International Journal of Engineering Education Vol. 30, No. 2, pp. 326–332, 2014
Printed in Great Britain

0949-149X/91 $3.00+0.00
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Key Success Factors in Cultivating Students' Learning Motivation*

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Engineering Education focuses not simply on the theories and principles in the curriculum, but stresses the instructional application and practice. In this case, with a designed curriculum the students in Engineering Education often precede learning and acquire the necessary knowledge. In the learning process, many students have reduced learning motives because of the passive learning and they can even become learning-dodgers. Nevertheless, there are some students who keep their learning motives. Looking at the difference between such motives and the learning process, this study aims to understand the approach of the students in Engineering Education who keep their learning motives and the factors involved in their motivational regulation strategies. Aimed at the factors in Learning Motivation, the AHP criteria established with the Delphi Method are organized by the consistent opinions of experts with repeated enquiry, conclusions, and revision. The instructors in the Department of Electronic Engineering in the national universities in Taiwan have distributed 110 copies of the questionnaires. A total of 83 valid copies have been retrieved, a retrieval rate of 75%. According to the overall results of the evaluation criteria, among the key success factors in the students' Learning Motivation acquired from the questionnaire data, the top five emphasized criteria. Amongst 20 evaluation criteria, are the Teaching Approach, Commendation and Concern, the Control of Learning Strategy, Goal Setting, and Family Care and Support.

Keywords: learning motivation; Delphi Method; key success factors; learning behavior; learning belief

1. Introduction

The departments of engineering have been in the mainstream in domestic colleges. From traditional machinery, chemical engineering, and civil engineering departments to electrical engineering and computer science, which become popular with technological development, such engineering departments have been the primary consideration when applying for a university. In addition, the graduates trained in colleges, universities, and graduate schools have undertaken various work in technical practice, research and development of science and technology, and team leading from which domestic engineering businesses are able to look for experts. The currently international concern is the abilities of such graduates cultivated in Engineering Education being able to achieve business demands. When the schools can educate the required manpower for the businesses, the competitiveness of such engineering students would be largely enhanced. As a result, it becomes extremely important to reinforce domestic Engineering Education for international competition. Promoting the quality of Engineering Education and reinforcing the international competitiveness of engineering students become the major tasks.

When students receive education, the academic performance is generally applied to judging the success of the learning. Motivation plays a critical role in student learning, as it could directly push individual activities to achieve a certain internal thrust [1]. Many learning failure result from learners lacking effort, insistence, a positive self-concept and escaping from work. In other words, motivation, in addition to intelligence, is considered to be a key factor in academic achievement. Consequently, finding out students' Learning Motivation and improving the instruction aimed at the key points could encourage students to favor learning and strive for learning. An ideal instructional condition is to have students remain in a constant high Learning Motivation. Learning Motivation is the intrinsic learning condition of a student, but their induction and the remaining are closely related to

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* Accepted 30 October 2013.

the teacher's teaching strategies and methods. School education aims to guide the students onto effective learning and inducing students' high Learning Motivation is the primary task of an educator. This study therefore tends to discuss the key success factors in cultivating students' Learning Motivation.

2. Discussion of literature and theory

2.1 Learning motivation

Motivation, the most complicated psychological property of human beings, is the core problem in psychology and presents the importance of pedagogic research. Motivation, an internal force to push an individual into various behaviors, refers to an internal function inducing individual activities, maintaining the induced activities, and facilitating such activities towards certain goals [1].

The motivation theories proposed by researchers are identical but they could be classified as below.

2.1.1 Dividing motivation into physiological motivation and psychological motivation.

Physiological Motivation indicates the internal demands generated from the physical changes of the body, such as the original motivation, demands, and forces of thirst, hunger, and sex. Psychological Motivation, on the other hand, is the psychological factors in individual behavior. The former is normally innate, while the latter is acquired through learning [1].

2.1.2 Dividing motivation into Ordinary Learning Motivation and Emphasized Learning Motivation

Based on the strength of Learning Motivation, students with Ordinary Learning Motivation would earnestly learn all knowledge-based subjects and extracurricular activities. Hu [5] indicated that students with Ordinary Learning Motivation revealed a consistent system for motivation, interest, habit, attitude, will, and value in knowledge acquisition, which is part of their unique personality. Students with Emphasized Learning Motivation, on the other hand, merely present Learning Motivation on certain subjects.

2.1.3 Dividing motivation into Extrinsic Motivation and Intrinsic Motivation

Based on the generation or origin of motivation, motivation resulting from external environments is regarded as Extrinsic Motivation, while that generated from internal demands is considered to be Intrinsic Motivation. Students with Intrinsic Motivation pursue learning activities that could result in satisfaction and pleasure, while those with Extrinsic Motivation expect to acquire rewards (awards) [6].

2.1.4 Dividing motivation into Physiological Motivation (such as hunger, thirst, and sex)

This is Stimulation-Seeking Motivation (including exploration, curiosity, and contact), Acquisition Motivation (such as fear, attack, and cooperation), and Unconscious Motivation [8].

2.1.5 According to the relationship [10], ordered motivation such as Physiological Needs, Safety

This is Needs, Love/Belonging Needs, Esteem Needs, Aesthetics/Knowledge Needs, Self-actualization Needs, and Self-transcendence Needs.

2.2 Factors in Learning Motivation

Regarding the control of learning knowledge and strategies is key in achieving learning effectiveness [14]. The pursuit of goals as a powerful factor in learning revealed the development of the success goal motivation theory [9]. Pintrich & Schunk [12] pointed out the effects of a teacher's teaching plan, schedule, classroom organization and management, and teacher–student interaction on students' Learning Motivation. McCown et al. [11] considered the factors of one's personal goal, belief, and self-concept, environment, others' expectation, and social value in a student's learning. Dev [3] proposed the key factors of having a student focusing on the learning process, their active response, praising the student, mastery in learning, presenting challengeable and exciting activities, and evaluation of affairs, rather than individuals enhancing students' intrinsic Learning Motivation. Stipek [13] believed in the effects of selection on intrinsic Learning Motivation and developed a selective organization mode. Herbert [4] pointed out the factors of the learning schedule, teacher's voice, eye contact, and body language, and the selection of textbooks in students' learning. Chang [2] concluded that the factors in vocational students' Learning Motivation are individual factors of individual variables and learning perception, school factors of school variables and school learning culture, and family factors of family variables and family learning culture, which had a mutual interaction [7].

Summing up the above research, the factors in Learning Motivation are organized as follows.

2.2.1 Learning environment

This includes

1. challengeable materials with moderate difficulty,
2. teachers, as the examples, presenting strong Learning Motivation,
3. teachers planning the instruction and controlling the schedule,
4. effective instruction of a teacher,

5. acquisition of concern,
6. being in the environment with proper competition,
7. presenting a classroom goal and reward structure,
8. opportunities to interact with classmates,
9. being in a favorable classroom organization and management,
10. a supportive learning environment,
11. a favorable classroom atmosphere,
12. concern and support of parents,
13. being influential and opportunities for participation,
14. having a warm manner,
15. having opportunities for being praised,
16. evaluating affairs rather than people,
17. teaching contents suitable for students' interests,
18. reducing the assessment of learning performance with grades,
19. more essential feedback,
20. a teacher or student model for learning,
21. active assistance from teachers,
22. teachers' body languages,
23. informing the learning results,
24. presenting strong teaching attempts and enthusiasm,
25. inducing students' curiosity or creating hesitation,
26. individualizing abstract contents,
27. making specific or familiar conditions,
28. guiding students to cultivate personal learning motivation,
29. stating learning goals,
30. providing prior knowledge,
31. giving demonstration ideas and problem solutions related the learning content,
32. participating in a social group,
33. nutrition,
34. constant feedback,
35. physiological conditions,
36. playing a role of a happy learner, and
37. material and spiritual security.

2.2.2 Learning behavior

This contains:

1. simulation opportunities,
2. selection opportunities,
3. application of motivation promotion strategies,
4. a focus on learning process,
5. gamed-based learning activities,
6. reducing learning anxiety,
7. curiosity, and
8. challenge.

2.2.3 Learning ability

This covers:

1. free creation,
2. mastering learning,
3. the extent of interest,
4. thinking of high-level and diffusive problems,
5. mastering learning knowledge and strategies,
6. using multiple intelligences, and
7. learning styles.

2.2.4 Learning belief

This contains

1. success attributes,
2. teacher expectation,
3. goal setting,
4. positive belief, and
5. self-affirmation and reinforcement.

3. Research design and method

3.1 Delphi Method

The above factors in Learning Motivation established the AHP criteria with the Delphi Method. The Delphi Method, also named 'expert investigation,' applies communications to separately delivering problems to various experts, asking for opinions, and collected the opinions to give comprehensive ones. Such comprehensive opinions and the predicted problems are fedback to the experts for further opinions or revisions. After repeating the steps several times, a decision that is more consistent with the prediction result is then acquired.

According to the system program, the Delphi Method allows anonymous opinions, i.e. the experts do not discuss with each other or present horizontal connections, but merely show a relationship with the investigators. The experts' opinions about the questionnaire are repeatedly enquired, organized, and revised for their consistent opinions, as the predicted result. Such a method gives a broad representativeness that is more reliable.

3.2 Establishment of evaluation criteria

The questionnaires, originally organized the considerations for Learning Motivation from theories and factors, are sent to the experts in various fields through emails. Considered factors with similar properties are organized into the same classification and returned to the experts for further opinions. The final results are acquired after several revisions through emails. All experts are finally invited to set the key success factors from the major classifications, including Learning Environment, Learning Behavior, Learning Ability, and Learning Belief. Such key factors are regarded as the AHP dimensions, and the criteria are applied to establishing the

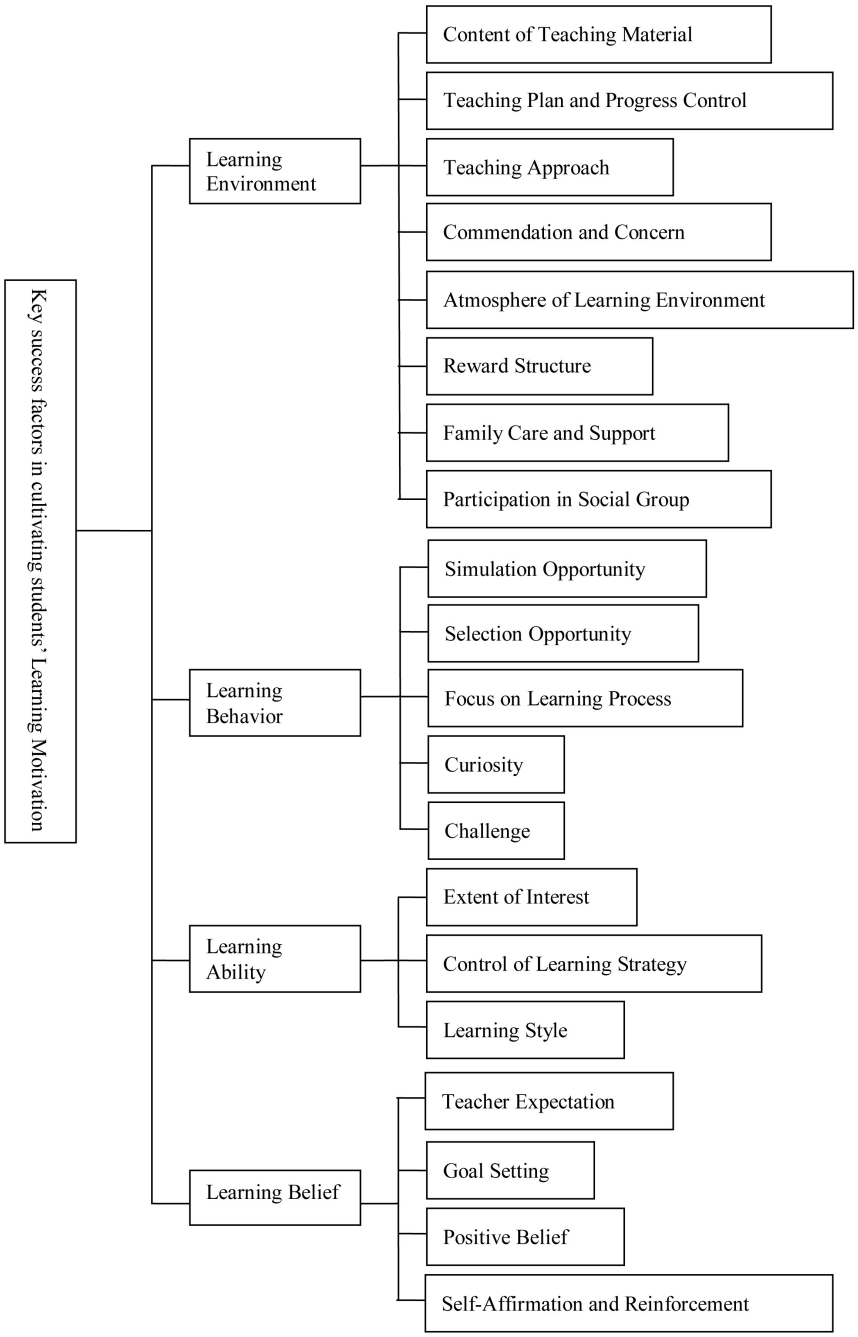

Fig. 1. Research framework.

AHP questionnaire. Figure 1 shows the research framework after the revision with the Delphi Method.

3.3 Research subject

Aiming at the teachers in the Department of Electronic Engineering in national universities in Taiwan, a total of 110 copies of the questionnaires were distributed, and 83 valid ones were retrieved, with a retrieval rate of 75%. The national universities with a Department of Electronic Engineering include the National Taiwan University of Science and Technology, the National Yunlin University of Science and Technology, the National Taipei University of Technology, the National Kaohsiung First University of Science and Technology, the National Kaohsiung University of Applied Science, the National Formosa University, the National Kaohsiung Marine University, the National Chin-Yi University of Technology, the National Taiwan Normal University, the National Ilan University, and the National United University.

4. Data analysis

Having completed all hierarchical weights, the relative importance of the evaluation criteria in various hierarchies is distributed, presenting the importance of criteria in the evaluation system, and the overall weight of cultivating students' Learning Motivation is organized in Table 1.

From Table 1, the following conclusions are summarized. Among the dimensions in Hierarchy 2, Learning Environment (weighted 0.415), about 41.5% of overall weight, is mostly emphasized, followed by Learning Ability (weighted 0.266), Learning Belief (weighted 0.211), and Learning Behavior (weighted 0.108). Apparently, Learning Environment is mostly stressed for cultivating students' Learning Motivation.

Among the evaluation criteria in Hierarchy 3, the hierarchical weights are ordered as follows.

1. The evaluation criteria in Learning Environment are ordered Teaching Approach, Commendation and Concern, Family Care and Support, Atmosphere of Learning Environment, Content of Teaching Material, Reward Structure, Teaching Plan and Progress Control, and Participation in Social Group.
2. The evaluation criteria in Learning Behavior are ordered Focus on Learning Process, Curiosity, Simulation Opportunity, Selection Opportunity, and Challenge.
3. The evaluation criteria in Learning Ability are ordered Control of Learning Strategy, Extent of Interest, and Learning Style.
4. The evaluation criteria in Learning Belief are ordered Goal Setting, Positive Belief, Self-Affirmation and Reinforcement, and Teacher Expectation.

5. Discussions

The research conclusion shows that the Learning Motivation of the students in the Department of Electronic Engineering would change with teachers' teaching methods and Commendation and Concern to the students. Besides, the Control of Learning Strategy is regarded as a critical factor in students' Learning Motivation. A teacher therefore should design the teaching activities with the aim of affecting the students' in their setting of learning goals and enhancing the learning intention, and to achieve the goals. It is suggested to the teachers that they try distinct teaching approaches, rather than applying traditional teaching methods, utilize various aided materials for supplementing the contents in textbooks, such as computer-based animation and films, and enhance students' learning interests. The schools should establish a curriculum that is suitable for students' characteristics and allow them learning knowledge and scientific research methods and attitudes with experienced teaching so that they

Table 1. Weights of students' Learning Motivation cultivation

Dimension	Hierarchy 2 weight	Hierarchy 2 order	Criteria	Hierarchy 3 weight	Hierarchy 3 order	Overall weight	Overall order
Learning environment	0.415	1	Content of teaching material	0.133	5	0.049	10
			Teaching plan and progress control	0.088	7	0.034	14
			Teaching approach	0.176	1	0.092	1
			Commendation and concern	0.163	2	0.089	2
			Atmosphere of learning environment	0.142	4	0.061	7
			Reward structure	0.107	6	0.043	12
			Family care and support	0.155	3	0.073	5
			Participation in social group	0.036	8	0.011	20
Learning behavior	0.108	4	Simulation opportunity	0.189	3	0.039	13
			Selection opportunity	0.173	4	0.029	16
			Focus on learning process	0.267	1	0.065	6
			Curiosity	0.223	2	0.047	11
			Challenge	0.148	5	0.016	19
Learning ability	0.266	2	Extent of interest	0.248	2	0.057	8
			Control of learning strategy	0.613	1	0.082	3
			Learning style	0.139	3	0.025	18
Learning belief	0.211	3	Teacher Expectation	0.145	4	0.027	17
			Goal Setting	0.358	1	0.077	4
			Positive belief	0.274	2	0.052	9
			Self-affirmation and reinforcement	0.223	3	0.032	15

can acquire better efficiency than by simply lecturing in classrooms. Regarding the teacher–student relationship, a student who perceives the teachers' concern, encouragement, emphasis, and trust, and offers correct learning attitudes and philosophy would present a strong Learning Motivation. Strategically establishing a competitive atmosphere and integrating peer competition and identity to encourage learning could encourage students' Learning Motivation.

6. Conclusions

Based on the empirical analyses, the following conclusions are proposed with the expectation of cultivating the Learning Motivation of students in the Department of Electronic Engineering and provide them with definite guidance and direction. From the overall weight of the evaluation criteria among the key success factors in the students' Learning Motivation, the top five criteria appear to be: Teaching Approach, Commendation and Concern, Control of Learning Strategy, Goal Setting, and Family Care and Support.

The above analyses reveal that active instructions in the Teaching Approach are likely to induce students' Learning Motivation. Perceiving teachers' concern, encouragement, emphasis, and trust in Commendation and Concern would encourage the students' performance to present a stronger Learning Motivation. Often, communicating learning value and reasons with students in the teaching process in the Control of Learning Strategy allows students to have an understanding of the reason for learning and achieving self-cognition to show better Learning Motivation. Properly setting goals for students and promoting students' learning in Goal Setting allows students to have Learning Motivation. Proper rewards from either teachers or parents for reaching the goal would enhance students' Learning Motivation. Parents giving students the right of believe is important in Family Care and Support, as a positive or negative belief depends on the people around them that a positive belief would lead student behavior in a positive direction, while a negative belief would affect the students' opinions. It is therefore suggested that one communicates with students about learning value and reasons. When students do not know the reason for learning, they do not present Learning Motivation. Learning strategies and methods should also be taught in the development process. Moreover, rewards and a learning model for students to imitate would have the students reveal higher Learning Motivation.

In other words, Engineering Education is seldom studied in modern research on education, most of which focus on Science Education. In fact, the knowledge models of Science Education and Engineering Education are distinct. The former is an abstract model of a real world, which has filtered some inappropriate details in the scientific descriptions. The latter, on the other hand, establishes real objects to solve the problems in the real world. Engineers cultivated in Engineering Education are required to observe the details in the engineering, as an improper neglect could result in failure. The knowledge and experiences of the experts in other majors are therefore collaborated. However, individual responsibilities are reduced and personal achievements cannot be evaluated in a collaboration where the engineering students would tend to reduce their efforts in collaborative works. The learning motive for Engineering Education is therefore critical.

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