How Note-Taking Instruction changes Student's Reflections upon their Learning Activity during a Blended Learning Course

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Abstract: The metrics of self efficacy and self assessment were surveyed and analysed in order to examine the effectiveness of note taking instruction on emotional aspects of participants during a blended learning course. The changes of emotional aspects due to student's individual characteristics were also analysed. Participants were surveyed twice during the course, using the metrics mentioned above, and their emotional and cognitive changes were evaluated. The number of valid participants was 54. Scores of metrics between the two surveys were compared. Though most scores for self-efficacy and self assessment decreased, this suggests that participants recognised their actual learning situation well. The relationship between the metrics and student's characteristics was examined. To illustrate participant's emotional and cognitive changes, causal analysis was introduced. The relationships between scores for self-efficacy and self evaluation in the two surveys were analysed and compared. Also, the impact of improvements in note-taking skills on changes in self-efficacy and self-evaluation were examined using causal analyses. These results show that note-taking activities significantly stimulated the level of self-efficacy and self-assessment when the lecturer's instructions were able to improve note-taking skills factor scores during the course.

Keywords: Note-taking, reflection, self-efficacy, student's characteristics, correlation analysis, causal analysis

1. Introduction

With the growth of various types of learning which use information communication technology (ICT), a wide range of educational styles such as flipped classrooms and active learning have also been developed, using open educational resources (OERs) and social media (Hill, 2012). Though these educational styles are important current topics of study, encouragement of the student's learning activity is still a key issue. This issue is often described as "self-regulated learning" (SRL) (Pintrich, 2004). Learning progress can be evaluated using empirical descriptions such as survey data from student's self reflections.

In addition to this topic, the relationships between student's emotional factors and their learning activity or performance are often studied and discussed (Sierens et al, 2009, Papaioannou et al, 2012). Recently, the effect of participant's emotional factors in the online learning environment has also been discussed (Cascio, Botta and Anzaldi, 2013).

Another conventional learning activity is note taking. Note taking contributes to student's learning activity and their learning achievement (Kiewra, 1989, Nye et al, 1984). As note taking activity affects responses to questions about student's reflections in addition to affecting their learning performance (Nakayama, Mutsuura and Yamamoto, 2016a, 2016b), instructions regarding note taking activity should be given carefully. The relationships between student's emotional factors and their learning performance are illustrated as causal models (Mega, Ronconi and De Beni, 2014, Nakayama, Mutsuura and Yamamoto, 2016b). As mentioned above, note taking instruction as a form of learning support for participants of a course may encourage their responses to questions about self reflection beyond the development of their note taking skills. The progress of the effect of giving instructions on development of note taking skills should be examined in detail.

The purpose of this paper is to examine the progress of participant's development of emotional factors during a blended learning course after note taking instruction has been introduced. The following topics are addressed:
1. Changes in participant's self efficacy and reflection during a blended learning course which includes note taking instructions are measured.
2. The dependencies of the changes in student's characteristics are examined using simple correlation analysis.

3. The transformation of causal relationships between participant's self reflections and how these characteristics affect each other are examined.

2. Method

2.1 Blended learning course

The course "Information System Network", a Bachelor level credit course which consists of 15 weeks of face-to-face sessions, was selected for the survey (Nakayama Mutsuura and Yamamoto, 2016a, 2016b). Since this was a blended learning course, online test assignments were given to participants using a learning management system (LMS). The lecturer asked all participants to take more detailed notes during course sessions and to present their notes for the evaluation. The students were encouraged to improve their note taking activity, and instructions were then given twice during the course, once early in the course and again at the midpoint.

2.2 Student's characteristics

Various characteristics of participants have been analysed by the authors (Nakayama, Mutsuura and Yamamoto, 2016a, 2016b), and these metrics are also surveyed in this experiment. In particular, information literacy and note taking skills are focused on, in order to observe contributions to changes in student's learning.

Student's personalities are measured using a construct of the International Personality Item Pool inventory (IPIP, 2001). The scores of Big 5 personality factors can be calculated such as ``Extroversion'' (IPIP1), ``Agreeableness'' (IPIP2), ``Conscientiousness'' (IPIP3), ``Neuroticism'' (IPIP4) and ``Openness to Experience'' (IPIP5).

Information literacy is measured using a developed inventory (Fujii, 2007), with two factor scores which measure skills (IL-1) and attitudes toward information literacy (IL-2) being calculated. Note-taking skills are also surveyed using a questionnaire developed for the experiment. The skills surveyed consist of the following three factors, NT-F1: Recognising note taking functions, NT-F2: Methodology of utilising notes, and NT-F3: Presentation of notes.

In addition, student's learning experience is measured using questions developed for a previous study. (Nakayama, Mutsuura and Yamamoto, 2016a, 2016b). This evaluation consisted of 10 question items scored using a 5-point Likart scale and three factors: Factor 1 (LE-F1) -Overall evaluation of the e-learning experience, Factor 2 (LE-F2) -Learning habits, and Factor 3 (LE-F3) -Learning strategies (Nakayama, Yamamoto and Santiago, 2007).

2.3 Participant's reflections

To evaluate changes in participant's emotional factors, two kinds of surveys were conducted during the course. The first one is a measure of self efficacy which was developed by Pintrich and Goot (1990) and is frequently used for assessing participant's emotions. The other one consists of participant's self reflections, on topics such as their level of satisfaction. Participant's self directed effort and the self assessment of the degree of their effort are also measured. Self satisfaction and study hours are frequently included in these course assessments (Nakayama, Mutsuura and Yamamoto, 2016b).

3. Results

3.1 Factors of self efficacy

Responses of participants to questionnaires about self efficacy in the two surveys, such as the first mean (Mean-F) and the second mean (Mean-S), are summarised in Table 1. There are significant differences in responses to some question items between the two surveys. Compared with the first survey, all means in the second survey decreased. Participants may be recognising and acting upon their own situation during the course.

Table 1: Question items for evaluating self efficacy and a factor loading matrix of two factors

	Question item	Factor1	Factor2	Mean-F	Mean-S	
3	Compared with other students in this class I expect to do well	**0.81**	0.02	3.19	2.69	**
2	I'm certain I can understand the contents taught in this course	**0.79**	0.08	3.72	3.07	**
8	Compared with other students in this class I think I know a great deal about the subject	**0.70**	-0.09	2.56	2.54	
9	I know that I will be able to learn the material for this class	**0.61**	0.07	3.54	3.24	
1	I expect to do very well in this class	**0.59**	0.23	3.81	3.17	**
5	Compared with others in this class, I think I'm a good student	-0.09	**0.77**	3.17	3.04	
6	I am sure I can do an excellent job on the problems and tasks assigned for this class	0.02	**0.72**	3.56	3.37	
4	I think I'll receive a good grade in this class	0.20	**0.59**	3.24	2.70	**
7	My study skills are excellent compared with others in this class	0.15	**0.44**	2.70	2.63	
Contribution ratio (of each factor with other factors eliminated)		0.18	0.12	Inter factor corr		
Contribution ratio (of each factor with other factors ignored)		0.40	0.34	*r = 0.6*		

To extract latent factors, factor analysis with promax rotation was applied to all responses in the two surveys. As a result, two factors structures were extracted. The factor loading matrix and pattern are different from the initial survey because the initial survey was conducted only once using a smaller cohort (Nakayama et al. 2016b). Though the structure is different, the two factors suggest "self confidence in student's own attitude" (SE-F1) and "self confidence in student's own level of competence" (SE-F2). The two factors correlate with each other, and the inter-factor correlation coefficient (*r*) is 0.60.

In regards to the results of factor analysis, the mean factor scores of the two surveys are summarised in the top panel of Table 2. As mentioned above, the scores of the second survey showed a decrease. There are significant differences in the means of the first factor (SE-F1) ($p<0.01$), though the means of the second factor (SE-F2) remain at the same level. This means that participants may loose some confidence in their attitude as a result of various learning experiences.

Table 2: Question items for assessing participant's reflection and their means in two surveys

		Question Items	Mean-F	Mean-S	
	SE-F1	Factor1: self confidence in student's own attitude	3.36	2.94	**
	SE-F2	Factor2: self confidence in student's own level of competence	3.17	2.94	
1	Syllabus reading	Read the syllabus of this course carefully in advance	3.46	3.07	
2	Out-of-class study	Study out of class for this course	3.11	3.29	
7	Learning hours	Grade a level of learning hours for this course out of the class	2.91	3.00	
3	Self directed effort	Self assessment of own attitude towards this course	**7.22**	**6.91**	
4	Self understanding	Self assessment of level of understanding for contents of this course	**6.41**	**5.98**	
5	Self achievement	Self assessment of level of achievement for this course	**6.31**	**6.31**	
6	Self satisfaction	Self assessment of level of overall satisfaction for this course	**7.37**	**6.70**	*

Bold means are based on a 10 point scale; ** $p < 0.01$, * $p < 0.05$

Table 3: Matrix of correlation coefficients for responses to reflection questions following the first and the second surveys

			First									Second							
			a	b	c	d	e	f	g	h	i	a	b	c	d	e	f	g	h	i
First	a	SE-F1	1.00	0.64	0.19	0.25	0.22	0.46	0.39	0.60	-0.29									
	b	SE-F2	0.64	1.00	0.22	0.37	0.61	0.50	0.50	0.54	0.08									
	c	Syllabus reading	0.19	0.22	1.00	0.29	0.29	0.45	0.33	0.36	0.08									
	d	Out-of-class study	0.25	0.37	0.29	1.00	0.47	0.26	0.22	0.18	0.35									
	e	Self directed effort	0.22	0.61	0.29	0.47	1.00	0.52	0.57	0.49	0.24									
	f	Self understanding	0.46	0.50	0.45	0.26	0.52	1.00	0.58	0.56	0.03									
	g	Self achievement	0.39	0.50	0.33	0.22	0.57	0.58	1.00	0.68	0.14									
	h	Self satisfaction	0.59	0.54	0.36	0.18	0.49	0.56	0.68	1.00	0.06									
	i	Learning hours	-0.29	0.08	0.08	0.35	0.24	0.03	0.14	0.06	1.00									
Second	a	SE-F1	0.71	0.51	0.23	0.34	0.17	0.46	0.39	0.41	-0.05	1.00	0.48	0.50	0.42	0.31	0.67	0.60	0.62	0.21
	b	SE-F2	0.29	0.61	0.21	0.30	0.32	0.25	0.35	0.41	0.18	0.48	1.00	0.25	0.35	0.53	0.33	0.45	0.29	0.20
	c	Syllabus reading	0.23	0.15	0.66	0.28	0.20	0.33	0.26	0.27	0.07	0.50	0.25	1.00	0.42	0.39	0.44	0.34	0.47	0.42
	d	Out-of-class study	0.18	0.41	0.36	0.51	0.43	0.34	0.41	0.31	0.40	0.42	0.35	0.42	1.00	0.44	0.47	0.43	0.39	0.42
	e	Self directed effort	0.21	0.43	0.37	0.29	0.62	0.35	0.56	0.58	0.21	0.31	0.53	0.39	0.44	1.00	0.45	0.62	0.43	0.19
	f	Self understanding	0.47	0.36	0.27	0.38	0.35	0.59	0.45	0.43	0.07	0.67	0.33	0.44	0.47	0.45	1.00	0.63	0.64	0.29
	g	Self achievement	0.53	0.39	0.27	0.21	0.32	0.46	0.51	0.64	0.02	0.60	0.45	0.34	0.43	0.62	0.63	1.00	0.73	0.21
	h	Self satisfaction	0.45	0.22	0.34	0.18	0.12	0.50	0.44	0.53	0.06	0.62	0.29	0.47	0.39	0.43	0.64	0.73	1.00	0.25
	i	Learning hours	0.01	0.11	0.26	0.24	0.15	0.11	0.11	0.16	0.54	0.21	0.20	0.42	0.42	0.19	0.29	0.21	0.25	1.00

3.2 Changes in participant's reflections

Responses to question items for the assessment of participant's reflections in the two surveys are summarised in Table 2. The middle panel of Table 2 shows the means for three items using a 5-point scale, and the bottom panel shows the means for four items using a 10-point scale. Most responses between the two surveys are comparable, except for "self satisfaction", which decreases significantly in the second survey ($p<0.05$). Some participants might feel difficulty in learning the contents of the course.
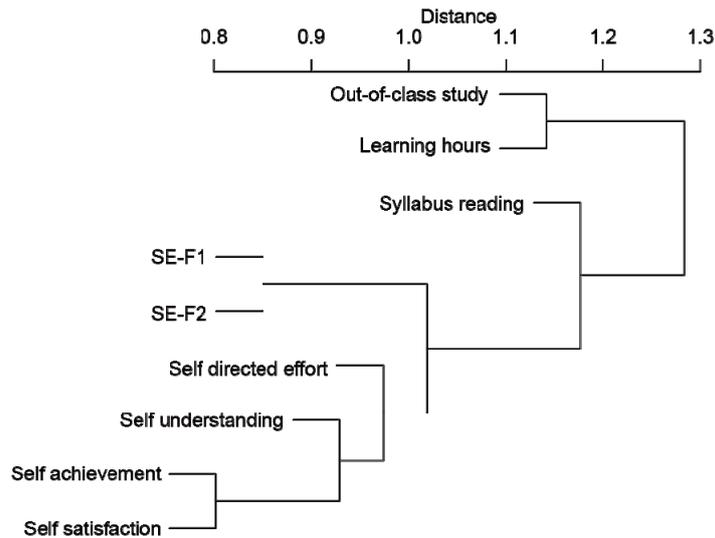
Figure 1: Cluster structure of responses using correlation coefficients across reflection items in the first survey

As the responses are similar across these question items, correlation analysis was conducted in order to extract the structures of responses from the surveys. Table 3 shows correlation coefficients between responses to question items. The top left panel indicates coefficients across responses in the first survey, and the bottom right panel indicates coefficients across responses in the second survey. The bottom left panel indicates coefficients of responses between the first and the second surveys. This panel shows the transformations in relationships across question items between the two surveys. Though the matrices in Table 3 show many coefficients, the change in correlational relationships which is due to note taking instruction is unclear.
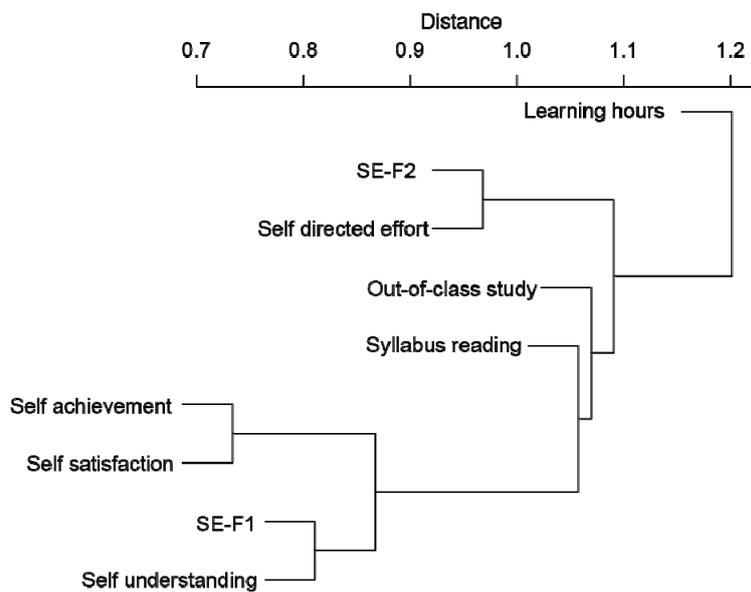
Figure 2: Cluster structure of responses using correlation coefficients across reflection items in the second survey
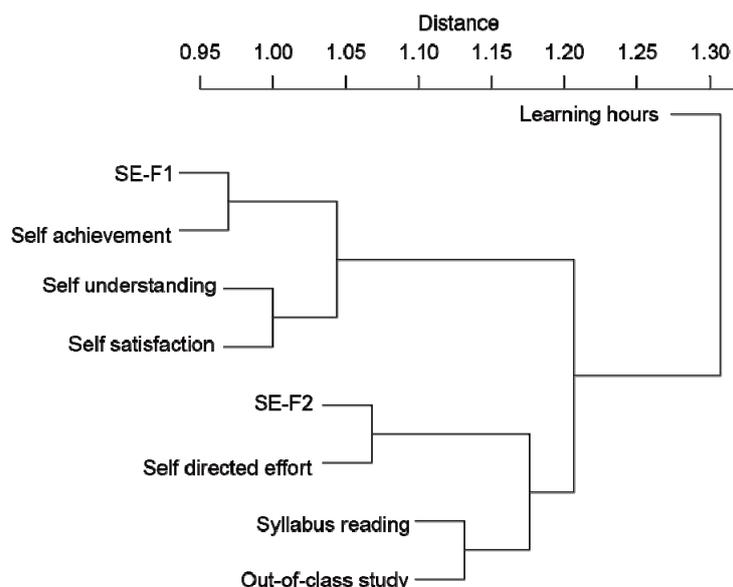
Figure 3: Cluster structure of responses using correlation coefficients across reflection items in the first and the second surveys

To illustrate the structure of reflection question items, a cluster analysis of the distances between question items was introduced. The correlation coefficients were transformed into distances using the law of cosines. Figure 1 displays a dendrogram of the results of the first survey. For items located on the left-hand side, the responses are similar. For items located on the right-hand side or located individually, the responses are independent in most cases. In regards to the question items from the first survey, Figure 1 shows that "Out-of-class study", "Learning hours" and "Syllabus reading" are independent of the other question items, while "Self achievement" and "Self satisfaction" are relatively similar to each other. The two factors for "Self efficacy" (SE-F1 and SE-F2) also show a close similarity to each other in Figure 1.

Figure 2 shows a dendrogram of the results of the second survey. In comparison with Figure 1, most items have shifted to the right, except for "Self achievement" and "Self satisfaction". Other items are mostly independent, since they are distributed some distance from each other, as shown in Figure 2. This result suggests that the learning process used, which included note taking instruction, has had an influence on the responses of students to the reflection questions in the second survey.

To denote relationships between reflection items in the first and the second surveys, a dendrogram was created using a correlation matrix of the two surveys, as shown in Figure 3. Though all items are equidistant, there are two rough clusters which include two self efficacy factors such as "SE-F1" and "SE-F2". The two clusters may be the keys to student's activity during the learning process in this blended learning course. In particular, the distance of "Learning hours" from the responses of other question items in Figures 2 and 3 indicates that it may not increase "Learning hours" since there are few direct contributions for this item.
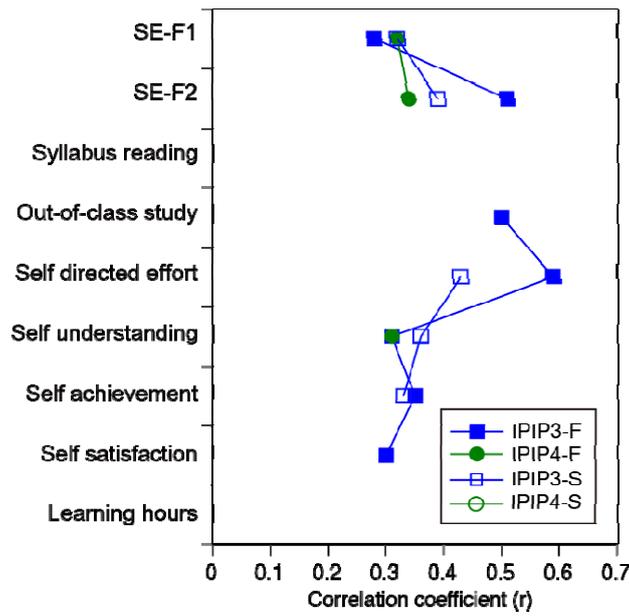
Figure 4: Correlation coefficients between personality (IPIP) and reflection responses across the first (F) and the second (S) surveys
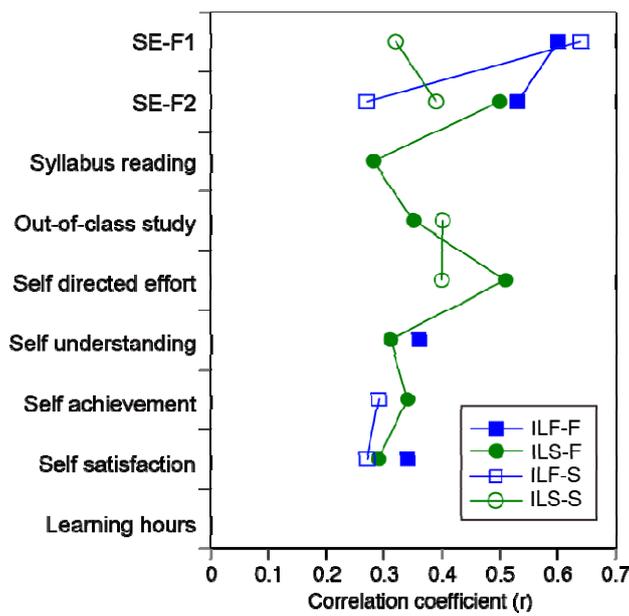
Figure 5: Correlation coefficients between information literacy (IL-1 and IL-2) and reflection responses across the first (F) and the second (S) surveys
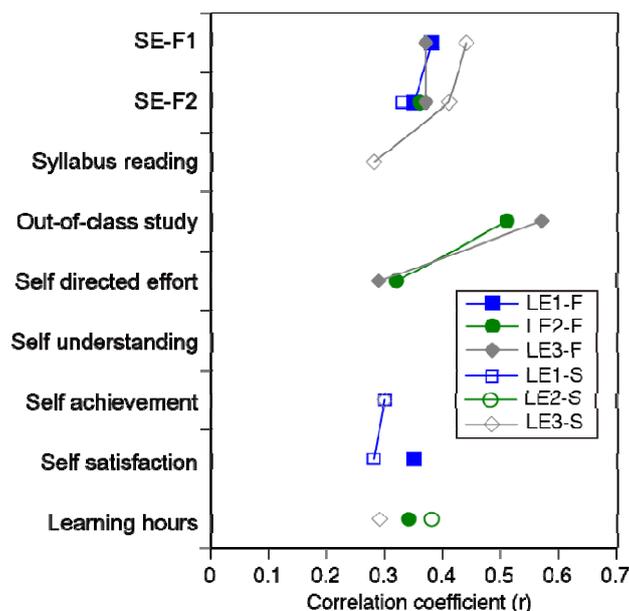
Figure 6: Correlation coefficients between learning experience (LE) and reflection responses across the first (F) and the second (S) surveys

In addition to the analyses mentioned above, the contributions of student's characteristics to reflection responses were examined using simple correlation analysis. The analyses determined that some characteristics affect student's reflections during the learning process.

Figure 4 indicates changes in correlation coefficients between scores of reflection items and personality scores. In an analysis, there were many significant coefficients between "Conscientiousness" (IPIP3) and "Neuroticism" (IPIP4). In Figure 4, only the significant coefficients are illustrated. As figure shows, the factor for "Conscientiousness" (IPIP3) correlates with many reflection items in the first survey, and with most of them in the second survey. All of the significant correlations with "Neuroticism" (IPIP4) have disappeared in the second survey.

As shown in Figure 5, the factors for information literacy (IL-1 and IL-2) correlate with reflection items, with the exception of "learning hours". These relationships remain throughout the two surveys. As the blended learning environment requires some information literacy, the results confirm the hypothesis.
Figure 6 shows the relationships between scores of reflection items and student's learning experience (LE). Though most relationships were apparent in the first survey, the factor for "learning strategy" (LE-F3) only correlated with two factors of self-efficacy and "syllabus reading" in the second survey. This confirms that some learning experiences promote self efficacy during student's learning process.

3.3   Development of note taking skills

During the course, participants were given note taking instructions twice, and encouraged to make better notes. In order to determine the effectiveness of the instructions, three factor scores of note taking skills from the two surveys are compared in Table 4. All factor scores increased during the course. In particular, both NT-F2 and NT-F3 increased significantly ($p<0.01$). Many participants might have better learned for themselves the methodology of note presentation and utilisation.
The development of note taking skills may affect participant's self reflection activity. The results of a detailed analyses are explained in the following section.

Table 4: Changes in factor scores for note taking skills between two survey during the course

	1st survey	2nd survey	
NT-F1: Recognition of functions of NT	3.74	3.86	#
NT-F2: Methodology of utilising notes	2.60	2.90	**
NT-F3: Presentation of notes	2.47	2.82	**

**:$p < 0.01$, #:$p < 0.10$

3.4   Causal relationships among metrics

The previous study suggested that note taking skills promote participant's proactive learning. To confirm the contribution of note taking skills to learning activity, causal analysis was conducted. The possible causal relationships between student's self reflections and other variables were examined using a structural equation modelling (SEM) technique. All parameters were estimated using AMOS software (Toyoda, 2007), and the validity of the models was tested using indices of the fitness of the model (the GFI: Goodness of Fitting index).
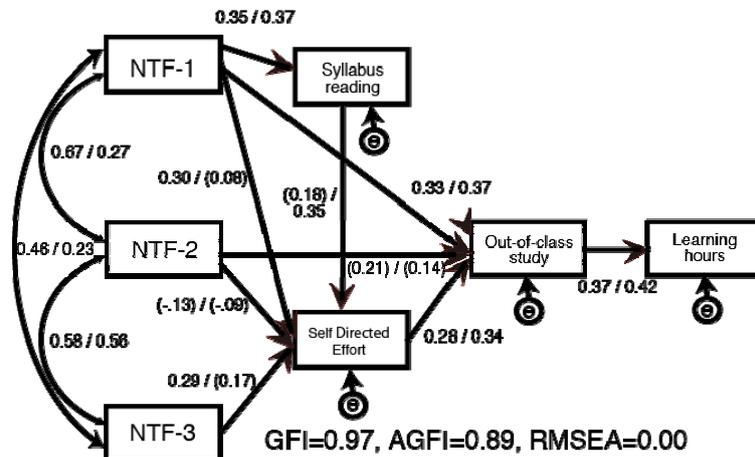
**Figure 7:** Note taking skills affecting metrics of reflections
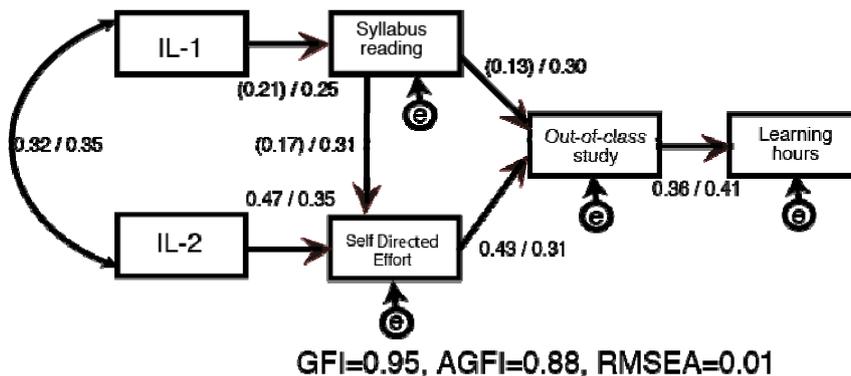
Figure 8: Factor scores of information literacy affecting metrics of reflections
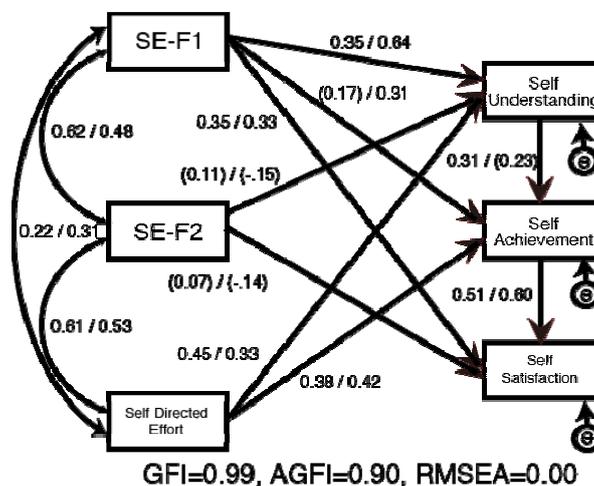

Figure 9: Factor scores of self efficacy affecting metrics of reflections

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The variables involved were selected step by step, and a causal relationship as shown in Figure 7 was created. The multiple group structural equation modelling technique was applied to the sets of data from the first and second surveys.

The factor score of NT-F1 (recognition of functions of note taking) significantly affects several variables of self reflection, such as "syllabus reading", "out-of-class study", and "self directed effort". NT-F3 (presentation of notes) significantly affects "self directed effort". Factor scores of note taking skills affect "learning hours" which are an index of participant's proactive learning, to a significant extent. In comparing the coefficients of the first and second surveys, the direct relationship between NT-F1 and "self directed effort" is replaced by a path via "syllabus reading", while the influence of NT-F3 is less. As a result of note taking instructions, the relationship between "syllabus reading" and "self directed learning" has become enhanced.

In the causal relational analysis shown in Figure 8, the effectiveness of the factors of information literacy (IL-1 and IL-2) is confirmed. In comparing the coefficients of the two surveys, IL-1 (information literacy skills) gradually promotes "syllabus reading", and "syllabus reading" significantly affects both "self directed effort" and "out-of-class study". Also, Figure 8 indicates that information literacy promotes an increase in the number of "learning hours".

The relationship between self efficacy and self reflections is examined. A causal relationship as shown in Figure 9 indicates the two factors of self efficacy and "self directed effort" which affect overall "self satisfaction". There is little change in coefficients between the two surveys. The factor of self efficacy (SE-F1: self confidence in student's own attitude) affects three variables, namely "self understanding", "self achievement" and "self satisfaction", in the second survey.


GFI=0.92, AGFI=0.86, RMSEA=0.00
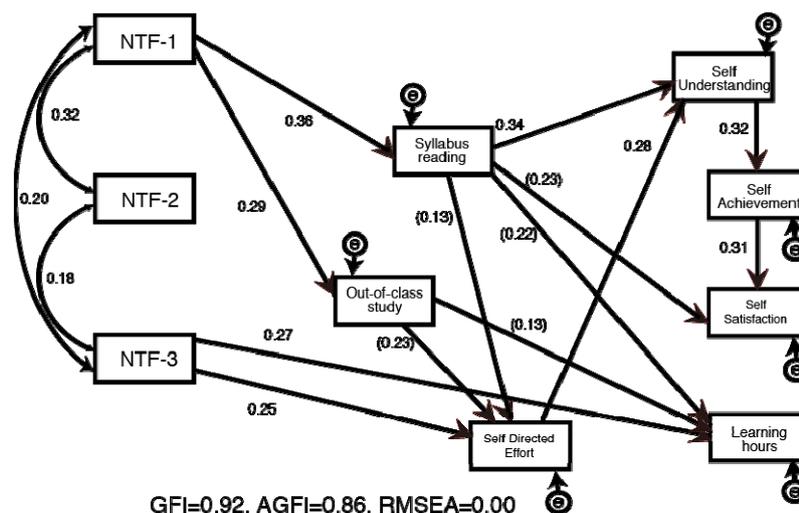
Figure 10: Casual relationship: development of note taking skills influencing changes in self reflections

3.5   Causal relationships across changes in survey metrics

When the values of metrics between the two surveys are compared, various differences are observed. Though all factor scores of note taking skills increased, scores for responses regarding self efficacy decreased, and most self reflections between the two surveys were comparable. Therefore, an additional causal relationship of differentials in metrics between the two surveys was examined, as shown in Figure 10. Here, the differences in means for the scores of the second survey were less than those of the first survey (2nd score - 1st score). Since the differences in the two factor scores for self efficacy did not contribute to the other metrics, a separate model was created for these. The differences of both NT-F1 and NT-F3 affected some of the differences in self reflections, such as those regarding "syllabus reading", "self directed effort", "out-of-class study" and "learning hours". The degree of recognition of the value of note taking functions (NT-F1) and presentation of notes (NT-F3) contributed to participant's self reflection. In addition to this, both "syllabus reading" and "self directed effort" affected the difference in "self understanding" which transformed "self satisfaction" through "self achievement". The direction of the arrow from "out-of-class study" to "self directed effort" changed between Figures 7 and 8, in regards to the index of model fitness.

As a result, the improvement in note taking skills produced significantly positive growth of participant's self reflections during the course. These relationships will be keys to the improvement of overall learning activity.

4.   Discussion

As the results in the above section show, most scores for both self-efficacy and self assessment decreased, though scores for note taking skills increased due to the note taking instructions that were given. In particular, the first factor score for self efficacy (self confidence in student's own attitude) decreased in the second survey. Even the score for self satisfaction decreased significantly in the second survey. These points suggest that participants gradually recognised their actual learning situation well and made additional effort to take better notes during the course.

As the mean scores for reflection question items varied slightly, the relationships between the responses in the first and the second surveys were compared. The structure of the responses were extracted using cluster analysis which was based on a correlation analysis of the question responses. The patterns of the structures changed between the two surveys, as shown in Figures 1 and 2, while the response patterns show some differences between the first and second surveys, as shown in Figure 3.

There are many factors causing changes to these structures. Since the learning process takes place over a long period of time, note taking instruction may be one of the factors. In addition to a few changes in responses between the two surveys, note taking skills improved during the course.
Student's characteristics, such as personality, information literacy and learning experience affected the responses to reflection questions. Though the contribution of student's characteristics decreases as learning progress, some factors, such as information literacy (IL-1, IL-2) and learning strategy (LE-F3) of learning experience also affected the scores for reflection in the second survey. Therefore, reflection activity and student's characteristics should be considered.

Two factor scores for note taking skills (NT-F2 and NT-F3) also increased significantly. Participants may have understood how to use their notes outside of the classroom. Therefore, the contributions of factor scores to note taking skills for "out-of-class study" and "learning hours" increased slightly in the causal analysis in Figure 7. These contributions were supported by some of the student's characteristics, such as their level of information literacy (IL-1, IL-2). Figure 8 shows various interactions between factors of student's characteristics which may affect their learning behaviour.

Though the first factor score for self efficacy decreased in the second survey, the scores that represent self reflection, such as "self understanding" and "self achievement", increased. Changes of scores in metrics were observed and these scores affected other metrics through causal relationships. As a result, another causal relationship was created using changes in metrics, in order to show the spread of changes to metrics in Figure 10. As all coefficients are positive, improvement in note taking skills due to the lecturer's instructions affected most of the differentials of student's self reflections.

These results also confirm that note taking activity produces better responses to questions about participant's reflections except for those reflecting scores of self efficacy. The results mean that note taking activity affects participant's emotional factors.

The development of an improved procedure for evaluating all emotional factors, including self efficacy, will be a subject for our further study.

5.   Conclusion

This paper examined the progress of development of participant's emotional factors during a blended learning course to which note taking instruction was introduced. Emotional factors, including self efficacy, were measured twice during the course using a set of questionnaires. The results of the two surveys were then compared.

Statistical analysis produced the following results.

1. Changes in scores for self efficacy and reflection were measured during the course. Though most of these scores remained at the same level during the course, significant changes in note taking skill factor scores between the two survey were identified.
2. The dependencies of the changes in student's characteristics were also examined. Although the contributions of most factors decreased during the course, information literacy and student's learning experience positively affected the results of second survey.
3. The causal relationships between reflection items and information literacy were examined, and the effectiveness of note-taking instruction are discussed.

This paper mainly discussed and analysed responses to surveys which used reflection questions to assess student's learning activities, such as note taking and learning performance. The examination of the relationships between responses to reflection questions and learning activities will be a subject of our further study.

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