Effect of discussion activities and interactions with faculty to mediate self-directed learning capability on learning outcomes of college students

Eunjoo Kim
Eulji University, Korea

Abstract

The purpose of this study is to validate the structural relationship among discussion activities, interactions with faculty, self-directed learning, and learning outcomes of college students. Data were collected through the National Assessment of Student Engagement in Learning (NASEL). NASEL was developed as part of the implementation of the 'university teaching-learning quality improvement strategy study' as a part of the 5-year (2013-2017) plan of the Korean Educational Development Institute. This study uses data from the author's home institution from a national 2013 survey on the teaching-learning process of Korean college students, in which 28,095 students in 47 four-year colleges participated. The sample consists of 336 survey respondents. Statistical analysis demonstrated that interactions with faculty and self-directed learning capability directly affect learning outcomes. However, discussion activities do not have a significant impact on the learning outcome unless self-directed learning capability is used as the parameter. Similarly, interactions with faculty have an indirect impact on learning outcome using self-directed learning capability as the parameter.

Introduction

Universities are experiencing rapid changes both internally and externally. The number of high school graduates has decreased annually; in 2010, 11% of the total 191 universities in Korea could not fill 70% of their quota, while from 2015, the university quota will surpass the number of high school graduates. Accordingly, internal efforts are required by universities to enhance the learning capabilities of their students. Intangible qualities, such as self-confidence and learning ability, are required in the society and thus should be particularly fostered in the students.

As an important factor to enhance the learning capabilities of students, research on the role of the faculty has been actively performed. Better learning outcomes occur when continuous trust was developed through interactions with faculty (P. S. Yang & Choi, 2009). Pascarella and Terenzini (1991) and Astin (1993) found that a student's experiences in college has a larger impact to their growth during college than their personal background or the college a student attends. They also expanded the scope of their research to the importance of the interactions between faculty and students regarding their courses. Faculty, as a transmitter of education, affect the results of the learner through the fulfillment of a promise, dependence, honesty, ability, and favorability, and the level of mutual trust between students and faculty. The same result was derived in studies on the trust in teacher and learning outcomes for primary and middle schools (Birch & Ladd, 1997; S. J. Lee & Han, 2004; Pape & Wang, 2003). Interaction with faculty, which is the focus of teaching and learning, not only raises the effectiveness of education, but also is very important because it meets the social psychological needs of a human being, getting recognition in the school society as well as experiencing self-conception or self-realization.

The faculty-student interaction should include not only course work but also informal interactions, such as discussion and dialog. Astin (1993) found that student development and satisfaction increases when faculty and students have more frequent contact. Kuh (1995) found that the relationship with faculty is related to student development in the five areas of personal relations, cognitive complexity, academic skill, practical competitiveness and philanthropy. Erwin and Delworth (1982) asserted that the academic and personal relationship environment of universities affect the identity and confidence of students. In addition, university is a place for faculty and students to work together within the academic boundaries to prepare students to become members of society (E. H. Chung & Park, 2009).

Faculty-student relationships that focus on teaching-learning activities are important not only because they enhance the learning outcome, but also because they satisfy the social and psychological needs of a person experiencing self-conception or self-realization as they gain recognition while living at school (S. W. Park, 2000). However, in the current higher education environment, where large lectures are increasing and research activity is gaining in importance for faculty evaluations, interactions between faculty and students can easily be neglected. Therefore it

becomes necessary to examine the effect of self-directed learning on faculty-student interactions.

Discussion activities are suggested as an effective teaching method to find out how learners accept the learning outcome as defined by experts and to achieve the learning outcome that students recognize as important (J. S. Kim, 2008). While the majority of classes may be teacher-oriented, with the delivery of material and learning by rote, discussion-based classes can improve the quality of learning outcomes by enlisting students to own their learning as they adopt a position on a specific theme and select, organize, and present various evidence to defend their position.

Most of the research on learning outcomes is simply focused on finding out the one dimensional influence of variables affecting the learning outcome of students. For example, research on learning outcomes and: satisfaction of study (S. B. Choi & Lim, 2012), self-directed learning preparedness (S. O. Park, 2015), self-efficacy (S. Y. Park, Nam, & Lim, 2012), psychological traits (S. Y. Kim, 2014) and family background (Chang, 2014). However, these studies neglected to identify the structural relationship between various predictor variables that affect learning outcomes. There is a particular paucity of studies that analyze the relationship and effect of the variables of interactions with faculty, self-directed learning and discussion activities with learning outcomes of students directly and/or indirectly.

Therefore, the objective of this study is to analyze the relationship between predictor variables that affect the learning outcome through a structural causal relationship. For this, we used the predictor variables of discussion activities, interactions with faculty, and self-directed learning capability as affecting students' learning outcomes, and we examined which variables show direct or indirect effects. Accordingly, our hypothesis is "Discussion activities and interactions with faculty affect learning outcomes directly and indirectly through self-directed learning capability." The identification of the relationship between the factors that can improve the learning outcomes of students may raise the quality of higher education and increase the competitiveness of university education. For this, we posed two research questions: (1) What is the relationship between discussion activities, interactions with faculty and self-directed learning capability, which are all related with learning outcomes of college students? (2) What are the direct and indirect effects of discussion activities and interactions with faculty on the learning outcomes, based on the self-directed learning capability of college students?

Literature review

Interactions with faculty, self-directed learning, and learning outcomes

Higher education learning outcomes have been reported to be affected by input variables such as intellectual, emotional, and family environmental variables of a student. The intellectual and emotional variables such as self-conception, self-efficacy, or learning motive have a positive correlation with scholastic achievement (H. S. Kim, 2004). Learning outcomes means a variety of outcomes wholly obtained as the results of educational activities, with the ability and competence of a student as its contents (J. Y. Choi & Rhee, 2009; Ewell, 2007). Learning outcomes of university students depend greatly on individual factors, such as motive or sense of purpose, will, and awareness of learning and knowledge, while the contents of the outcome are still difficult to standardize or manage as outcomes since there is a wide variety (Altbach, Berdahl, & Gumport, 1999; Hartley & Bendixen, 2001; Pascarella & Terenzini, 1991).

Müller (2008) conducted a qualitative study on the effect of interactions with faculty to learners' continuous learning through self-directed learning, and examined reasons for continuous learning by the undergraduate and graduate students who registered for on-line degree courses supplied by universities in the northeastern part of the United States. The 20 participants said that when they are satisfied with the teaching ability of faculty and feel like they have sufficient interactions with faculty, they take relevant classes and use self-directed learning ability even after the class. Thus, interactions with faculty affects not only the learning outcomes but also self-directed learning ability. H. J. Lee's (2000) research showed that, in interactions between teachers and students, structured appropriate assistance by the teacher can bring out the cognitive development and improvement in students' problem solving capabilities.

Interactions with teachers in the early stage of problem solving particularly affects the successful participation of learners in later learning activities and self-directed accomplishment. Zimmerman (1989) asserted that, in self-directed learning, a learner can use a specific process, procedure, or reaction to increase his or her own learning, and understand, through self-feedback, how and why this works. Education is the activity to pursue educational values through interaction of people who teach and learn. Education is the premise consisting of a relationship of trust and love. It is also the teaching and learning activities taking into account the individual's aptitudes, characteristics, levels, etc. to help reach a higher level (S. G. Baek, 2000), therefore the relationship between faculty and students is very important in university education.

S. W. Choi (2001), in a study of the relationship between types of teacher-student interactions and learning outcomes, suggested three types of interactions: accepting interaction and being recognized, controlled interaction, and affective interaction. He reported that teacher-student interactions are particularly relevant to learning outcomes and the nature of teacher. Also, G. S. Kim (2002) reported that teacher-student interactions are highly relevant to students' academic self conception and learning attitudes, while studies of middle-high school students (S. S. Baek, 2003;

Bang, 2002) reported that learning outcomes and attitudes are related to interactions between teachers and students. The research so far on teacher-student interactions has mostly dealt with primary and middle-high school students; there has been no active research on undergraduates. Accordingly, it is meaningful to discern the relationship between interactions with faculty and self-directed learning abilities and learning outcomes of university students.

The relationship between discussion, self-directed learning, and learning outcomes

Discussion is a specific form of collective interaction to expedite knowledge or understanding, evaluation or judgment and to arrive at a decision, resolution or action on the issues under discussion. Participants exchange or review different arguments, raise questions, and obtain answers on common matters of interest. In other words, the goal of discussion is not to reach an acceptable answer; rather, it is so that learners participate positively to discuss a matter that either does not have a correct answer or may have many correct answers (Dillon, 1994). Through discussion, students have opportunities to organize their own ideas and hear those of their friends. In doing so, they can refine their own assertions while refining the evidence they use to support their arguments (Solomon, 1991).

Discussion activities have the potential to overcome multiple problems: a cultural climate that shuns presentations in the classroom; students who are not trained to speak aloud; environments that do not prioritize structured learning; cultural expectations to conform to existing lectures, and so on. By motivating students to know more and think deeply about a topic, discussion sparks students' interests, thus allowing them to participate in a self-directed way. Also, since discussion requires peer interactions, cooperative learning with one's group helps an individual feel less burdened by educational demands while also leading them to appreciate more on a given topic and comprehend new and difficult problems (J. H. Kim, 2007).

When discussion activities occur on a large scale, between many people, students are prompted more readily to self-direct their participation, thereby expanding their opportunity to express themselves freely, without being burdened by the social and psychological stress of being a learner (J. H. Lee, 2002). In particular, web-based discussions typically require learners to be self directed, since it requires active interaction and positive participation of the learning group member (Hogan, 1997; Romiszowski & Mason, 1996). Some studies have reported that one's self-directed learning ability is not fixed, but can be improved by changes in teaching and learning, including teaching design (Ahn, 1999; C. W. Park, 1998), while Y. H. Chung (2000) identified that self-directed learning of an individual is a significant factor affecting interaction and satisfaction in discussion learning. Like this, discussion has been known as the main factor in predicting learning outcome as well as self-directed learning ability of a learner. Chung, Lee, Seo, and Park (1998) also reported that

discussion can be used as a pedagogical method to let students discover by themselves a desired learning outcome, through opposing oral arguments presented by other students on a specific topic.

As shown above, discussion is a key predictor of learning outcomes as well as self-directed learning ability, as long as it occurs in a class atmosphere where discussion is freely allowed. For this, the teacher's role is important. M. C. Park (2002) asserted that discussion is in contrast to the one-directional nature of teaching that takes the form of a question and answer dialog between teachers and learners. It is thus a highly appropriate and necessary learning method in higher education, which also is pertinent to students' relationships with faculty.

Self-directed learning ability and learning outcomes

Self-directed learning means diagnosing one's own learning desire and, based on that, setting learning objectives; identifying human and material resources; and studying while selecting and implementing an appropriate learning strategy, maintaining individual control of one's own independent learning, even evaluating the results of one's learning efforts (M. H. Yang, 2000). In other words, it means that one selects books and lectures after setting objectives for oneself without assistance, while applying one's own way of learning and even checking whether one has studied properly. Self-directedness encompasses the process where learners activate and maintain their own perceptions, behaviors, and emotions systematically to achieve their learning objectives. When effective improvement of learning outcomes is made by applying the self-directed process to learning, it is called self-learning (A. Y. Kim, Joo, & Joeng, 2005). Although self-directedness is a skill the importance of which extends beyond just the educational sphere, the ability to engage in self-learning should be nourished through other ways. In a subject where the amount of information is increasing at a tremendous speed and assignment load is high, sometimes the learning outcome cannot be shown, even if one uses one's ability to engage in self-directed learning.

Studies are increasing of self-directed learning capability among characteristics that are focused more on the student as an individual as the factor affecting learning outcomes. Among the results of previous studies asserting that self-directed learning capability has an effect on learning outcomes, Zimmerman and Martinez-Pons (1988) explain that the sub-elements of self-directed learning capability have a meaningful relationship with learning outcomes. Pintrich and De Groot (1990) also demonstrated that self-directed learning capability and learning outcomes have a meaningful positive relationship, regardless of types of task. Morris, Wu, and Finnegan (2005) noted that self-directed learning capability can predict learning outcomes. The term 'self-directed learning capability' became commonly known from the motto of the 7th curriculum, and is gathering attention continuously. Nevertheless, the excessive expansion of the private education market and students' attitudes toward dependent

study, which is the opposite of self-directed learning, are still evident. Moreover, the complicated entrance examination policy is eliciting various types of private education, and a huge industry sector is forming where even large corporations are intervening. Indeed, we have reached an age of learning where self-directedness is lost; regretfully, self-directed learning is now becoming the inevitable trend.

Method

Data

This study used data collected through the National Assessment of Student Engagement in Learning (NASEL), which was developed during the implementation of the 'university teaching-learning quality improvement strategy investigation study.' This was a part of the 5 year (2013-2017) plan of the Korean Educational Development Institute. The data in the 'survey on the teaching-learning process of Korean college students in 2013' came from 28,095 students in 47 four-year colleges in the first year. For the purposes of this study, we only used the data from the author's institution, due to the limitation of information disclosure of another university,

Sampling was done by volunteer sampling; data collection was done by an on-line survey. Using the institutional survey software, we generated a URL and shared it with students while encouraging them to participate. The university where this study was conducted is located in Gyeonggi Province with 5,000 students in total. A total of 337 students participated in the survey, and total of 336 survey responses were usable. General characteristics of the objects of the research are shown in Table 1.

Table 1. General characteristics of research participants (N = 336)

Variable	Group	Frequency (n)	Percent (%)
Sex	Male	115	34.2
	Female	221	65.8
Colleges	Humanities	16	7.5
	Social sciences	117	34.8
	Engineering	97	28.9
	Medicine	34	10.1
	Arts	72	21.4

Participants

The majority of participants were female (184; 74.5%). Just over one third of participants were in the social sciences (117; 34.8%), with a little fewer in engineering (97; 28.9%). Art and physical education provided 72 students (21.4%), medical field 34 students (10.1%), and humanities 16 students (7.5%).

Measures

The NASEL, from which we used data, examined the quality of university education from all angles. It encompasses a broad spectrum up university-related activities, covering the inputs, progress and outcomes of university education. It represents both faculty and students, and even includes administrative support systems.

In this study, learning outcomes were the dependent variable, while discussion activities, interactions with faculty and self-directed learning capability were predictor variables that affect learning outcomes. We analyzed their influence on learning outcomes. Table 2 presents analysis object variables and survey items.

Table 2. Variables and survey items

Variable	Measuring items	Scale
Discussion activities (Cronbach α= .911)	1. I had in-depth discussions with friends whose values and worldviews are different from mine.	1 = Almost never 2 = Sometimes 3 = Often 4 = Very often
	2. I had in-depth discussions with friends whose political views are different from mine.	
	3. I had in-depth discussions with friends whose religious beliefs are different from mine.	
Interactions with faculty (Cronbach α= .846)	1. I have discussed course registration with faculty.	1 = Almost never 2 = Sometimes 3 = Often 4 = Very often
	2. I have discussed course content and assignments with faculty.	
	3. I have discussed tests and grades with faculty.	
	4. I have discussed my career with faculty.	
	5. I have interacted with faculty on matters other than courses or career. (MT (Membership Training), dining, drinking, hobby, etc.)	

Variable	Measuring items	Scale
Self directed learning capability (Cronbach α= .846)	1. I have exchanged help with classmates for projects. (presentation by team, etc.)	1 = Very dissatisfied 2 = dissatisfied 3 = Satisfied 4 = Very satisfied
	2. I have exchanged help with students who are not in the same class for projects (presentation by team, etc.).	
	3. I have tried to connect the ideas and concepts gained in other classes when doing homework or class discussions.	
	4. I have tried to think about connecting ideas, experiences and information, and so on, comprehensively.	
	5. I have tried to look for solutions or alternatives to the problem.	
	6. I have applied the concepts learned in class to everyday life.	
	7. When studying a textbook or class related materials, I have reviewed the information quality, data quality and usability, and logical conformity with a critical eye.	
	8. I have talked with fellow students, friends, family, and other people about the content learned in class.	
	9. I have found a solution to a problem, and explained it to others.	
	10. I engage in study activities related classes.	
	11. I study interest areas other than course work and learning community activities.	
	12. I engage in study activities related to my job and career.	
Learning outcomes (Cronbach α= .943)	1. Humanistic attainments	1 = No change 2 = Little improvement 3 = Some improvement 4 = Greatly improved
	2. Knowledge and skills related to class or job	
	3. Knowledge and skills related to major field	
	4. Clear and effective writing	
	5. Clear and effective speaking	
	6. Critical and analytical thinking	
	7. Creativity development	
	8. Understanding and analysis of quantitative data (statistics)	

Variable	Measuring items	Scale
	9. Use of computing and information technology and software	
	10. Teamwork and cooperation with others	
	11. Self-directed learning skills	
	12. Comprehension about yourself	
	13. Comprehension about multiculturalism	
	14. Problem-solving ability	
	15. Values and ethics	
	16. Sense of community	
	17. Stress management ability	
	18. Effective time management ability	
	19. Foreign language ability	

The survey items pertaining to learning outcomes of college students consist of 19 items in the sub-domains of the NASEL, with Cronbach's α of .943. Learning outcomes are composed of: cognitive accomplishments, such as cognitive attainments, knowledge in major field, critical and analytical thinking, effective writing and speaking, and statistical analysis; sociality or interpersonal relation capability, such as teamwork or cooperation with others, comprehension of multi-cultural situations, view of value and ethical belief, and community spirit; and self-improvement capability, such as self-directed learning capability, self-understanding, and stress and time management. Since the measurement of learning outcomes covers not only the knowledge of major fields but also a variety of outcomes that can be demonstrated through university education activities, there should not be any problem in content validation.

In this study, learning outcomes were not obtained from students' school records, such as using university grade points. Rather, it was measured in the non-cognitive domain in the form of self-report, because we used the concept of learning outcomes suggested by NASEL, which reflects the learning resulting from a university education, or specifically, content knowledge in one's major field and liberal arts in general. The 19 questions to measure learning outcomes cover: oral and written communication, creative thinking, and knowledge in one's major field (G. J. Lee & Lee, 2015). Therefore, the learning outcomes come from all activities experienced at university, and the learning outcomes of all students in a college were measured on the same basis.

Among the independent variables, which predict learning outcomes, there were five items for interactions with faculty with a Cronbach's α of .846. Interactions with faculty are represented by discussions with faculty about course registration, course work and tasks, examination and grade, and career. There were survey items for

discussion activities, with Cronbach's α of .911. They covered serious discussions with a friend who holds a different world view, political view, and religious conviction. There were 12 items for self-directed learning capability, with Cronbach's α of .846. They examined whether: assistance is exchanged with classmates for tasks; students engage in concept linking, synthesis, alternative searches, and application to enhance thinking power; one explains the communications and solutions regarding course content to other students; and whether students perform study activities other than those that are course related for their job searches or career exploration.

In addition, since we used path analysis in solving this study, item parceling was used for the factors of learning outcomes, discussion activities, interaction with faculty, and self-directed learning capability. Item parceling combines several items, so creates a higher possibility of forming a normal distribution through an enlarged range of index points. This makes the index more reliable. It also reduces the estimation error due to the reduced number of estimated parameters, compared to using individual items (Kishton & Widaman, 1994; Landis, Beal, & Tesluk, 2000).

Data analysis

We used PASW Statistics 18.0 (IBM, Armonk, NY) and AMOS 18.0 (SPSS Inc, Chicago, IL) for statistical analysis. We calculated Cronbach's α for item internal consistency of the survey instrument, descriptive statistics of the survey parameters, and a correlation analysis to examine the relationship between the survey variables. In addition, we identified multicollinearity, meaning high relatedness between the independent variables of this research. Multicollinearity can be investigated generally using tolerance, variance inflation factor (VIF), and correlation coefficients (Cha & Cha, 2013).

Finally, to estimate the direct and indirect effects of the three variables of discussion activities, interactions with faculty and self-directed learning capability, we conducted a path analysis. For parameter estimation, we used maximum likelihood estimation (ML).

Results

Descriptive statistics

Table 3 shows the averages and standard deviations of discussion activities, interactions with faculty, self-directed learning capability, and learning outcomes. In this study, we supplement the question of external validity by identifying the normality of data through review of discussion activities, interactions with faculty, average learning outcomes of students, standard deviation, skewness, and kurtosis.

Table 3. Descriptive statistics of survey variables (N = 336)

Observed variables	Skewness	Kurtosis	Min	Max	Mean	SD
Discussion activities	1.23	1.01	1	4	1.59	.771
Interactions with faculty	1.12	1.07	1	4	1.67	.769
Self-directed learning capability	.39	-.29	1	4	2.21	.846
Learning outcomes	.27	-.46	1	4	2.21	.815

For the predictor variables among survey variables, the average (standard deviation) of discussion activities is 1.59 (.771), the average (standard deviation) of faculty-student interactions is 1.67 (.769) and the average (standard deviation) of self-directed learning capability is 2.21 (.846). The average (standard deviation) of learning outcomes, which is the dependent variable, is 2.21 (.815). Skewness ranged from a minimum of .27 to a maximum of 1.23, and kurtosis ranged from a minimum of -.46 to a maximum of 1.07. When skewness of major variables is less than 2 and kurtosis is less than 7, data can be considered normally distributed (Curran, West, & Finch, 1996).

Correlations

To discern the relationship between the variables that are related to learning outcomes, we analyzed the correlation between and the dependent variable of learning outcomes and the predictor variables of discussion activities, interactions with faculty and self-directed learning capability. The correlation coefficient was significant at .001, as shown in Table 4.

Table 4. Correlation coefficient matrix between the variables related to learning outcomes of students (N = 336)

	Discussion activities	Interactions with faculty	Self-directed learning capability
Interactions with faculty	.441***	1	
Self-directed learning capability	.471***	.543***	1
Learning outcomes	.340***	.522***	.557***

*** p < .001, two-tailed.

Learning outcomes are positively correlated with discussion activities (r = .340, p = .000), interactions with faculty (r = .522, p = .000), and self-directed learning (r = .340, p = .000). In addition, upon checking for multicollinearity of the data, there

is no variable for which the correlation coefficient between the variables is higher than 0.9, confirming that there is no problem in multicollinearity. Therefore, learning outcomes positive correlate with discussion activities, interactions with faculty and self-directed learning capability.

Direct and indirect effects

We constructed the model to analyze the direct and indirect effects of discussion activities, interactions with faculty, and self-directed learning capability of college students to learning outcomes based on findings in the literature. We assumed that discussion activities, interactions with faculty, and self-directed learning capability will directly affect the learning outcomes. Also, we assumed that discussion activities, interactions with faculty, and self-directed learning capability will indirectly affect the learning outcomes using self-directed learning capability as a parameter. Figure 1 shows the model, and Tables 5 and 6 provide the model fitness and path coefficient.
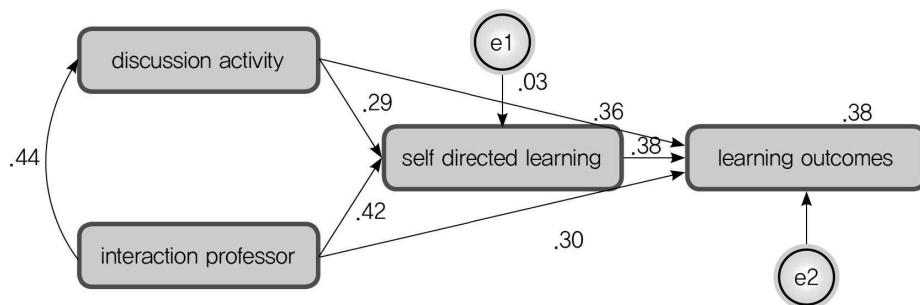

Figure 1. Research model for the relationships between discussion activities, interactions with faculty, self-directed learning capability, and learning outcomes.

Table 5. Fitness of model

	x^2 (p)	df	RMSEA	CFI	NFI
Model	3.44(.000)	2	.433	.91	.91
Acceptance criteria	$p > .05$		< .05	.9 <	.9 <

Table 6. Estimated values of path coefficients in the model

Model path			Estimate	b	S.E.	C.R	p
Self-directed learning capability	←	Discussion activities	.946	.28	.160	5.90***	.000
Self-directed learning capability	←	Interactions with faculty	.927	.41	.108	8.55***	.000
Learning outcomes	←	Interactions with faculty	1.109	.30	.193	5.73***	.000
Learning outcomes	←	Self-directed learning capability	.623	.38	.088	7.05***	.000
Learning outcomes	←	Discussion activities	.147	.02	.272	.539	.590

*** $p < .001$, two-tailed.

The exact fit index for our model is not satisfactory, assuming the null hypothesis that the model is fit when the x^2 value is at the significance level of .05 (x^2 = 3.44, p = .000). The RMSEA, which is the close fitness index, is .433, meaning that it does not accommodate the null hypothesis that the model does not match the data. Therefore, the model cannot be considered satisfactory. However, CFI and NFI, which are relative fitness indices, are all satisfactory. Accordingly, the model was partly modified by reflecting the above theories, with the modified model shown in Figure 2. Research model modifying is the process of finding the model closest to the data by theoretically judging and modifying it to obtain a model suitable to empirical data while theoretically simple. Methods of model modification include: adding a free particular number while keeping the theoretical variables of the foundation model; fixing a free particular number while keeping the basic theoretical variables; adding or deleting theoretical variables; and the Wald verification method (Y. M. Kim, 2011).
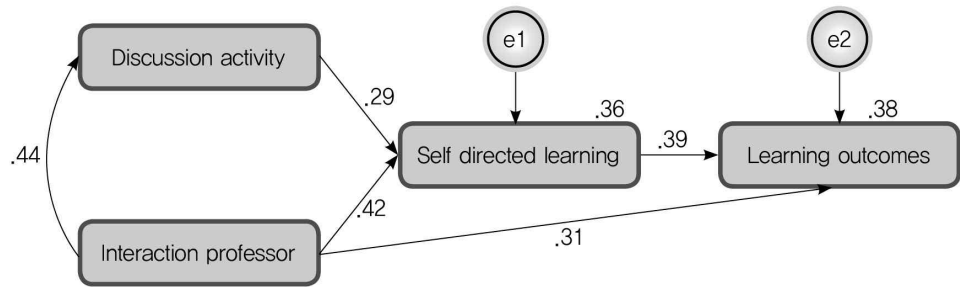

Figure 2. Modified model for the relationships between discussion activities, interactions with faculty, self-directed learning capability, and learning outcomes (standardized path coefficient)

After conducting a regression analysis to modify the model and having calculated the path estimation number, it turned out to be higher at the level of significance of .05, and accordingly we used the theoretical variable deletion method to delete the paths that were not significant. Table 6 shows the estimated value of the path coefficient in the model.

As shown in Table 6, we calculated estimated values of path coefficients to verify the effectiveness of the path set in the model. Table 6 shows that, excluding the path of discussion activities to learning outcomes, interactions with faculty and self-directed learning capability turned out to meaningful to learning outcomes. Here, the fact that the effect of discussion activities on learning outcome is insignificant shows that discussion activities themself does not affect learning outcomes directly, but influences class attitude, thus indirectly affecting learning outcomes. Although it is difficult to find any similar results to this study, this result shows that learning outcomes can be affected by the mediated effect of self-directed learning or affected by the interrelationship between faculty and students.

Looking now at the relative worth parameters, the worth parameter of self-directed learning capability to learning outcomes (b = .38) was higher than that of interactions with faculty to learning outcomes (b = .30). In other words, interactions with faculty and self-directed learning capability were meaningful relative predictors to learning outcomes, and the influence of self-directed learning capability to learning outcomes turned out to be bigger than the influence of interactions with faculty. The worth parameter of interactions with faculty to self-directed learning capability (b = .41) was higher than that of discussion activities to learning outcomes (b = .28). In other words, discussion activities and interactions with faculty were meaningful relative predictor parameters to self-directed learning capability, and the influence of interactions with faculty to self-directed learning capability turned out to be bigger than the influence of discussion activities to self-directed learning capability.

Based on the above result, the insignificant path of discussion activities→learning outcomes was deleted and the research model was modified, and then the path analysis was repeated. The most appropriate model is shown in Figure 2 (standardized path coefficient). In Figure 2, the path coefficients between each variable can be identified, and show the direct and indirect effects between variables. Table 7 shows the fitness data for this model, and Table 8 shows the path coefficients of the modified model.

Table 7. Fitness of modified model

	x^2 (p)	df	RMSEA	CFI	NFI
Modified model	.291(.590)	1	.000	.99	.99
Acceptance criteria	p > .05		< .05	.9 <	.9 <

Table 7 shows a x^2 of .291, and significance probability of .590. These data accommodate the null hypothesis where model and data are identical at the significance level of .05, and RMSEA, which is the close fitness index, is .00, also meaning that it accommodates the null hypothesis. Therefore, the modified model can be judged as satisfactory. Relative fit indices, CFI and NFI, are used to evaluate how well a theoretical model can explain the data compared to an independent model.

Table 8. Estimated values of path coefficients for the modified model

Modified Model Path		Estimate	β	S.E.	C.R	p
Self-directed learning capability	← Discussion activities	.946	.28	.160	5.90***	.000
Self-directed learning capability	← Interactions with faculty	.927	.41	.108	8.55***	.000
Learning outcomes	← Interactions with faculty	1.135	.31	.187	6.063***	.000
Learning outcomes	← Self-directed learning capability	.637	.38	.084	7.581***	.000

*** $p < .001$, two-tailed.

From the estimated values of path coefficients for the modified model shown in Table 8, interactions with faculty and self-directed learning capability, excluding discussion activities, turned out to be a meaningful predictor variable to learning outcomes. Regarding the relative worth parameters of interactions with faculty and self-directed learning capability to learning outcomes, self-directed learning capability ($b = .39$) was higher than interactions with faculty ($b = .31$). Table 9 shows the effectiveness factor of the modified model to learning outcomes.

Table 9. Effectiveness factor of modified model

		Discussion activities	Interactions with faculty	Self-directed learning capability
Self-directed learning capability	Direct effect	.29	.42	-
	Indirect effect	-	-	-
	Total effect	.29	.42	-
Learning outcomes	Direct effect	-	.31	.39
	Indirect effect	(.29 x .39) = .11	(.42 x .39) = .16	-
	Total effect	.11	.47	.39

The overall effect of discussion activities → self-directed learning capability is .29, and the overall effect of interactions with faculty → self-directed learning capability is .42. The overall effect of discussion activities → learning outcomes is .11. The overall effect of interactions with faculty → learning outcome is .47. The overall effect of self-directed learning capability → learning outcome is .39.

It is thus clear that interactions with faculty and self-directed learning capability directly affect learning outcomes. Also, discussion activities and interactions with faculty have an indirect effect on learning outcomes using self-directed learning capability as their parameter. The overall effect of interactions with faculty on learning outcomes turned out to be relatively bigger than the effects of discussion activities and self-directed learning capability. In addition, the indirect effect of interactions with faculty turned out to be relatively larger than the indirect effect of discussion activities.

Therefore, it can be said that, when interactions with faculty and self-directed learning capability are increased, learning outcomes rise and when discussion activities and interactions with faculty are increased using self-directed learning capability as the parameter, learning outcomes also rise. Although discussion activities are important in raising learning outcomes, increasing interactions with faculty is more effective. And when comparing the effect of discussion activities to the effect of interactions with faculty using self-directed learning capability as the parameter, the indirect effect of interactions with faculty is larger than the indirect effect of discussion activities. Therefore, although raising the effect of discussion activities using self-directed learning capability as the parameter is important, raising the effect of interactions with faculty turned out to be more effective.

Discussion

This study aimed to uncover the direct and indirect effects of discussion activities, interactions with faculty and self-directed learning capability on learning outcomes of college students. We found that interactions with faculty directly affect learning outcomes. Our results support those of a previous effect analysis by Han (2010) on the interactions with faculty on dance ability achievement. Many educationalists considered the faculty-student interactions that influence cognitive and affective developments as one of the important educational experiences related to the learning outcomes of university education (Astin, 1993). We aimed to investigate this empirically. Yu, Ko, and Lim (2011) found in their research on 2,019 Korean university students that the students who have more interactions with faculty tend to have higher comprehensive thinking ability. M. J. Choi (2015) found that the higher the emotional and scholastic interaction with faculty, the higher the learning outcome of music therapy major students. In the effect analysis by J. Y. Choi (2010) on the nature of faculty-student interactions on learning outcomes, when faculty-student

interactions are positive, it improved the learning outcomes in college. School, having an institutional structure, is a social structure where comprehensive interrelation is formed between two to three people or group members. Hence, school allows the formation of human relationships that no other social structure can provide, and interactions in school carry far greater meaning than in any other social organization. The basis for the importance of interactions in school society is that since most of the learning process occurs through interactions, the type of interaction has a big impact on a student's learning. Therefore, to increase the learning outcomes of college student, a faculty-learning support program that increases interactions with faculty should be developed.

We also found that self-directed learning capability directly affects learning outcomes. Our results align with previous studies. Our results align with previous studies (Kwon, 2013; Morris et al., 2005; Pintrich & De Groot, 1990; Zimmerman & Martinez-Pons, 1988). Learning attachment, self-assurance, curiosity and sense of responsibility, all of which are sub-factors of self-directedness, have positive effects on learning outcomes. Y. M. Kim (2011) found that learning activities, learning management, and learning control of self-directed learning in an online university have significant effects on learning outcomes. Y. W. Kim, Park, and Jeon (2013) investigated the effect of self-directedness of adult learners in an online university, finding that it has a positive effect on learning outcomes. These findings all suggest the necessity in a course's instructional design of enabling self-instruction that supports continuous development of one's own capability. For example, courses should be structured to allow students to set objectives, which is the major concept of self-directed learning, and to establish a detailed plan to achieve it, or to perform a task that is important to achieving the plan, etc.

In this study, discussion activities had only an insignificant direct impact on learning outcomes, and indirect impact on learning outcomes when using self-directed learning capability as a parameter. There have been few studies supporting these results thus far, but our results are congruent with research by S. S. Lee (2002) on online discussion activities. Lee found that by participating in online discussion activities, learners also participated actively in the process of their education, yielding higher learning outcomes as a result. Contrary to our findings, Lim and Kim (2013) reported that discussion activities nourish self-directed learning abilities of primary school pupils and allowed them to reach the instructional objectives. Thus, through discussion, students can acquire a deeper understanding of the knowledge to be acquired by structurally connecting their prior personal knowledge to the newly obtained knowledge. This then aids them in developing the ability to search for new knowledge, with the self-efficacy to think for oneself. To promote effective discussion that supports these learning gains, it strategies to stimulate discussion should be developed in a manner that does not allow discussion to degrade into a formatted activity.

Finally, we found that interactions with faculty have an indirect impact on learning outcomes using self-directed learning capability as a parameter. This aligns

with H. Y. Kim's (2000) finding that self-directed learning capability shown during the learning process can bring out a high scholastic achievement. Kim also noted that autonomous self-directed learning is important to scholastic achievement and faculty-student interactions are also important. Hong (2014) investigated the effect of interactions with faculty on immersion in college life for students, finding that when there is high interaction with university members, even without frequent visits, the degree of university immersion of students rises. Hong describes university immersion as a concept similar to satisfaction, a sense of belonging, loyalty, attachment, or organizational identification to university. Hong notes that university immersion can be expected to affect self-directed learning ability and learning outcomes as well. Thus, interactions with faculty can affect university and learning outcomes. In addition, J. Y. Choi and Shin (2010) showed that interactions between students and faculty promotes students' analytical thinking skills. Therefore, it is necessary first to develop a university educational environment that can raise the frequency and quality of faculty-student interactions. This effort should then be followed by an attempt to improve learning outcomes through self-directed learning capability, based on the result that faculty-student interactions have an indirect effect on learning outcome. Nevertheless, students certainly need to develop self-directed learning capabilities, which are related to self-change and growth, to raise learning outcomes.

Conclusion, implications, and limitations

This study provides important information in the quest for measures that can raise learning outcomes of college students. It can also serve as base line data in improving support for faculty-learning relationships, including the learning processes and learning activities of college students in the future. In the long term, we expect our findings to contribute to the effective distribution of human and material resources in universities, as well as to educational policy, to raise learning outcomes of college students. To improve students' self-directed learning ability and learning outcomes, it is necessary to increase faculty members' understanding and use of teaching methods that promote discussion activities and active interactions with faculty. In addition, in this period where knowledge is central to success, it is necessary for faculty, and the university community as a whole, to focus their efforts on the learners' understanding, to let future learners acquire higher learning outcomes.

There are two main practical implications of this study. First, it empirically identified the importance of trust between faculty and students to raise learning outcomes and the self-directed learning ability of students. Therefore, to raise the trust between faculty and students through positive interaction, it is necessary to introduce teaching methods such as blended learning and flipped classrooms, which can increase learner's participation and interaction, rather than the traditional lecture-based classes led by faculty. Second, non-class programs, such as creative

humanities, mentoring, or volunteer activities that can effectively develop an individual's potential could provide alternatives for raising learning outcomes of students, together with programs focused on strengthening capabilities in major fields.

Our study has two main limitations. First, since we used a quantitative approach, there is the possibility of distortion or bias in the relationship between variables, or the existence of other relationships that were not considered. Therefore, a multilateral analysis would be helpful in the future, whereby researchers set various relationships to identify detailed causal relationships between related variables. Second, since the study limited the data to students from a single university, it may not be representative of the general level of learning outcomes of college students throughout the country. Therefore, in future research, the characteristics of the population should be more representative by opening it up to a larger NASEL dataset.

Address for correspondence

Eunjoo Kim
Visiting Faculty
Department of Educational Psychology
Eulji University
SanseongDaero, Sujeong-gu, Seongnam-si
Gyeonggi-do, 13135, Korea.
Email: kej70@eulji.ac.kr

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