

Full Length Research Paper

The influence of self-efficacy and motivational factors on academic performance in general chemistry course: A modeling study

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This study aims to determine the predictive and explanatory model in terms of university students' academic performance in 'General Chemistry' course and their motivational features. The participants were 169 university students in the 1st grade at university. Of the participants, 132 were female and 37 were male students. Regarding their department, while 89 of them were students at Chemistry Department, 80 participants were at Chemistry Engineering Department. In order to determine students' motivational stimulants towards General Chemistry, Science Motivation Questionnaire (SMQ) was used. The questionnaire was developed by Glynn et al. was adapted into Turkish by Ilhan et al. The scores that students got from General Chemistry course were obtained from the lecturers teaching them and they were the average academic performance grades measured during the term. The data were analyzed with SPSS 17.0 and AMOS 21.0 software program through Structural Equation Model (SEM). In this research, the first suggested model was tested and as a result of fit indexes, some modifications were done and it was verified accordingly.

Key words: Academic achievement, extrinsic motivation, intrinsic motivation, Structural Equation Modeling.

INTRODUCTION

There are many factors that influence a students' academic achievement such as cognitive, affective and psychosocial state. It has long been discussed whether affective characteristics determine their interest as well as their preferences, social skills, academic achievements and failures (Kocak et al., 2012). According to Djigunović (2006), it was in the mid-twentieth century when they first started to research and measure affective features and measured in a more systematic way. It was

hard to define and measure as it seems quite difficult. The affective learning domain attracted growing interest after it had been understood that individual should be accepted as a whole in education along with his/her personality, intellect and emotions. It is thought that affective features contribute to one's learning process significantly. There are those who emphasize that without motivation, learners' cognitive abilities would lack in the learning process. Furthermore, Tabane and Human-

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Vogel (2010) stated that sense of belonging, respect, fair treatment, respect and positive attitudes towards others, safety, and freedom all influence personal motivation in terms of their academic achievement and social settings. A quite profound proof for that is a study by Siann et al. (1998) where male and female Asian students stated that their parents and family had great contribution to their academic achievement.

It was found out in some researches that outcomes such as curiosity, persistence, learning and performances also refer to motivation (Deci and Ryan 1985). As these outcomes are quite important, it is easy to understand why researchers are concentrating their studies on motivation in the instructional settings. The willingness and effort which students show in accordance with engagement and persistence are generally thought to be the definition of motivation (Wolters, 2004). As Hlalele (2012) stated motivational beliefs directly influence students' affective learning proportionally. Since motivation and other affective factors are essential in many settings, particularly in education, it is of great importance to take these into consideration while designing the curriculum. Even though the usage and significance of scientific knowledge in an industrialized society is increasingly appreciated, it has been a matter of discussion whether interest in science and willingness to pursue a scientific career has reduced significantly (Raes and Schellens 2012). It was proven by Bank and Finlapson (1980) that the students with a high level of academic achievement had a higher willingness to learn than the students with lower level of academic achievement.

In spite of the fact that many countries encounter lack of interest in motivation in science subjects, Raes and Schellens (2012) argue that there is little research concentrating on the factors that affect learner's motivation. Chen (2012) also maintains that policy documents and academic research in science education would help students increase their consciousness in science and advance their beliefs in the nature of scientific knowledge and knowing itself. In other words, students must improve certain habitual minds such as developing self-confidence in science, resilience against failures, and belief in change in scientific knowledge from time to time.

Furthermore, Deci and Ryan (1985) claim that in self-determination theory (SDT) motivation can be reinforced by self-determination. According to them, motivation can exist at different levels of self-determination. In this respect, the most self-determined style of motivation is intrinsic motivation (Raes and Schellens, 2012). In this theory, different reasons or goals that stimulate an action attribute to different types of motivation. A simplest distinction can be made between intrinsic motivation and extrinsic motivation. Here, while intrinsic motivation refers to carrying out tasks with a high interest, extrinsic motivation refers to conducting them to get rewards. Research indicates that learners who are motivated intrinsically have appreciation in quality and performance

compared to extrinsically motivated ones. This distinction clearly manifests functional differences between these two types of motivation (Ryan and Deci 2000). Mo (2011) points out that a growing number of college students forget their responsibility for their own learning. The idea shared by most lecturers here is that students attend classes merely for attendance taken and mandatory quizzes given. These students are believed to have a short-term attention span and get distracted easily by some distractors such as texting to friends. What Fortier et al. (1995) found out, in relation to this, is that academic competence and academic self-determination had a positive impact on academic motivation, thus a positive impact on school performance. Since self-determination fosters motivation in learning and it enhances academic achievement, it can be applied to many courses, especially chemistry. Kocak et al. (2012) describe science as a challenging field. They claim that as it contains abstract terms and concepts, students find it difficult to understand at times.

Intrinsic and extrinsic motivation

As human motivation is a complex phenomenon involving a number of diverse sources and conditions, it has always been a matter of discussion (Dornyei and Csizer, 2002). Motivation is surely one of the concepts of great importance that it is related to energy, directing, persistence and intention. Also, motivation has a significant effect on the attitude and learning learners' behaviors (Deci and Ryan, 1985; Fairchild et al., 2005; Ryan and Deci, 2000; Vallerand et al., 1992). Perceived as a single concept by putting a general level of motivation in terms of certain behaviors, self-determination theory directs its focus on classifying different kinds of motivation. The idea underlying the theory is that the quality of motivation would be more significant than the quantity in terms of mental health, happiness, effective performance, creative problem solving, and deep or conceptual learning. That has been justified as a result of a considerable number of research (Deci and Ryan 2008; Areepattamannil et al., 2011).

According to this theory,

- a) people are motivated intrinsically though meaningful exercises;
- b) self-regulation is affected by internalization
- c) Internalization process and regulated learning types are affected by the society. It takes place as introjection where a value or behavior is taken without acceptance, where regulation is absorbed by personality (Deci et al., 1994).

In this sense, being intrinsically motivated requires perceptions of control and competence (Schunk 2012, 391). According to Bester and Brand (2013), intrinsic motivation is resulted from the willingness of a student to

conduct a task. In this regard, concentration can be manifested during that process. For example, an intrinsically motivated student studies a subject diligently because he finds it interesting to learn or persists at solving a challenging problem. He is also curious about the answer to the problem. On the other hand, extrinsic motivation is the type of motivation that aims to complete work to obtain a reward from others or study for an exam to get a good grade (Moreno, 2009, 329).

Autonomous motivation and controlled motivation are the main ways of distinction in SDT. Intrinsic motivation and the kinds of extrinsic motivation are the types in which autonomous motivation exists. When people have autonomous motivation, they act on their own. When people are controlled closely, they are forced to think, feel and act in a scheduled way. Behaviors are stimulated and controlled by both autonomous and controlled motivation (Deci and Ryan, 2008). According to Vallerand (2000), Deci and Ryan's theory is quite up to date and SDT reveals that psychological needs matter in motivation and outcomes. On the other hand, as Dornyei (1994) argues, intrinsic motivation has been thought to be undermined by extrinsic motivation and similarly, there is some research showing that students will experience lack of intrinsic motivation for an activity (e.g. compulsory readings at school).

Self-efficacy

Bandura's (1977) social learning theory, though renamed as social cognitive theory in 1986, has given path to self-efficacy. According to his theory, the way people think, feel, act and motivate themselves is affected by self-efficacy (Zulkosky, 2009). Researchers studying self-efficacy suggest that people lacking self-efficacy have problems with motivating themselves to carry out tasks. When students have the impression that they will not be able to complete a certain task, they will not make an effort to fulfill it and they will easily quit (Margolis and McCabe, 2006). Bandura (2006, 307) claims that self-efficacy is about people's confidence in themselves to fulfill any task. As everyone has different capabilities, their self-efficacy levels can also be different. For example, while a mathematician can have high operational efficacy, he can have low social efficacy.

Bandura (1977) also states that the extent to which a person copes with obstacles and failures is determined by personal efficacy; and furthermore, when students insist on carrying on the activities that are threatening, they may not perceive it as threat in fact. This can result in enhanced self-efficacy. As seen above, self-efficacy is the thing one understands from their skills regarding certain activities. Therefore, students can either be of the opinion that they are going to have a positive outcome or they are going to have a negative outcome for a certain task (Schunk, 2012, 149).

What is more, self-efficacy can have influences in

people's performance, observation, social persuasion. It can also have physiological symptoms such as heart rate, stress and high blood pressure. The prior experience is vital in this respect. For this reason, an increase or decrease in efficacy is directly related to one's accomplishments or failures although a random failure does not necessarily have an effect on self-efficacy (Schunk, 2012, 147).

This study, in particular, was designed to investigate the relationships among the affective factors (intrinsic motivation, extrinsic motivation and self-efficacy) above and their predictive implications on academic achievement in the General Chemistry Course. This relationships and implication were tested using the Structural Equation Modeling.

Purpose of the study

For these reasons, it is considered that intrinsic motivation, extrinsic motivation and self-efficacy are affective factors which have significant influences on people's performance or academic achievement in learning and teaching process. Therefore, knowing and increasing the level of intrinsic motivation, extrinsic motivation and self-efficacy before or during the learning and teaching process can contribute students' academic performance directly. On this account, the main purpose of this study is to find out the relationship between students' intrinsic motivation, extrinsic motivation and self-efficacy levels and their academic achievement in general Chemistry course which is considered as a problematic area. As a result, it is purposed to develop a model. Eventually, by using these findings it is aimed to provide recommendations for lecturers to increase students' achievement. In his regard, the answers of the following questions were researched:

1. What is the predictive validity level of the students' intrinsic motivation, extrinsic motivation, self-efficacy and their achievement in General Chemistry course?
2. What is the correlation between the students' intrinsic motivation and extrinsic motivation in General Chemistry course?
3. What is the relationship between the students' intrinsic motivation and self-efficacy in General Chemistry course?
4. What is the relationship between the students' extrinsic motivation and self-efficacy in General Chemistry course?
5. What is the predictive and explanatory model between university students' academic performance and intrinsic motivation, extrinsic motivation, self-efficacy in General Chemistry' course?

Figure 1 shows both the interrelated relationships of the affective factors (intrinsic motivation, extrinsic motivation and self-efficacy) and the relationship of these factors with academic achievement.

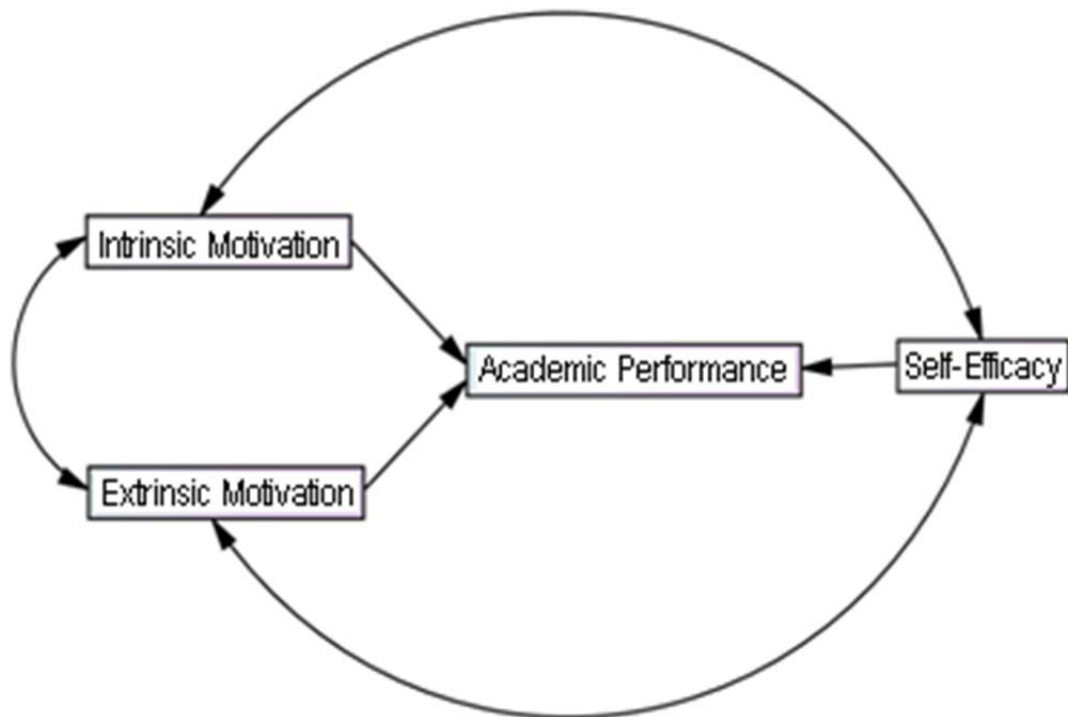


Figure 1. The tested model.

METHODOLOGY

Research design

This research employed a survey method. This method is usually used to reach a decision out of a large population. By using this method, it is possible to get a group or a sample which is considered to represent the general population (Karasar, 2004: 79).

Participants

The participants comprised 169 university students of 1st grade. Of the participants, 132 were females and 37 were males. 89 of them were students at Chemistry Department and 80 were students at Chemistry Engineering Department. The participants participated in the research voluntarily and prior to the study they were informed about the purpose of the study.

Data collection/Instrument

The data were collected through "Science Motivation Questionnaire (SMQ) developed by Glynn et al. (2007) and Glynn et al. (2009). The questionnaire was translated into Turkish by Ilhan et al. (2012). It had two parts. The first part aimed to gather knowledge about the education students' demographic features and the second part consists of 22 items to determine the students' motivational features towards General Chemistry course. The original scale had 4 sub-dimensions. However, in this study, it had 3 sub-dimensions as intrinsic motivation, extrinsic motivation and self-efficacy. In order to determine their intrinsic motivational features, 4 items were used (16, 1, 22 and 30). For determining their intrinsic motivational features, 3 items were used (3, 7 and 15). For self-efficacy, 3 items were tested (28, 24 and 21). The participants' responses were

indicated on a 5-point Likert scale ranging from Not at all (1) to Very much (5).

The students' academic scores which they got from General Chemistry course were obtained through the lecturers teaching them. They were the average scores of their academic performance during the term.

Reliability

The total Cronbach Alpha reliability of the scale was calculated as .82. It was 0.81 for intrinsic motivation sub-dimension; it was 0.74 for self-efficacy sub-dimension and it was 0.62 for extrinsic motivation sub-dimension (Ilhan et al., 2012).

Data analysis (Structural Equation Modeling)

The data were analyzed through SPSS 21 and AMOS 21 software programs. In order to analyze descriptive statistics, SPSS 21 was used and for the other analysis related to research questions AMOS 21.0 software program was employed. In addition, Structural Equation Modeling (SEM) was used to test the hypothesized model. The strength of SEM is that it can be used to analyze models, identify and remove weaknesses and reveal complex relationships in a hypothesized model. A good SEM analysis is usually based upon the theoretical ground for the tested models (Violato and Hecker, 2007). SEM model is targeted at testing whether the theoretical model is in harmony with the data obtained for the reflection of that theory (Lei and Wu, 2007). It has an aim to summarize the relationships among the variables optimally (Weston and Gore, 2006; Kline, 1998). Another important strength of SEM is that it can analyze both direct and indirect relationships. While a dependent variable is the predictive one in equation, it can be the predicted one in another. SEM indicates the effect of independent

Table 1. Descriptive statistics.

	N	Minimum	Maximum	Mean	Std. Deviation
Self-Efficacy	169	4,00	15,00	11,64	2,22
Exrtinsic Motivation	169	3,00	15,00	11,94	2,56
Intrinsic Motivation	169	6,00	20,00	15,83	3,25
General Chemistry Course Academic Performance	169	17,00	98,00	56,45	18,78

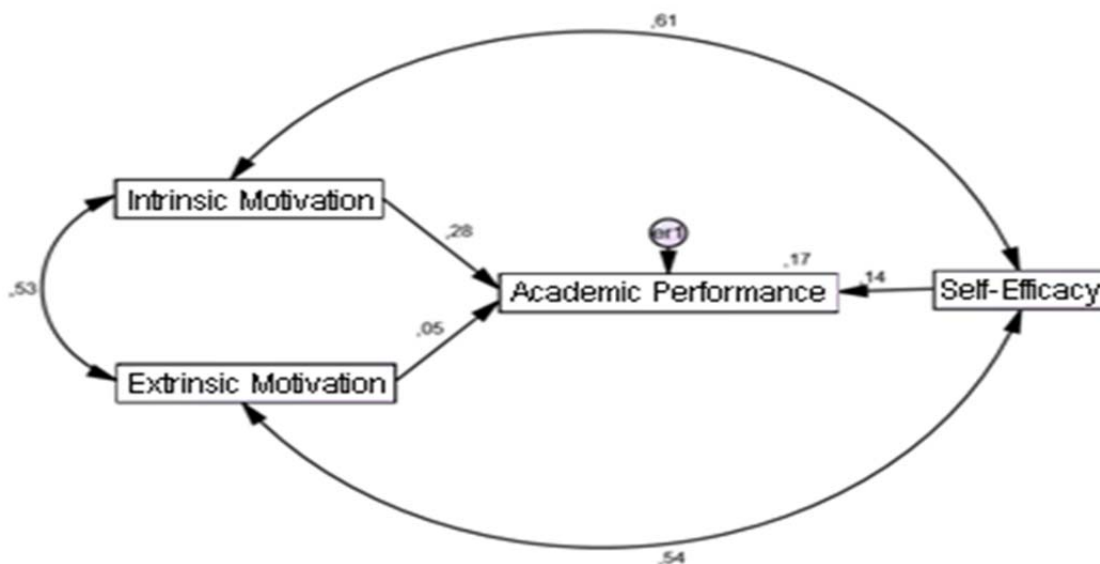


Figure 2. The results of the calculated initial model regarding the relationship between self-efficacy, extrinsic motivation, intrinsic motivation and academic performance.

variable on the dependent variable through intervening variable or variables (Hoyle, 1995). Model specification, data collection, model estimation, model evaluation, and model modification are usually the steps through which a SEM analysis goes (Lei and Wu, 2007). The process consists of stages as the determination of the model, the collection of the data, the evaluation of the coherence, and interpretation (Hoyle, 1995; Weston and Gore, 2006). It can be said that SEM is a challenging process where model estimations may not be successful or the results may not be in the targeted way (Lei and Wu, 2007). As a whole, SEM model is somewhat focused on handling the variables within any models to be tested.

RESULTS

The findings and results obtained through this research were presented and discussed in this part. In Table 1, Descriptive Statistics regarding research variable was presented.

Table 1 shows that while minimum value for self-efficacy is 4.00, maximum value is 15.00 and mean is 11.64; minimum value for Extrinsic Motivation is 3.00 whereas maximum value is 15.00 and mean is 11.94; minimum value for Intrinsic Motivation is 6.00 whereas maximum value is 20.00 and mean is 15.83. Finally,

while minimum value for General Chemistry Course Academic Performance is 17.00 whereas maximum value is 98.00 and mean is 56.45. The results of the calculated initial model regarding the relationship between Self-Efficacy, Extrinsic Motivation, Intrinsic Motivation and academic performance are shown In Figure 2.

Table 2 indicates that CMIN/DF=.00; R-CFI=1.00; RNNFI=1.00; RMSEA=.42; and, RFI=1.00. The 22-item scale was tested and it reveals that the overall model does not fit the statistics within the generally accepted thresholds and does not suggest an acceptable goodness-of-fit described by Hu and Bentler (1999). They suggested that the χ^2 statistic should be non-significant, and RMSEA be lower than 0.06 for any analyses involving factor or path estimates.

In the model, it can be seen that the level of extrinsic motivation on the prediction of academic achievement in General Chemistry course was .06 and this was not statistically significant. In this respect, the row that shows the link between extrinsic motivation and academic achievement was crossed out and as a whole the model was recalculated. The recalculated new model and its figures are shown in Figure 3.



Figure 3. The recalculated final model.

Table 2. The results of fit index for initial model.

	CMIN/DF	R-CFI	RNNFI	RMSEA	RFI
MODEL	.00	1.00	1.00	.42	1.00

Table 3. The fit index results in the recalculated final model.

	CMIN/DF	R-CFI	RNNFI	RMSEA	RFI
MODEL	.34	.99	.99	.02	.98

As can be seen in Table 3, the current complete model clearly presents an adequate fit with a CMIN/DF of .34 ($p > .05$). In addition, R-CFI is $.98 > .90$; RNNFI is $.97 > .90$; RMSEA is $.02 < .08$, and RFI is $.98 > .90$. These values indicate good fit in order to test the model. When the results of the scale are evaluated in general, it can be accepted as a good model.

As presented in Table 4, the level of intrinsic motivation in the prediction of academic achievement in General Chemistry course is .29 and this is statistically significant at the level of $p = .01$. In the same way, it also shows that the level of self-efficacy in the prediction of academic achievement in General Chemistry course is .16 and this is statistically significant at the level of $p = .01$ as well; also, Table 4 demonstrates, as a whole, that intrinsic motivation and self-efficacy are significant predictors of academic achievement.

As shown in Table 5, the correlation coefficient between intrinsic motivation and self-efficacy is .61; the correlation coefficient between extrinsic motivation and

intrinsic motivation is .52; the correlation coefficient between extrinsic motivation self-efficacy is .54. It reveals that all these figures are statistically significant at the level of $p = .01$. In Table 5, as can be seen, there is a significant difference between self-efficacy and intrinsic motivation; between intrinsic motivation and extrinsic motivation; and, between self-efficacy and extrinsic motivation.

DISCUSSION AND CONCLUSION

This research was carried out to verify the relationship between the predictive and explanatory model and university students' self-efficacy, extrinsic motivation, intrinsic motivation and academic performance towards General Chemistry course. As a result, a number of results were obtained.

First of all, it was tested with *through Structural Equation Model (SEM)*. In the first tested model, as can be seen in Figure 2, the degree of the predictive relationship is low and it is not significant in terms of extrinsic motivation. As a result of this finding, this row was crossed out. After crossing out the row that shows predictive relationship between extrinsic motivation and academic performance in General Chemistry course, the model was verified (Figure 3).

In this respect, it can be concluded that intrinsic motivation and perception of self-efficacy are the predictive variables in General Chemistry course academic achievement. On the other hand, it was found that it was not statistically predictive. This result is consistent with the findings that Lepper et al. (1973) and Areepattamannil et al. (2011) obtained in their studies. They state that extrinsic motivation has less influence on

Table 4. Regression loads, standard error, critical ratio, P values of the variables in the model.

		Estimate	S.E.	C.R.	P
Academic Performance <---	Intrinsic Motivation	.29	.51	3.27	.00
Academic Performance <---	Self-Efficacy	.16	.75	1.85	.04

Table 5. The correlation between intrinsic motivation, self-efficacy and extrinsic motivation.

		Estimate	P
Intrinsic Motivation <-->	Self-Efficacy	.61	.00
Extrinsic Motivation <-->	Intrinsic Motivation	.52	.00
Extrinsic Motivation <-->	Self-Efficacy	.54	.00

learners than intrinsic motivation. In addition, Ryan and Deci (2000) support this idea and mention that extrinsic motivation undermines intrinsic motivation and thus decreases academic motivation. Setting performance goals for academic achievement and performance is a constant fact suggested by a number of research (Church et al., 2001; Senko and Harackiewicz, 2005).

Also, a considerable amount of research suggests that internal factors have a greater and more direct impact on academic achievement or failure than external factors (Brown et al., 2001; Wigfield, 1994). Research has shown that students having intrinsic motivation are more likely to pursue their studies when faced with an academic challenge (Vallerand and Bissonnette 1992). They have a stronger academic self-concept (Cokley et al., 2001), show their creativity more (Moneta and Siu, 2002). It is claimed that they volunteer for tasks (Johnson et al., 1998), and finally they produce higher academic performance (Deci and Ryan, 1985; Goldberg and Cornell, 1998; Mitchell, 1992; Gottfried, 1985; Vallerand et al., 1993). Wang and Guthrie (2004) found out in a study they carried out that encouragement and raising the students' confidence in confronting challenges will help them become better readers.

Similarly, Mcgeown et al. (2012) found that there was no positive correlation between extrinsic motivation and students' reading skills. In contrast, they claim that there was a positive correlation between reading skills and intrinsic motivation.

On the other hand, Saribaş and Bayram (2009) found out in their study that there was no significant difference between experimental and control group of pre-service science teachers towards their attitudes and motivation levels.

What is more, with respect to General Chemistry course, it was found that there is a strong correlation among perception of self-efficacy, intrinsic motivation and extrinsic motivation. This finding supports the results of the modified final model here (Figure 3). In a study done

by Chowdhury and Shahabuddin (2007), it was found out that students with high academic performance also had high self-efficacy; and, had both extrinsic and intrinsic motivation at the same time. All in all, Lepper et al. (2005) found out that low and high levels of extrinsic or intrinsic motivation can vary according to grades and ages. The recommendations reached in this study are:

1. Intrinsic motivation has influence on students' academic performances. Therefore, lecturers should plan activities that stimulate their intrinsic motivation.
2. As intrinsic motivation has influence on students' academic performances, curriculum designers should provide activities and material to stimulate the students.
3. Extrinsic motivation does not have effect on students' academic performance. One of the reasons of it can be the teachers themselves. For this reason, teachers should be reminded how to motivate them extrinsically.
4. Teachers should support students' self-efficacy by giving them responsibilities in different group or individual activities.

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