58	1.5289308	159	243.1	<0.0001
31 Considering the difficulty of this course, the teacher, and my skills, I think I will do well in this class.	5.52	1.563587	160	250.17392	<0.0001
Overall	5.47				

The identified item equivalents to investigate test anxiety are MSLQ items 3, 8, 14, 19, and 28 (See Table 6). Within the items used to examine test anxiety, item 14 had the highest average while item 3 had the lowest. As a group, the task value items averaged 3.74 on the seven-point scale. The sampling variance was again due to the fluctuation in participants' responses. Evaluation of the chi-square statistic and the proportional value associated with each item indicated that all five of the MSLQ items significantly differed from each other and were smaller than the predetermined value for significance. Since items 3, 8, 14, 19, and 28 were not found to be significant, the null hypothesis that test anxiety is an independent component of motivation and learning failed to be rejected.

Table 6. MSLQ Test Anxiety

Item	Mean	Sample Var.	DF	Chi-Square	P-value
3 When I take a test I think about how poorly I am doing compared with other students.	3.09	3.5225155	160	563.6025	<0.0001
8 When I take a test I think about items on other parts of the test I can't answer.	4.24	3.1689441	160	507.03107	<0.0001
14 When I take tests I think of the consequences of failing.	4.30	4.2880435	160	686.087	<0.0001
19 I have an uneasy, upset feeling when I take an exam.	3.77	3.2406056	160	518.4969	<0.0001
28 I feel my heart beating fast when I take an exam.	3.31	3.5154502	160	562.47205	<0.0001
Overall	3.74				

CONCLUSIONS

Item 13 ("If I can, I want to get better grades in this class than most of the other students"); in the Extrinsic Goal Orientation subgroup, item 18 ("If I try hard enough, then I will understand the course materials"); in the Control of Learning Beliefs subgroup, item 20 ("I'm confident I can do an excellent job on the assignments and test in this course") and item 21 ("I expect to do well in this class") of the Self-Efficacy Learning Performance subgroup were identified by the study as continuing motivational and learning factors for learning engineering graphics in the introductory engineering graphics course at NC State University. Considering the fact that these statements "standout" among the others and that each in some way is associated with the level of understanding and the grade they wish to receive in class, grades are still a good motivation factor to consider with these participants. The ability to do well and see relevance in what is being taught is also paramount to a student's motivation in a course, like a fundamentals of engineering graphics. From the data collected for this study, it can be observed that grades, relevance of content, and understanding subject matter are the main factors that affect students' motivation. Based on these findings, more research in areas of strategic learning of students in engineering graphics courses as it relates to their abilities to be self-motivated needs to be conducted, particularly as the structure and delivery methods of engineering graphics courses are rapidly changing. Also, considering the change and growth of new areas and concepts in the engineering graphics profession, how can we utilize contemporary methods to increase student motivation? Again, more investigation is needed in this area of student motivation as the profession works to educate future professionals that use graphics for the 21st century.

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