Exploring of Students' Performances, Motivation Processes and Learning Strategies in Studio Physics

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Abstract

The purpose of this study is to evaluate the students' motivational beliefs and use of learning strategies in the Introductory Calculus-Based Physics II course using the studio physics model, also to examine the students' academic performances and the relationship among the variables. This research was conducted with 302 students in USA during spring 2009 semester. Research data were collected with Motivated Strategies for Learning Questionnaire (MSLQ) and students' grades obtained from LON-CAPA problems, LON-CAPA/written homework, hands-on activities, and exam. According to the results of the present research, it can be said that the use of the studio physics was effective on the achievement, motivational beliefs, and use of learning strategies of the students. Thus, this promising learning method will encourage the educators to replace the traditional instruction methods with student-centered, interactive learning methods.

Keywords: Learning Strategy, Motivation, Physics Education, Studio Physics.

Resumen

El propósito de este estudio es evaluar las creencias motivacionales y el uso de estrategias de aprendizaje en el Curso de introducción Cálculo basado en Física II utilizando el modelo de estudio de la física, también examinar el desempeño académico los estudiantes y la relación entre las variables. Esta investigación se llevó a cabo con 302 estudiantes en los EE.UU. durante la primavera del semestre 2009. Los datos de la investigación fueron recogidos con el Cuestionario de Aprendizaje para Estrategias Motivadoras (MSLQ) y las calificaciones de los estudiantes obtenidas a partir de los problemas de LON-CAPA, LON-CAPA/ tareas escritas, actividades prácticas y el examen. De acuerdo con los resultados de la presente investigación, se puede decir que el uso de estudio de la física fue eficaz en el logro, creencias motivacionales y el uso de estrategias de aprendizaje de los estudiantes. Por lo tanto, este método es prometedor para incentivar a los educadores para reemplazar los métodos de enseñanza tradicional con el centrado en el estudiante, y los métodos de aprendizaje interactivo.

Palabras clave: Estrategia de Aprendizaje, Motivación, Física Educativa, Estudio de la Física.

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I. INTRODUCTION

The physics education research group has long been concerned about the nature and effectiveness of physics education for those students seeking to become professional physicists as well as for those physics background should enable them to live responsibly in a technological society. Research through years has shown the traditional lecture-recitation-lab format of the introductory university physics sequence to be ineffective in helping most of students either to take a firm grasp of Newtonian mechanics, or to build a strong foundation for subsequent learning [1].

It is know that students learn more physics in classes where they interact with faculty, collaborate with peers on interesting tasks, and are actively involved with the material they are learning [2, 3, 4, 5, 6]. Research on learning and curriculum development has resulted in instructional materials and teaching methods that can correct many of the drawbacks of traditional physics instruction. Careful study of these research-based introductory curricula in small classes points out that they can significantly improve students' conceptual understanding [2, 7, 8, 9]. However, introductory physics lecturers with large classes who want to incorporate active learning into their classrooms must typically choose between a) hands-on activities [10] in small recitation or laboratory sections that supplement the lecture [11] and b) interactive lecture activities for larger classes such as Peer Instruction [3] and interactive lecture demonstrations [12] that do not allow hands-on experiments and limit faculty interactions with individual groups.

Rensselaer Polytechnic Institute (RPI) has introduced a new model for the large enrollment undergraduate courses that has been become known as the studio physics [13, 14].

The studio physics is based on a learning environment which was designed to facilitate students' ability to interact with one another, with the lecturer, and with the course material during their time in class [13]. Studio courses have been introduced to replace some of the large introductory lecture-based courses in science and engineering with a format including daily lectures, in-class activities, homework assignments, hands-on activities which are more integrated and incorporate technology. It presents a better interactive learning environment for students and a better teaching environment for faculty [15].

A dynamic teaching environment which integrates the traditional instruction activities (lecture, recitation, and laboratory) is created by student workstations, tabletop experiments, computer software, and traditional textbooks in this system of learning. Students' communication skills are improved with the design and analysis done in workstation computers and they learn to be a part of a team. Students can discuss their results with their neighbors. The student-centered activities also offer a friendly lecture to students and even to those lecturers who tend toward the traditional style of classroom. The lecturer acts more as a guide and/or advisor and can move freely from lecture into hands-on activity in a facility with a configuration of a theater-in-the-round classroom. The studio classroom provides an excellent opportunity to introduce large scale undergraduate level courses to students in an interactive learning environment with its technology and team-based learning.

When researches done on studio physics were examined, it can be said that studio physics is effect on students' conceptual learning. But researches related to students' achievement, motivation processes and learning strategies have not been examined so far. These parameters were investigated in this present study. Two research questions for this study were determined as follows.

Research Questions

1. Does teaching of the studio physics make an impact on students' achievement performance?
2. Do students' motivational beliefs and use of learning strategies increase if they have practiced studio physics?

II. METHOD

In many cases, active-learning modes are adopted by an entire course so that there is no longer a comparison group using traditional instruction [16]. For this reason, the present research was conducted with one group. The primary aims of the present research were: to explore and describe the motivational orientation and learning strategies of students; and to explore the relationship between motivational and learning strategy constructs and academic performance of students during studio physics course in spring 2009 (S09) semester.

Almost all science and engineering students in the Colorado School of Mines (CSM) need to take the same core of math and science courses. This core includes ICBP-I and ICBP-II, the first and second semesters of Introductory Calculus-Based Physics. The data of this research was collected in ICBP-II course. ICBP-II introduces students to the fundamental ideas of physics. The basic goal of this course is:

1. to understand the fundamental laws of electromagnetism as summarized in the Maxwell equations and related concepts and principles,
2. to be able to apply these laws with the fundamental laws of motion using calculus,
3. to construct a suitable understanding of the electromagnetic properties of physical systems in an applied context, and
4. to begin to develop critical problem solving strategies.

Each semester, about 300 students are divided into three class sections taught by two lecturers. All students enrolled in a given course follow the same syllabus, do the individually assigned homework, and take common exams as a single group, both at finals and during the semester. A standard course design including daily lectures, in-class activities and solutions, homework assignments and solutions, and reading assignments is provided by a course supervisor for use by all lecturers.

Studio physics in the CSM consists of two one-hour lectures per week, and two two-hour blocks of studio time. Course material is separated into two-day blocks, where new principles are introduced in the lecture on one day, and students study applications the next day in the studio. Studio physics has two primary purposes;

1. to model and practice problem solving strategies, show physics principles in different contexts, and to review the application of mathematical physics techniques to describe physical situations.
2. to provide direct, hands-on experiences with electromagnetic phenomena in various situations. The activities provide connections between the abstract mathematical forms of the Maxwell laws of electromagnetism and their exhibitions in physical phenomena.

The studio class contains ten tables for groups of up to three/four students; the chairs have wheels to increase the mobility of the students around the table. Each table (workstation) is equipped with four computers. The computers contain the LON-CAPA (The Learning Online Network with a Computer-Assisted Personalized Approach) software and are connected to the Internet. One printer in the room is shared by all groups. The room has daily lab demo equipment storage. Also near each table, there is a small whiteboard for chalk-talks among students or between students and lecturers. At the front center, there are two mobile lecture tables, two overhead projectors, and two large whiteboards for the lecturer. The ceiling has a grid of beams capable of supporting apparatus.

Each studio section of roughly 100 students is staffed by two faculty members, two graduates, and one or two undergraduate teaching assistants. The purpose of this assistant team is to communicate with students and help them. This cooperation leads to communication both in the studio physics (a certain time of the week) and outside the class. Faculty members or graduate teaching assistants then give a minilecture of 10-15 minutes that serves to introduce the basic concepts and experimental approaches that the students use to examine that day's material. During the largest portion of each class period (~two hours), students work in pairs or groups of three/four, with lecturers moving around the room, answering and asking questions. Thus, students are exposed to teamwork and active learning, and the multiple learning modalities used provide formats friendly to students with various learning styles. The last ten minutes or so of each class period are a wrap-up session in which the lecturer reviews the important concepts and student share data and summarize their findings.

To interpret and discuss the findings of this study, the data of this research was collected with the help of Motivated Strategies for Learning Questionnaire (MSLQ) and students' grades obtained from LON-CAPA problems, LON-CAPA/written homework, hands-on activities, and exam.

A. Materials

Motivated Strategies for Learning Questionnaire [17] is a self-report instrument designed to measure university students' motivational beliefs and use of learning strategies. The MSLQ is based on a general social-cognitive perspective of motivation and learning strategies, with the student represented as an active processor of information whose beliefs and cognitive are important mediators of instructional input and task characteristics [18, 19, 20]. The MSLQ can provide student development educators with essential information for establishing structured training for university students [21]. This viewpoint is based on the learning literature that assumes that students' motivation and use of learning strategies can be controlled by the students and changed through teaching. Universities are often in need of ways to help students succeed once they have enrolled. The information that can be gained from assessment with the MSLQ can be valuable in guiding high-risk students to success.

There are two sections to the MSLQ, a motivation section and a learning strategy section. Table I illustrates these sections.

The motivational section proposes three general motivational constructs [17]: value, expectancy, and affective. The value components focus on the reasons engage in an academic task. The expectancy components refer to students' beliefs that they can accomplish a task. The affective component has been operationalized in terms of responses to the test anxiety scale, which taps into students' concern over taking examinations. The motivation section consisted of 31 items that assess students' goals and value beliefs for a course, their beliefs about their ability to succeed in a course, and their anxiety about tests on the course.

TABLE I. The components of the motivation and learning strategies (MSLQ).

Section I: Motivation Scale (M_MS)		Section II: Learning Strategies Scale (L_LSS)	
Value Components Subscale (M_VCS)		Cognitive Strategies Subscale (L_CSS)	
M_IGO	Intrinsic Goal Orientation	L_R	Rehearsal
M_EGO	Extrinsic Goal Orientation	L_E	Elaboration
M_TV	Task Value	L_O	Organization
Expectancy Components Subscale (M_ECS)		L_CT	Critical Thinking
M_CLB	Control of Learning Beliefs	Meta-Cognitive Control Strategies Subscale (L_MCCSS)	
M_SELP	Self-Efficacy for Learning Performance	L_MCSR	Meta-Cognitive Self-Regulation
Affective Component Subscale (M_ACS)		Resource Management Strategies (L_RMS)	
M_TA	Test Anxiety	L_TSE	Time and Study Environment
		L_ER	Effort Regulation
		L_PL	Peer Learning
		L_HS	Help Seeking

Students rate themselves on a 7-point Likert scale, from 1 (not at all true of me) to 7 (very true of me).

The learning strategy section is based on a general cognitive model of learning and information processing [17]. It contains three general types of scales: cognitive strategies, meta-cognitive control strategies, and resource management strategies. There are 31 items that assess students' use of different cognitive and meta- cognitive strategies. In addition, the learning strategies section included 19 items concerning students' management of different resources.

The MSLQ has received broad acceptance and use by others. Pintrich et al. [17], Pintrich & Smith [18], and Watson et al. [23] have demonstrated that the MSLQ is a reliable and valid measure of self-regulated learning. The total reliability of the motivation scales is 0.79 and the values of Cronbach's alpha for each motivational subscale are acceptable, ranging from 0.57 and 0.84. The total reliability of the learning strategies scales is 0.89 and the values of Cronbach's alpha for each of the learning strategies subscales are also acceptable, ranging between 0.62 and 0.83 [23].

III. RESULTS

Results of the study are presented and analyzed by following order of the listed research questions.

RQ 1: Does teaching of studio physics make an impact on students' achievement performance?

The results for student performance during the use of the LON-CAPA system are reported with the cumulative scores from hands-on activities, LON-CAPA problems, LON-CAPA/written homework, and exams. The final scores on the studio activities (LON-CAPA problems, and hands-on activities) typically contribute 20% to the grade. The rest of the marks come from lecture participation (5%), homework (written/LON-CAPA) (15%), mid-term exams (15% each) and the final exam (15%). To pass the lecture, students should gain a score of at least 60%. Exams were given in the traditional method (pen-paper, multiple-choice, and open-ended questions).

Table II represents the scores of students' enrolled for S09 from five different activities. The table clearly shows that students had poorest performance on their exams. The main reason for this outcome could have been students' tight schedules and inability to complete the activities during the semester. Being tested in two hours with 20 problems put much pressure on them during the exams. Exams cover a large variety of chapters and their activities (hands-on, LON-CAPA homework, written homework, lecture notes) therefore; students couldn't combine and present their knowledge easily.

TABLE II. The results of the studio physics activities in terms of students' grades.

N	LON-CAPA Problems	Hands-On Activities	LON-CAPA Homework	Written Homework	Exams
302	84.74	80.05	94.21	76.00	70.24

Note. *The grades weren't considered for students who didn't attend the activities, and the number of students is shown with N.

Also some students had some behaviors which were potential causes of failure. One of these attitudes was students' preference to review the instructor's lecture notes even though the fundamental concepts and exercises were also presented in the textbook. Further, some didn't read the material to be covered in class, didn't come prepared for class, and didn't take good lecture notes. They didn't use office contact hours of teaching assistants and lecturers to have better understanding of the subject.

Some LON-CAPA activity habits of students may also have caused a decrease in exam scores. These habits can be listed as follows: *i)* there was no feedback to the students that they have completed the problem properly as in LON-CAPA *ii)* students normally focused on getting some answer or calculating some number rather than organizing a problem solving framework on paper *iii)* the interaction they had with their peers in the form of small groups led to their getting lost in the problem as an individual, and students' motivation decreased.

As remarked in Table II, another striking result was students' considerably lower grades on manually graded (written) assignments than for LON-CAPA homework. LON-CAPA scores may reflect higher performance because the system has some advantages over written homework. Although they have the ability to enter a solution multiple times with a trial-and-error strategy in LON-CAPA homework, in written homework students have to show their work on the paper and get one correct result. Persistent students can get the correct answer. In addition, the most active member of the group may solve the problem on LON-CAPA and the others get the same grades from that person's effort, while in written assignments he/she has to submit the solution individually. Also, they don't revise and complete the written homework shortly after class while the material is fresh in their mind, thus they forget how to solve that type of problem. Even though it has little effect on the grades, the grading criteria of graduate students who grade the written homework may also change from time to time.

Another outcome is that students were more successful in solving related chapter problems (LON-CAPA problems) than experiments (hands-on) done in the studio class. The results show that students had difficulty in making conceptual connections between the recitation/problems and laboratory experiments. Hands-on activity provides learning theoretical concepts with a range of versatile tools that enable experiments to be performed. However, students preferred to watch demonstrations or applets (simulations) about the theory behind the experiment before application instead of just performing an experiment. The simulations show how the parameters can be affected if they change the values. Thus they are able to imagine the experiment and learn how to use the limits. Further, unless the lecturer or teaching assistants gives a short talk at the beginning of the laboratory session, students don't have enough understanding of the purpose of the experiment. Another possible reason for difficulty with experiments could be the students' distraction by computer activities (internet, on-line games etc.)

According to Table II, it can be said that the results of the studio physics activities in terms of students' grades were successful (min average is 70.24). What are the findings when these results obtained from students' grades are combined with their' motivational beliefs and learning strategies?

RQ 2: Do students' motivational beliefs and use of learning strategies increase if they have practiced studio physics?

The results of the MSLQ are reported according to the steps followed in the statistical analysis. Whenever appropriate, relevant interpretation and discussion of the findings are presented together with the results. The results can be interpreted two ways as follows.

A. The Results in terms of Motivation Scale

Table III presents the mean, standard deviation, Cohen's d value, and effect size for the six motivation subscales. Also, for each subscale, a separate mean score and standard

TABLE III. The results of the descriptive statics for motivation section.

	Pre-Test		Post-Test		Statistical Values	
	M	SD	M	SD	Cohen's d*	Effect Size
(M_VCS)	51.38	1.07	77.06	1.01	24.68	0.99
M_IGO	8.91	1.01	18.11	0.95	9.38	0.97
M_EGO	15.03	1.12	22.83	1.10	7.02	0.96
M_TV	27.44	1.11	36.12	0.97	8.32	0.97
(M_ECS)	47.67	1.21	64.47	1.02	15.01	0.99
M_CLB	16.22	1.15	21.82	1.10	4.97	0.92
M_SELP	31.45	1.28	42.65	0.94	9.97	0.98
(M_ACS) M_TA	10.21	1.20	15.03	1.17	5.88	0.89
(M_MS)	109.26	1.15	156.56	1.07	42.58	0.99

*Cohen's d value [24] was defined as any value over 0.8 as large effect size, while those between 0.5 and 0.8 are considered medium. M: Mean Score, SD: Standard Deviation.

deviation were got to test if there are any significant differences between pre and post test for the mean motivation section scores of the group. To examine the interrelationship between students' motivational beliefs and academic performance variables, Pearson product-moment "r" correlations were computed. The statistical analysis was done related to pre and post test scores. The increase in motivation section scores (21.79%) can interpret as the studio physics was effective on students' motivation beliefs. Also, Cohen's d and effect size values support this outcome. The findings for each motivational component were explained as follows.

Intrinsic Goal Orientation (IGO)

Intrinsic goal orientation is motivation that stems from primarily internal reasons (e.g., being curious, wanting to challenge, wanting to master the content). The result indicated main effect positive interaction with academic performance for the group ($M=18.11$, $p<0.05$, $r=0.42$).

Extrinsic Goal Orientation (EGO)

Extrinsic goal orientation is caused by primarily external reasons (e.g., getting good grades, competing with others, and seeking approval or rewards).The result indicated that the students were most interested in their level of performance or getting good grades as evident through a positive correlation ($M=22.83$, $p<0.05$, $r=0.36$).

This research shows that students with an intrinsic goal orientation tend to value a deeper level of understanding of tasks than those with an extrinsic goal orientation, and that conversely, those with an extrinsic goal orientation tend to use more surface-level processing strategies such as memorization or guessing. Intrinsic goal orientation, compared to extrinsic goal orientation, would also likely promote both short-term and long-term persistence toward the learning subject. Therefore, development of intrinsic goal orientation is more desirable for improving academic self-regulation [25].

Task Value (TV)

Students evaluate the course material in terms of interest, important, and utility. The result indicated a high level of interaction between task value and academic performance of the students ($M=36.12$, $p<0.05$, $r=0.49$). The result indicated that the students did not only find the lecturers that they pursued interesting, but also important and usable in their future careers. Task value had a much higher level of correlation with academic performance than the two prior value components, intrinsic and extrinsic value.

Control of Learning Beliefs (CLB)

This subscale was used to measure the level to which students believed that their efforts to study made a difference in their learning. The result indicated that this subscale interacted with the students academic performance ($M= 21.82$; $p< 0.05$; $r = 0.41$).

Self-Efficacy for Learning & Performance (SELP)

Students' *self-efficacy* is also an important self-regulative learning characteristic that influences academic self-regulation and performance. Self-efficacy, defined as a "belief in one's capabilities to organize and execute the courses of action required to manage prospective situations", affects both cognitive and affective dimensions of learning processes. Students can construct their self-efficacy beliefs through four different sources of experiences: mastery experiences, vicarious experiences, verbal persuasion, and physiological and affective states. Among the four sources, mastery experiences of successfully solving problems are considered the most effective source for developing self-efficacy, because they help students build cognitive foundations for determining the level of efforts necessary for a success. High self-efficacy helps students become persistent in pursuing intrinsic goals and willing to attempt difficult tasks [25].

Self-efficacy is not only a means for successful outcomes, but also a product of successful learning experiences. The result of this present research indicated that self-efficacy, or the ability of the students interacted strongly with their academic performance ($M = 42.65$; $p< 0.05$; $r = 0.48$).

Test Anxiety (TA)

Test anxiety is a psychological condition in which a person experiences distress before, during, or after a test or other assessment to such an extent that this anxiety causes poor performance or interferes with normal learning.

This subscale was used to measure the students' test anxiety. The result indicated that the test anxiety was inversely related to academic performance: the higher the anxiety, the poorer the academic performance (M = 15.03; p> 0.05; r = 0.01).

B. The Results in terms of Learning Strategies Scale

Table IV presents the mean, standard deviations Cohen's d value, and effect size for the nine learning strategies subscales. Also, for each subscale, a separate mean score and standard deviation were got to test if there are any significant differences between pre and post test for the mean learning strategies section scores of the group. To examine the interrelationship between students' use of the learning strategies and academic performance variables, Pearson product-moment "r" correlations were computed. The statistical analysis was done related to pre and post test scores. The increase in learning section score (37.03%) can interpret as the studio physics was effective on students' use of the learning strategies. Cohen's d and effect size values support this outcome. The findings for each learning strategies components were explained as follows.

TABLE IV. The results of the descriptive statics for learning strategy section.

	Pre-Test		Post-Test		Statistical Values	
	M	SD	M	SD	Cohen's d	Effect Size
(L_CSS)	62.24	1.13	116.09	1.10	48.29	0.99
L_R	15.46	1.17	23.46	1.14	6.92	0.96
L_E	19.20	1.11	35.86	1.06	15.30	0.99
L_O	14.28	1.15	24.72	1.15	9.07	0.97
L_CT	13.30	1.14	32.05	1.01	17.41	0.99
(L_MCCSS) L_MCSR	41.52	0.76	61.66	0.70	27.56	0.99
(L_RMS)	61.32	1.11	116.93	1.05	51.47	0.99
L_TSE	27.24	1.00	49.52	0.75	25.20	0.99
L_ER	14.03	1.04	24.47	1.04	10.03	0.98
L_PL	8.97	1.30	19.15	1.28	7.92	0.96
L_HS	11.08	1.08	23.79	1.09	11.71	0.98
(L_LSS)	165.08	1.00	294.68	0.97	131.55	0.99

M: Mean Score, SD: Standard Deviation

Rehearsal (R)

The rehearsal strategy uses repeated practice of information to learn the concepts or subjects. The repeated practice increases the student's familiarity with the information. The result indicated that rehearsal was related to the academic performance of students (M = 23.46; p< 0.05; r = 0.33).

Elaboration (E)

This subscale was concerned with students' idea, discussion, interpretation, and deep-thinking related to subjects and concepts. This result showed that elaboration was related to the academic performance of students (M = 35.86; p< 0.05; r = 0.43).

Organization (O)

This subscale was used to examine students' creativity and awareness. The result showed that organization was significant correlated with academic performance (M = 24.72; p< 0.05; r = 0.40). Thus engaging directly with the material to be learned is important for academic achievement.

Critical Thinking (CT)

This subscale was used to measure students' assumptions, discerns hidden values, evaluates evidence, and assesses conclusion. This result indicated that critical thinking was significant correlated with academic performance of the students (M=32.05; p< 0.05; r =0.47).

Metacognitive Self-Regulation (MCSR)

This subscale was used to measure to students' knowledge concerning their own cognitive processes or anything related them. The result indicated that metacognitive self-regulation was significant correlated with academic performance of the students (M=61.66; p< 0.05; r =0.40).

Time and Study Environment (TSE)

This subscale measured the level at which students must be able to manage and regulate their time and their study environment. The result indicated that time and study environment as utilized by the sample of students was positively related to the students' academic performance (M = 49.52; p< 0.05; r =0.42).

Effort Regulation (ER)

This subscale measured the level of students' effort and commitment to completing their study goals, even in the presence of difficulties or distractions. The result indicated that effort regulation was related to the academic performance of students (M = 24.47; p< 0.05; r = 0.44).

Peer Learning (PL)

The level of collaboration with peers to assist a learner to clarify materials and reach insights on coursework that was not attained in the classroom. The result indicated that peer learning was significantly related to the academic performance of the students (M = 19.15; p< 0.05; r = 0.35).

Help Seeking (HS)

This subscale was used to measure to students' help seeking. The result indicated help seeking subscale was significantly correlated with academic performance of the students (M = 23.79; p < 0.05; r = 0.32).

IV. CONCLUSION AND DISCUSSION

The purpose of this study was not only to evaluate the motivational beliefs and use of learning strategies of the students who enrolled in the Introductory Calculus-Based Physics II course using the studio physics model, but also to examine the students' academic performances and the relationship among the variables.

With the respect to the motivational beliefs concerning the relationship between the academic performance and motivational strategies of students, the findings indicated that the motivational constructs, namely, intrinsic goal orientation (r=0.42), extrinsic goal orientation (r=0.36), task value (r=0.49), control of learning beliefs (r=0.41), and self-efficacy for learning and performance (r=0.48), were all positively and significantly related to academic performance of the students. But test anxiety (r=0.01) was not significantly related to academic performance. The results implied that the motivational components were directly linked to students' academic performance in the lecture. The strongest correlation coefficients for the motivational components were task value and self-efficacy for learning and learning. The results indicated that, as pertained to the students' task value and self-efficacy, they not only found the courses they studied interesting, but also understood the course content was very important and it was their intention to utilize the learned coursework. The results also show that the students were confident that they had the necessary ability to accomplish and the necessary skills to perform the tasks.

With the respect to the learning strategies concerning the relationship between the academic performance and use of learning strategies of students, the findings indicated that the learning strategy constructs, namely, rehearsal (r=0.33), elaboration (r=0.43), organization (r=0.40), critical thinking (r=0.47), meta-cognitive self-regulation (r=0.40), time and study environment (r=0.42), effort regulation (r=0.44), peer learning (r=0.35), help seeking (r=0.32). The results indicated that the nine subscales were positively related to academic performance. Help seeking, although significantly related, achieved the lowest correlation with academic performance in the group. It was evident that the student participants were more comfortable meeting with their peers to discuss coursework issues, than obtaining help, tutoring or individual assistance from lecturers. The results implied that learning strategy constructs were positively related to students' academic performance.

The results provide evidence for the importance of considering both motivational and learning strategies components in the lecture in an effort to enhance the academic performance of university students. According to the research' results, it can be said that the use of the studio physics was effective on the achievement, motivational beliefs, and use of learning strategies of the students. So, nowadays traditional instruction methods should be no longer used. Interactive learning and teaching methods should be taken the places instead.

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