SYSTEM DESIGN FOR E-MENTOR SUPPORT SYSTEM WITH PREDICTION OF LEARNING STYLE

Masanori Yamada[1], Yoshiko Goda[2], Yutaka Saito[3], Takeshi Matsuda[4], Hiroshi Kato[5], Hiroyuki Miyagawa[3]

[1] Research Center for Higher Education, Kanazawa University (Japan)
[2] Research Center for Higher Education, Kumamoto University (Japan)
[3] School of Social Informatics, Aoyama Gakuin University (Japan)
[4] Office of Academic Planning, Yamagata University (Japan)
[5] Center of ICT and Distance Education, The Open University of Japan (Japan)
mark@mark-lab.net, ygoda@kumamoto-u.ac.jp, yutaka@hirc.aoyama.ac.jp, tmatsuda@jm.kj.yamagata-u.ac.jp, Hiroshi@Kato.com, miyagawa@si.aoyama.ac.jp

Abstract

As online education expands, there has been an emphasis on the importance of mentoring for quality education. The more meaningful and customized supports mentors provide, the larger their burdens become. This study aims to design a mentor support system to reduce mentors' burden in predicting learners' behaviors and learning styles prior to a course. For the learner type prediction, the authors developed an e-Learning Self-regulated Learning Scale (eSLS) (Goda, et al., 2010). It was based on the sample items of Wolters, et al. (2003) and consisted of 40 Likert items with 4 factors: (1) affective strategies, (2) cognitive strategies, (3) help-seeking, and (4) self-Independency. This paper reports and discusses the research background and procedures for the instrument development, prediction model equation formulation, and interface design for mentors. The significance of this research is to introduce a new approach to improve online learner supports from the perspective of mentor-supports.

Keywords: online learning, learning style prediction, mentoring support

1 INTRODUCTION

In online learning, learners can control when, what, and how they learn without the restrictions of time, learning space, or the use of printed materials [1]. In order to have the control in online learning, learners are required to have self-regulated learning (SRL) skills [2]. SRL is the active learning process used to regulate and monitor learning cognition, motivation, behavior, and setting personal learning goals [3].

However, one common problem with online courses is that learners easily drop out halfway through the course, in particular, with asynchronous distributed learning environments (ADLE) [4]. Mentoring—the process through which mentors support learners with their in-depth knowledge and experience with online learning strategies though continuous and rapid communication—is needed to support learning appropriate to each learner's learning style [4].

Many universities around the world offer online learning with ADLE supported by mentoring. However, although the importance of mentoring in ADLE is regarded as effective for learners' successful learning, mentors' workloads should be reduced. For example, one university [5] opened five online courses in 2008, in which about 500 learners studied (two mentors supported learners in all courses). In 2009, this university opened nine online courses; the number of learners increased from about 500 to 1,600, but the number of mentors did not change. About 75% of learners were satisfied with the online course in both years. This case indicates the importance and necessity of taking the mentoring assignment, management, and mentoring, into consideration in order to reduce the mentor's workload and improve the efficiency of mentoring [5]. One solution for reducing the mentor's workload is to make plans for effective mentoring by knowing the number of learners who will need intensive support before learners start online learning. This solution seems to prevent mentors from mentoring learners who do not need as much support by classifying learners before online learning starts into those who need intensive support and those who do not. In order to develop this solution, it is desirable to implement a learning style prediction function into ADLE.

2 PREDICTION OF LEARNING STYLE BASED ON SRL

Many scholars have conducted research on the relationship between SRL skills and online learning [6], [7]. SRL is related to motivation, cognition, and self-control toward the accomplishment of learning purposes [8], [9]. SRL learners are able to make a learning plan, adjust it, and conduct self-control and self-evaluation [10]. SRL is strongly concerned with autonomy, evaluated from three viewpoints: meta-cognition, motivation, and learning behavior [11], [12], in order for learners to have responsibility for learning on their own. SRL skills are essential for effective and continuous learning.

Wolters et al. [3] suggested an SRL framework, which indicates that SRL can mediate with four relationships: (1) active and constructive; (2) controlling; (3) establishing learning purposes and criteria for the accomplishment of learning purpose; and (4) individual, context, accomplishment, and performance. The first point in this framework means that learners construct knowledge actively from the viewpoint of human cognition. The second point explains that learners can adjust, monitor, and control environmental cognition, motivation, and behaviors. The third point indicates that learners make criteria for the judgment of learning performance, and control learning with the criteria. The last point is concerned with factors affecting learning performance—not only personal, but also contextual factors such as learning environment, have an influence on learning performance.

Wolters et al [3] organized the SRL phases, which are displayed in table 1. The first phase is forethought: planning and activation. The second phase is monitoring, and the third is control. The last is the reaction and reflection phase. Several studies reveal that the second and third phases can happen at the same time [13]. Schunk and Zimmerman [11] also suggest a similar model of SRL, which consists of three phases: forethought, performance/volitional, and self-reflection.

Schunk and Zimmerman [11] compared novice and expert SRL learners by learning behaviors in each SRL phase (table 2). In the forethought phase, skillful learners were able to put their final goal and small steps for the accomplishment of final goal. The features of the goal and small steps were constructive and clear. Learners tended to have internal motivation and high self-efficacy. In the performance/volitional phase, skillful learners concentrated on learning by monitoring the learning process. In the self-reflection phase, skillful learners wanted to evaluate learning performance by themselves and tended to attribute quality of performance to learning strategies and practice. The SRL features of skillful learners in each phase are helpful to predict learning styles in ADLE.

However, this research did not reveal cohesive results [14], some research indicated the negative correlation between SRL skills and quality of learning outcomes in online learning [15], [16]. A valid SRL scale should be required to predict learners' learning style, before learners begin studying in ADLE.

In SRL research, Motivated Strategies for Learning Questionnaire (MSLQ) [17] is often used, but MSLQ seems inappropriate to look at learner's SRL skills in online learning, because it was developed for the evaluation of SRL in a real classroom.

Barnard et al. [14] developed a self-regulated learning scale for online learning environments. Online Self-regulated Learning Questionnaire (OSLQ) [14] consists of 24 items in 6 areas: goal setting, environment construction, task strategies, time-management, help-seeking, and self-evaluation. OSLQ determines learning style for SRL in online learning using small scales, and its internal validity in each area is very high (Cronbach's alpha = 0.87-0.96). However, OSLQ does not contain items about motivation, which is an important factor in online learning [18], [19]. Therefore, we applied the SRL scale "eSLS"(e-Learning Self-regulated Learning Scale) developed by Goda et al. [20]. Goda and their colleagues developed their SRL scale for online learning based on Wolters et al. [3].

Table 1 The relationship between the SRL phases and regulation areas (Wolters et al, 2003)

Areas of regulation				
Phases	Cognition	Motivation/affect	Behavior	Context
Forethought, planning, and activation	1) Target goal setting 2) Prior context knowledge activation 3) Metacognitive knowledge activation	1) Goal orientation adoption 2) Efficacy judgment 3) Perceptions of task difficulty 4) Task value activation 5) Interest activation	1) Time and effort planning 2) Planning or self-observations of behavior	1) Perceptions of task 2) Perceptions of context
Monitoring	1) Metacognitive awareness and monitoring of cognition	1) Awareness and monitoring of motivation and affect	1) Awareness and monitoring of effort, time use, need for help 2) Self-observation of behavior	1) Monitoring changing task and context conditions
Control	1) Selection and adaption of cognitive strategies for learning and thinking	1) Selection and adaption of strategies for managing motivation and affect	1)Increasing/decreasing effort 2) Persisting/giving-up 3) Help-seeking behavior	1) Changing or re-negotiating task 2) Changing or leaving context
Reaction and reflection	1) Cognitive judgment	1) Affective reactions	1) Choosing behavior	1) Evaluation of task
	2) Attributions	2) Attributions		2) Evaluation of context

The scale developed by Wolters et al. [3] consists of three areas in each of the phases mentioned above: cognition, motivation and emotion, and behavior. Their scale has 103 items in total. Goda et al. [20] eliminated items about online learning and developed a new SRL scale. The scale of Goda et al. [20] consists of 4 factors that have 40 items in total: affective strategies, cognitive strategies, help-

seeking, and independence. Appendix.A displays concrete items. Table 3 shows the internal validity of this scale.

Table 2 The differences between naïve and skillful self-regulated learners

Classes of self-regulated learners		
Self-regulatory phases	Naïve self-regulators	Skillful self-regulators
Forethought	Nonspecific distal goals Performance goal orientation Low self-efficacy Disinterested	Specific hierarchical goals Learning goal orientation High self-efficacy Intrinsically interested
Performance/volitional control	Unfocused plan Self-handicapping strategies Outcome self-monitoring	Focused on performance Self-instruction/imagery Process self-monitoring
Self-reflection	Avoid self-evaluation Ability attributions Negative self-reactions Non adaptive	Seeking self-evaluation Strategy/Practice attributions Positive self-reactions Adaptive

Table 3 Internal validity of the scale (Goda et al, 2010)

Factor	No. of Items	Cronbach's alpha
1	16	0.904
2	11	0.852
3	9	0.833
4	4	0.781

3 SYSTEM DESIGN

This system was developed as a one-server module for a Learning Management System (LMS). The LMS has two main functions: Social Networking Service (SNS) and learning management. The SNS part displays a learners' friends, friends' diaries, course schedule and learning goals. The SNS part allows learners to add friends, make/edit a learning plan, and read friends' diaries. When a learner pushes the LMS button, the SNS part moves to the learning management part. In the learning management part, learners can watch and read learning material, submit assignments, take tests, and confirm their learning procedure. Figs. 1 and 2 display the interface of each part. E-Mentors belong to communities about classes. E-Mentors are engaged in mentoring activities such as notifying information and sending mail for encouragement and trouble-shooting.

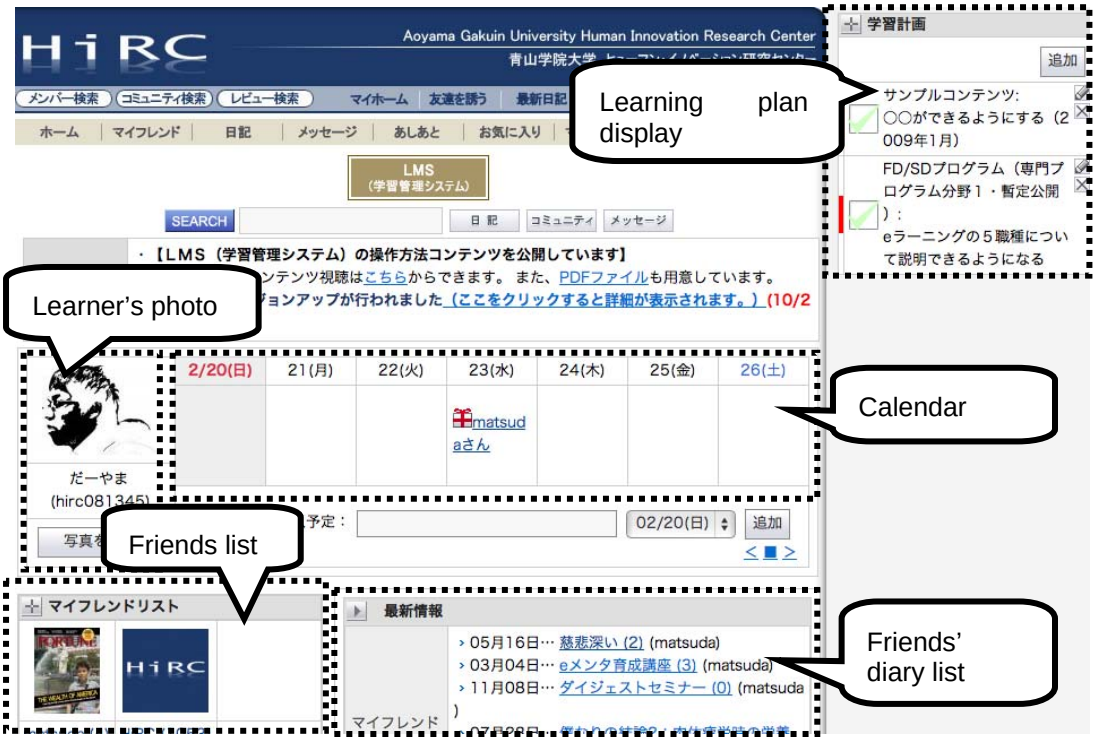


Fig.1 Interface of SNS part

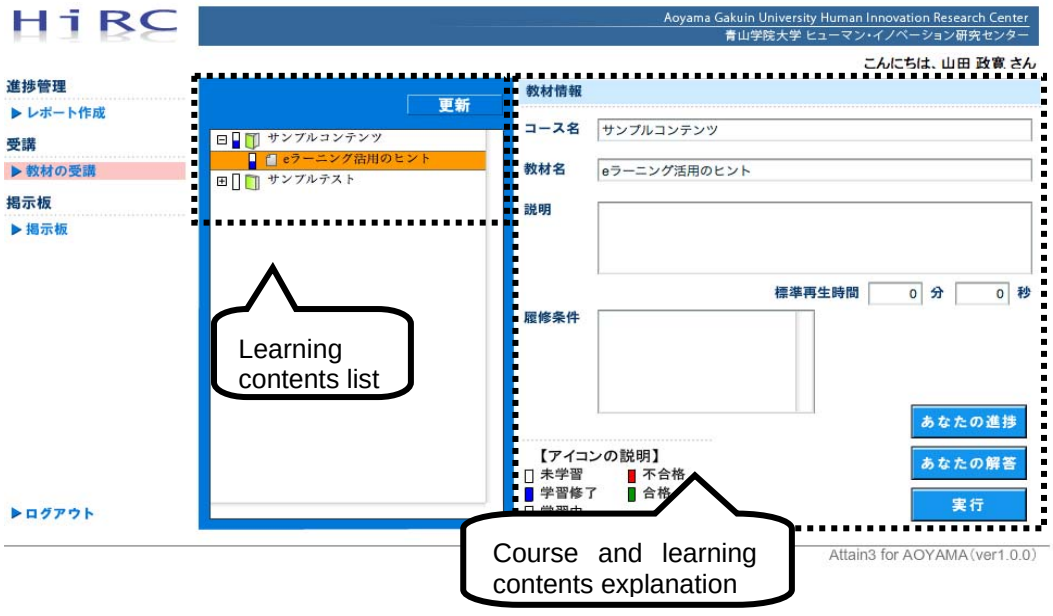


Fig. 2 Interface of learning management part

The module that we developed allows e-mentors to indentify would-be drop-out learners visually. First, learners answer a learning style questionnaire through an online questionnaire system in ADLE. This module starts factor analysis function, and calculates learner's factor score in each factor based on this formula:

$$FScore_{st(i)\cdot Fn} = \sum_{j=1}^{40} \left(C_{fn\cdot j} Z_{st(i)\cdot j} \right)$$

FScore: factor score

st: student

i: student number

F: factor

n: factor number (1~4)

C: factor score coefficient

j: question number (1~40)

Z: Z-score

Next, the module divides learners into three ranks: low (-1 >= factor score), middle (-1 < factor score < 1) high (1 <= factor score). Based on the learners' rank, the module displays the appropriate emoticon for the factor score. For example, a sad face for a low score in each factor is displayed to e-mentors in the learning style display. Fig. 3 shows the interface for the course management display.

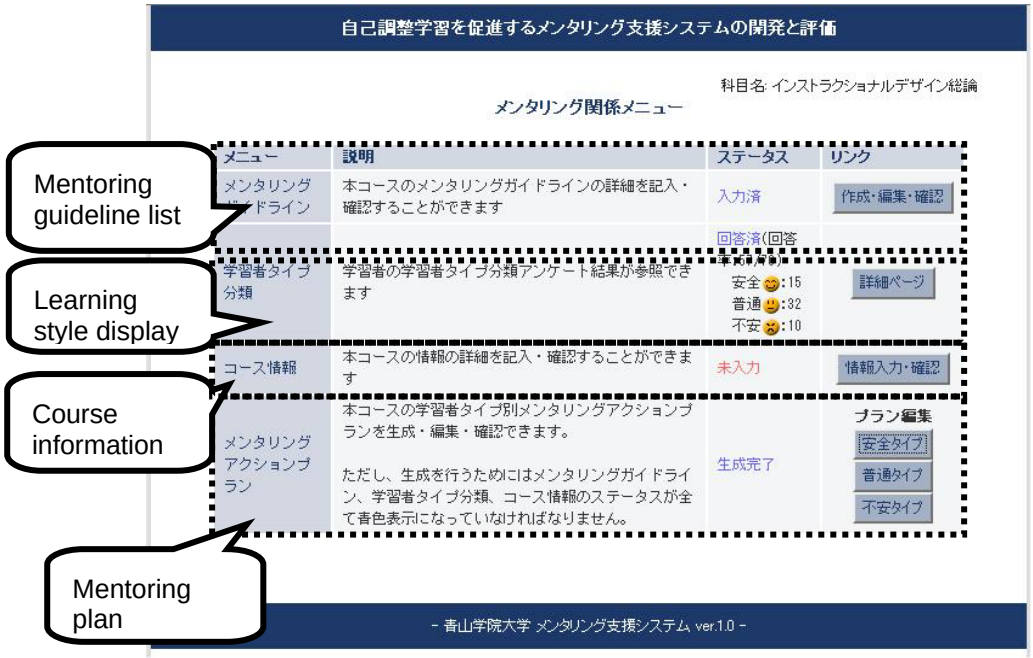


Fig. 3 Interface of Course Management Area

E-Mentors can add mentoring guidelines, which show mentoring rules for situations, course information, and mentoring plans. The mentoring guidelines describe dropout triggering events such as the first report submission. Course information shows course name, class name, class purposes, and acceptance criteria. The mentoring plan includes mentoring actions (e.g., self introduction, notification of report submission deadline), dates that e-mentors must conduct, e-mentor's name, which has responsibility to do mentoring plan. These functions work, using learners' learning style data. This system allows e-mentors to refer to the mentoring plan that is appropriate to learners' learning styles.

4 CONCLUSION AND FUTURE WORKS

This study intended to design an e-mentoring support system with the prediction of learner's learning style. The approach is considered from the viewpoint of learning style, which is one of the most important factors to promote learning, in designing a learning support system. The prediction module of learning style before a learner begins learning in an online environment identifies which learners will easily drop out, and helps e-mentors to support learners effectively. In order to predict learning style, a learning style scale is useful. We selected one scale, which has high validity to calculate learning style score (factor score) in an online learning environment. E-mentoring is difficult task to maintain learner's motivation for continuous learning in an online learning environment.

The following works aimed at the development of an effective e-mentoring environment in the future are recommended.

(1) Development of the prediction module of learning style

The approach for designing the prediction module uses learning style scale. The next step is developing this module.

(2) Development of learning style visualization function

The prediction of learning style will not be enough to help e-mentors support learner's learning activities. Visualization will allow e-mentors to know who are would-be drop-out learners. Sub functions, which support e-mentors to know this information intuitively, are required.

(3) Evaluation

After development of this module, we will evaluate whether the e-mentoring module will be helpful for e-mentors and learners. We will compare the learning management system embedded in this module with a plain one from the viewpoints of educational psychology and cognitive science.

REFERENCES

[1]. Cunningham, C. A., and Billingsley, M.: Curriculum Webs: A practical guide to weaving the web into teaching and learning. Massachusetts: Allyn and Bacon (2003)

[2]. Yukselturk, E., and Bulut, S.: Predictors for student success in an online course. Educational Technology & Society, 10(2), 71-83. (2007)

[3]. Wolters, C. A., Pintrich, P. R., and Karabenic, S. A.: Assessing Academic Self-regulated Learning. Paper prepared for the Conference on Indicators of Positive Development: Definitions, Measures, and Prospective Validity. Sponsored by ChildTrends, National Institutes of Health. (2003)

[4]. Matsuda, T. and Harada, M.: e-Mentoring: practice of learner support. Tokyo Denki University Press, Tokyo, Japan (2007)

[5]. Hata, K. and Tanaka, H.: Practical Report of e-Learning in 2009 CELL Educational Research, 1, 23-28. (2010)

[6]. Kramarski, B., and Gutman, M.: How can self-regulated learning be supported in mathematical e-learning environments? Journal of Computer Assisted Learning, 22, 24-33. (2006)

[7]. Lan, W. Y.: The effect of self-monitoring on students' course performance, use of learning strategies, attitude, self-judgment ability and knowledge representation. Journal of Experimental Education, 64, 101-115. (1996)

[8]. Pintrich, P. R., The role of motivation in promoting and sustaining self-regulated learning. International Journal of Educational Research, 31. pp. 459-470. (1999)

[9]. Zimmerman, B. J., and Paulsen, A. S.: Self-monitoring during collegiate studying: An invaluable tool for academic self-regulation. In Pintrich, P. R. (Ed.), Understanding self-regulated learning. Michigan: New Directions for teaching and Learning, pp. 13-28. (1995)

[10]. Deci, E. L., Ryan, R. M., and Williams, G.: Need satisfaction and the self-regulation of learning. Learning and Individual Differences, 8, 165-183. (1996)

[11]. Schunk, D. H., and Zimmerman, B. J.: Self-Regulated Learning: From Teaching to Self-Reflective Practice. NY: The Guilford Press. (1998)

[12]. Zimmerman, B. J.: Development of self-regulated learning: Which are the key subprocesses? Contemporary Educational Psychology, 16, 307-313. (1986)

[13]. Pintrich, P. R., Wolters, C., and Baxter, G.: Assessing metacognition and self-regulated learning. In G. Schraw (Ed.). Metacognitive Assessment. Lincoln, NE: The University of Nebraska Press. (2000)

[14]. Barnard, L., Lan, W. Y., To, Y. M., Paton, V. O., and Lai, S-L.: Measuring self-regulation in online and blended learning environments. Internet and Higher Education, 12, 1-6. (2009)

[15]. McManus, T. F.: Individualizing instruction in a Web-based hypermedia learning environment. Paper presented at the annual meeting American Educational Research Association, San Diego, California. (2000)

[16]. Lynch, R., and Dembo, M.: The relationship between self-regulation and online learning in a blended learning context. International Review of Research in Open and Distance Learning, 5(2), 1-16. (2004)

[17]. Pintrich, P. R., Smith, D. A., Garcia, T, and McKeachie, W. J.: A Manual for the USE of Motivated Strategies for Learning Questionnaire (MSLQ). The National Center for Research to Improve Postsecondary Teaching and Learning Project on Instructional Processes and Educational Outcomes. NCRIPTAL- 91-B-004. (1991)

[18]. Pintrich, P. R., and Schunk, D. H.: Motivation in Education: Theory, Research, and Applications. Englewood Cliffs, NJ: Prentice Hall Merrill. (2002)

[19]. Graham, S., and Weiner, B.: Theories and principles of motivation. In D. Berliner and R. Calfree (Eds.), Handbook of Educational Psychology. New York: Simon and Schuster Macmillan. pp. 63-84. (1996)

[20]. Goda, Y., Yamada, M., Kato, H., Matsuda, T., Saito, Y., Miyagawa, H.: Preliminary Development of Learner Support Prediction Model for E-Learning Based on Self-Regulated Learning Factors, Proceedings of ICERI 2010, 1960-1967. (2010)

APPENDIX.A SRL scale based on Wolters et al. (2003) (Goda et al., 2010)

Factor	Question Item
1.Affective Strategies	I remind myself how important it is to do well on the tests and assignments in this course.
	I tell myself that I need to keep studying to do well in this course.
	I persuade myself to keep at it just to see how much I can learn.
	I tell myself that I should keep working just to learn as much as I can
	I remind myself about how important it is to get good grades.
	I tell myself that I should work at least as hard as other students.
	I think about how my grade will be affected if I don't do my reading or studying.
	I keep telling myself that I want to do better than others in my class.
	I try to study at a time when I can be more focused.
	I convince myself to work hard just for the sake of learning.
	I make good use of my study time for this course.
	I think about trying to become good at what we are learning or doing.
	I usually study in a place where I can concentrate on my course work.
	Even when course materials are dull and uninteresting, I manage to keep working until I finish.
	I promise myself I can do something I want later if I finish the assigned work now.
	I change my surroundings so that it is easy to concentrate on the work.
2.Cognitive Strategies	When studying for this class, I read my class notes and the course readings over and over again.
	When I study for this class, I pull together information from different sources, such as lectures, readings, and, discussions.
	When I study for this course, I go through the readings and my class notes and try to find the most important ideas.
	When I study for this course, I go over my class notes and make an outline of important concepts.
	I memorize key words to remind me of important concepts in this class.
	When I study for this class, I practice saying the material to myself over and over.
	When reading for this class, I try to relate the material to what I already know.
	When I study for the readings for this course, I outline the material to help me organize my thoughts.
	I try to understand the material in this class by making connections between the readings and the concepts from the lectures.
	I make simple charts, diagrams, or tables to help me organize course material.
	I try to relate ideas in this subject to those in other course whenever possible.
3.Help Seeking	Getting help in this class would make me a better student.
	Getting help in this class would make me a smarter student.
	If I needed help understanding the lectures in this class I would ask for help.
	If I needed help with the readings in this class I would ask for help.
	If I needed help in this class I would ask someone for assistance.
	If I were to get help in this class it would be to better understand the general ideas or principles.
	I would get help in this class to learn to solve problems and find answers by myself.
	Getting help in this class would be a way for me to learn more about basic principles that I could use to solve problems or understand the material.
	Getting help in this class would increase my ability to learn the material
4.Self-Independency	Others would think I was dumb if I asked for help in this class.
	I would not want anyone to find out that I needed help in this class.
	Getting help in this class would be an admission that I am just not smart enough to do the work on my own.
	I ask myself questions to make sure I understand the material I have been studying in this class.