

Development of a method generating criteria and standards of rubric for problem-solving on VLEs

- From learner's products for the assignment

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Abstract:

We developed a rubric to enhance active learning on an online classroom of a graduate school. The analysis of the learner's products for assignment offers inspection of criteria and standards for the self-assessment in the rubric. In the present paper we show that a procedure to extract the criteria and standards for self-assessment based on outcomes of their continuous learning activities and the effect of the self-assessment with use of the rubric. It is found that the new elements of the rubric checked the performance assessment for problem-solving learning improve the quality of learner's outcomes, especially documents, for assignments required in the course.

Keywords: problem-solving, virtual learning environment, VLE, self-assessment, rubric, self-regulated learning

Introduction

Learners on Virtual Learning Environments (VLEs) are often isolated because they can see no presence of co-learners, Teaching Assistants (TAs), teachers in asynchronous learning activities. Although Learning Management Systems (LMSs) provide learners with bulletin board system (BBS) for communication tool, learners cannot have an opportunity to examine, evaluate, or/and improve his/her work through observing others learning. Learning on VLE is difficult because of asynchronous interactions with computer-mediated communication tools such as BBS cannot feedback learners in timely manner.

Consequently the difficulty with online asynchronous learning is as follows.

Teachers and TAs:

- cannot confirm the learner's condition or state, which leads to fail to personalized guidance in timely manner.
- are difficult to confirm whether learners follow appropriate procedure or not.

Learners:

- cannot obtain right answer or corrective action immediately.
- have little opportunity to enhance their learning through observing other learners working.
- tend to drop out in early stages of semester because of insufficient academic support.
- assume teachers provide little feedback with their work in the period of learning.
- are passive to receive assignments as "a mere task" with little concerns to promote cognitive strategies.

This study addressed the effect on the self-assessment using rubric for promoting self-regulated learning against the difficulty with learning of problem-solving on VLE as above.

The advantages of using self-assessment are as follows:

Teachers and TAs:

- enable learners to assess their performance with specific standards on courses period of time, then enhance learner's achievement.

Learners:

- have clear understanding of goals in terms of self-assessment.
- obtain appropriate learning guidance that leads to reduce drop out rate of the course.
- can easily know differences between expected and actual achievements with on-going self-assessment.
- understand what is essential to improve their performance.

The target course is compulsory subject offered at Kumamoto University-Graduate School of Social and Cultural Science. The course offers problem-solving, collaborative learning and VLE. Certification of credit is required to learner offering a product for assignment of assuming corporate setting, learners are required to develop proposal to meet request for proposal (RFP) of curriculum development for new employees of a virtual corporation. Items described must be included in the product for assignment is specified by teacher. The analyzed data are nineteen products for assignment.

Purpose of the Research

This study addressed effects on the self-assessment using rubric for promoting self-regulated learning against the difficulty with learning of problem-solving on VLE as above. Participants were graduate students who have various academic backgrounds and have many social experiences. These heterogeneous conditions promoted meaningful learning regarding PBL using mini-case.

On the other hand those conditions sometimes results in collision of meaning to interpret the requirements of exercises assigned on the course. We aim at to prevent learners from misunderstanding the stem, which lead to re-work or drop out.

Research question is: How can we make learner understand themselves their mistakes and lack of skills in the academic requirements clearly?

Literature Review

Definition of rubric

Arter & Chappius define the rubric which is one of the mechanisms that determines the quality of learner's tasks¹⁾. Rubric is structured as matrix with performance criteria on vertical axis and levels should be achieved by each performance criteria on row axis. Tanaka(2003) mentioned use of rubric to grade according to standards for qualitative changing point of learner's cognitive activities for learning subjects, and describes samples of product or anchors⁷⁾.

Huba & Freed insisted the meaning of evaluation using rubric, quoted Locker as bellows³⁾.

"Learning is promoted when learner themselves notice what they learn, recognize the standards described clearly, and recognize the methods understanding what is they learned. Assessment demand educational providers the performance standards with verbalism expressed clearly".

Evaluation for individual activities as "the self intension about specific items", refers to levels that achieved will structures as follows:

- Level 1: He/she cannot lead to a conclusion.
- Level 2: He/she leads to a conclusion without data based on the fact.
- Level 3: He/she leads to a conclusion with data based on the fact, but they cannot mention to prove the conclusion.
- Level 4: He/she leads to a conclusion with data based on the fact, and they mention to prove the conclusion.

Arter & Chappius mentioned the facilities by using rubric as bellow¹⁾:

- 1) Rubrics help teacher clarify themselves what ambiguous learning targets look like. They help learners do the same.
- 2) Well described rubric that includes clear performance criteria and standards is worked as the assessment for learners.

Procedure of rubric development

Linn & Gronlund offer four categories as general standards to describe the learning targets using rubric, that is to say performance criteria⁶⁾.

- 1) Definite contentions, arguments and composition
- 2) Embodiment, Specified
- 3) Exquisite main subject
- 4) No lexical error

In addition, they mentioned that it should do following procedures to determine the performance criteria and standards for each level should be achieved. The table 1 is procedure for rubric development that Linn & Gronlund insist, arranged by Taga.

Table 1 procedure for rubric development by Linn & Gronlund

Step	Details
1)	Reviewing the learning targets assigned each lecture. By review, the learning targets and instructions will be accommodated standards for grading.
2)	Introducing attributes should be included/not included in the product. By this work, the skills and the behaviors mastered through the learning will be observed.

Table 1 continued

Step	Details
3)	Expressing idea for explain the each attributes. The method should be explained clearly for the excellent /average/poor performance for observed each attribute introduced at step 2.
4)-a	As holistic rubric, describing complete details about excellent and poor performance for each attribute. Connecting up descriptions for whole attributes to describing both the highest and lowest class's performance levels.
4)-b	As individual rubric, describing complete details about excellent and poor performance for each attribute. Describing the details for that suitable grade. Prompts or encouragements for learners should be included in the described details.
5)-a	As holistic rubric, determining the edges the highest/lowest levels for the holistic attributes. And describing the middle range level.
5)-b	As individual rubric, determining the edges the highest/lowest levels for the holistic attributes. And describing the middle range level.
6)	Collecting samples of learner's products to instance each level.
7)	Revising rubrics on needs. Evaluating the result of rubric at classroom. Revising before next semester.

(Linn & Gronlund(2000) ⁶⁾ arranged by Taga)

The elements including rubric for performance assessment

Jonassen(2004)⁵⁾ mentioned that rubric should develop addressing both product and process. Jonassen(2004)⁴⁾ quotes Elliott(1995)²⁾:

Elliott insists that performance assessment includes these elements.

- Learner must construct a response or a product rather than simply select from a set of predefined alternatives or answers.
- Assessment consists of direct observation or assessment of student behavior on problem-solving tasks.

To those, Jonassen add a third:

- Assessment of quality of the product or observation using a rubric, that is, a description of desirable performance.

Self-regulation at cognitive strategies

Zimmermann mentioned there are three stages of self-regulation: Planning, Execution, Introspection⁸⁾. On social cognitive theory, Execution stage is composed by three sub-stages: Self-monitoring, Self-judgment, Self-reaction. Self-recording helps Self-monitoring⁹⁾.

Method

Target course and analyzed data

The target course is compulsory subject offering at Kumamoto University-Graduate School of Social and Cultural Science. Course objectives are to acquire knowledge and skill regarding problem-solving through collaborative learning activities on VLE. Participants are nineteen graduate students who had experienced practices. Teachers gave learners a case which describes a corporate situation. Learners are required to submit proposal of employee's performance improvement for technical boot camp of the corporation. Components of proposal were pre-defined by teachers and the course material on the VLE gave learners instruction to include specific topics related the components in their products assignment. The data analyzed were documents submitted for course assignments.

Viewpoints for developing criteria of rubric

Linn & Gronlund⁶⁾ mentioned the criteria described in the rubric is "learning targets and attribute include in it", as prior chapter.

The learning target of problem-solving belongs to cognitive domain. According to Bloom cognitive performance criteria are grouped into six categories: Knowledge, Comprehension, Application, Analysis, Integration and Evaluation. Problem-solving requires to be conducted all six kind of performance including analysis, integration and evaluation. Therefore, performance criteria should be required not only Knowledge or Comprehension level but also next step of learning, so-called, Application, Analysis, Integration and Evaluation.

The target course is designed as a *learning sequence* that learner should collect data on the case that presented, analyze problems, consider solutions, estimate various essential resources, and offer the feasible planning sheet as document finally. We aim rubric has *elements based on the structure of product* required in the course assignments.

The performance criteria and level achieved are evaluated by decoding the attributes included in the product, and relation, strength and weakness between them.

Concept of rubric development for continuous learning activities at problem-solving

We developed the concept of method of generating criteria and standards for rubric as self-assessment for problem-solving based on the “*sequence of learning activities*” that learners should take. The method is as follows:

- (1) List up items that should be described in the product for assignment by instruction.
- (2) Relate these items with each other.
- (3) Identify activities what should to perform the task required. These activities that found are “true learning activities”.
- (4) Re-compose these activities into “true sequence of learning activities”.
- (5) Categorize the sequence of learning activities as “the performance that should be assessed”.
- (6) Integrate/organize collections of performances that should be assessed into “holistic skills will be achieved” that is to say “learning target of the course/curriculum”.
- (7) Offer the standards for each level achieved as each activity in the learning sequence.
- (8) Offer the anchor for the standards as the product which is made at the activity in the learning sequence.

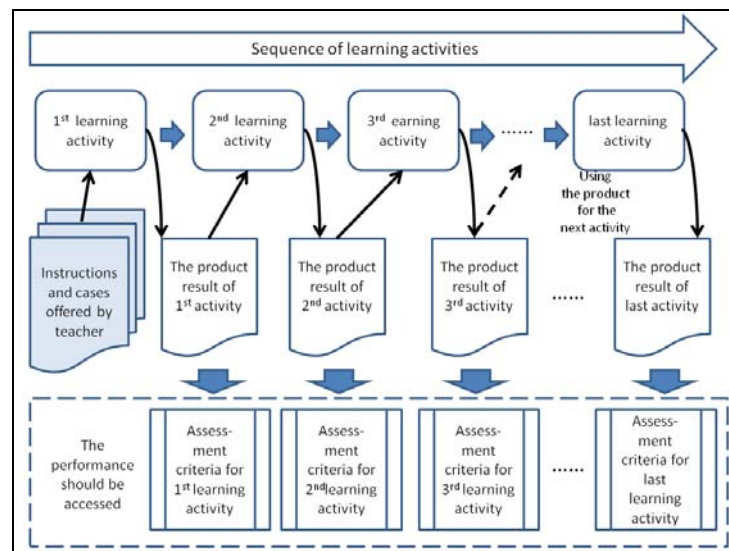


Figure 1 Concept of rubric development for continuous learning activities at problem-solving

Analytical processes of products for assignment

We used to data analysis method in order to develop achievement’s grade. The procedure for the analysis is:

- (1) Obtain nineteen products for assignment with digital data.
- (2) Segment product into a unit of phrase in relation to chapter.
- (3) Code every segmented data with appropriate labels.
- (4) Examine if the description of the segmented data is related to other description of the product.

The rating rules are:

- a. There is no description about the subject that must be included by instructions.
 - b. There is a description without the fact based on case offered.
 - c. There is a description without coherence on the case offered to mention to prove the conclusion.
 - d. There is a description with coherence on the case offered to mention to prove the conclusion.
- (5) Deform achievement level for each unit of learning in terms of the rating of step (4).

Implement technique of development rubric

Actual technique for making rubrics is as follows:

- (1) Describe or illustrate whole sequence of events in the course. Make the material that teacher would offer and

products learners should submit clear.

- (2) Make the items and indexes of product to be submitted should be clear. Describe or illustrate flowchart of the sequence of events in the lecture.
- (3) There may be several products of learner's work. Divide a sequence into several sub-sequences each product. Make only one "re-arranged sequence" for one product. Each criteria of rubric for self-assessment corresponds these re-arranged sequence.
- (4) By step above, only one product is corresponded only one sequence of events. Several products may correspond to one sequence of activities, constraint on which meets the condition that the sequence of learning activities needs all products for progress to next sequence.
- (5) Set different criteria, if identify a fork of the sequence of events.
- (6) Consider the loop of sequence of events whether the whole of loop can regard as one sequence. For example, the sequence of learning activities is an analysis from various points of view to obtain appropriate resolve for the problem that found by needs analysis
- (7) Arrange the standard achieved of the lowest level is the first activity of the sequence of learning activities, and the standard achieved of the highest level is the last activity of that one.

Results and Discussion

Formative evaluation

We did the formative evaluation by questionnaires to learners and interviews to teacher. Based on analysis on the responses of the questionnaires, we concluded that offering rubrics in the course as self-assessment on problem-solving in VLE is effective in advance promote learning, and self-judgment of self-regulated learning.

These opinions from the questionnaires to learners categorized evaluation indexes by social cognitive theory as follows:

(1) Encouragement of Self-monitoring

- I used it as rating of perfection at developing the product for assignment.
- Rubric is useful for checking if there was lack of consideration or description.
- It is useful not only check-list but also interactive evaluation.
- To continue such learning and guidance, it may progress with learner's achievement.
- Rubric is useful to learners who have scant experience in this field.
- Rubric is useful to follow up learning appropriate such VLE, it includes difficulty to interact each learner synchronously.
- Self-assessment is important both VLE and face-to-face classroom. It is meaningful to train method or concept about assessment.

(2) Encouragement of Self-Judgment

- I used it as self-checking before tendering the products for assignment.
- Rubric offers criteria and standards for learning goals and levels achieved.
- Rubric is useful to learn critical viewpoint.

(3) Encouragement of Self-Reaction

- First I couldn't use it effective. When feedback from teacher has returned, I have understood the meanings of the rubric how to use.
- I have understood that I should pass judgment on samples offered on the course too.

These opinions from the interviews to teacher directed our attention to sequence of the learning activities:

- There were differences of grading between teacher's assessment and learners self-assessment for the products for assignment. The learners almost tend to grade their products higher than teacher.
- Teacher's impression was the learners tried to carry on their learning by their own interpretation without true comprehension or confirmation that the tasks required.
- Teacher guessed those results were the reasons why the rubric first we developed was based on only instructions and items described must be included in the product for assignment and there was no concrete anchor in the rubric.

To implement rubrics developed by our insist is supposed hopeful to obtain the effect that both learners and teachers can confirm the absolute improvement for individual level achieved, or can sense the fulfillment as a learner.

Sample of self-assessment

As described prior section, we extracted elements of rubric and used them to conduct self-assessment on the course. Figure 2 illustrates an example of self-assessment worksheet, its criteria and standards were derived from the extraction procedure.

We have considered series of the learning actions of analysis need as follows:

- (1) Extracting the data, writings regarding needs from assignment case.
- (2) Subdividing writings into simple sentences.
- (3) Classify simple sentences as categories of needs.
- (4) Relate each classified category with other categories.
- (5) Leading the issues from related categories of needs.

	Level 1	Level 2	Level 3	Level 4	Level 5
	<p>Extracting the data, writings regarding needs from assignment case.</p> <p>ニーズを抽出できている状態。「抽出する」とは、元のデータをそのままの形で、表などでまとめることである。「文」にするには、接続詞や句点(、)の箇所を分断する。元データは、「文章」として表現されている。</p>	<p>Subdividing writings into simple sentences.</p> <p>データが細分化できている状態。「細分化する」とは、元データを「文」の単位で切り出すことである。「文」にするには、接続詞や句点(、)の箇所を分断する。元データは、「文章」として表現されている。</p>	<p>Classify simple sentences as categories of needs.</p> <p>「分類」が出来る状態。「分類する」とは、細分化したデータが示していることが何に属するものなのかを識別することである。識別した結果、似たもの同士を示す共通の言葉(カテゴリー)を見つける。そして似たもの同士をまとめる。</p>	<p>Relate each classified category with other categories.</p> <p>カテゴリー同士の統合(関連付け)が出来ている状態。抽出したカテゴリーが示している事項に着目し、他のカテゴリーでの事項と関連があるか見極める。あるカテゴリーと親子関係になるかなど、判断する。</p>	<p>Leading the issues from related categories of needs.</p> <p>課題が導き出されている状態。カテゴリーに統合したニーズから、課題や問題点、確認すべき事項を短い言葉で表す。</p>
<p>Analysis Needs, then Finding the problems</p>	<p>課題抽出</p> <p>課題抽出の目的は、課題抽出の目的を達成するために必要なデータを抽出することである。課題抽出の目的は、課題抽出の目的を達成するために必要なデータを抽出することである。</p> <p>課題抽出</p> <p>課題抽出の目的は、課題抽出の目的を達成するために必要なデータを抽出することである。課題抽出の目的は、課題抽出の目的を達成するために必要なデータを抽出することである。</p> <p>課題抽出</p> <p>課題抽出の目的は、課題抽出の目的を達成するために必要なデータを抽出することである。課題抽出の目的は、課題抽出の目的を達成するために必要なデータを抽出することである。</p>	<p>課題抽出</p> <p>課題抽出の目的は、課題抽出の目的を達成するために必要なデータを抽出することである。課題抽出の目的は、課題抽出の目的を達成するために必要なデータを抽出することである。</p> <p>課題抽出</p> <p>課題抽出の目的は、課題抽出の目的を達成するために必要なデータを抽出することである。課題抽出の目的は、課題抽出の目的を達成するために必要なデータを抽出することである。</p> <p>課題抽出</p> <p>課題抽出の目的は、課題抽出の目的を達成するために必要なデータを抽出することである。課題抽出の目的は、課題抽出の目的を達成するために必要なデータを抽出することである。</p>	<p>課題抽出</p> <p>課題抽出の目的は、課題抽出の目的を達成するために必要なデータを抽出することである。課題抽出の目的は、課題抽出の目的を達成するために必要なデータを抽出することである。</p> <p>課題抽出</p> <p>課題抽出の目的は、課題抽出の目的を達成するために必要なデータを抽出することである。課題抽出の目的は、課題抽出の目的を達成するために必要なデータを抽出することである。</p> <p>課題抽出</p> <p>課題抽出の目的は、課題抽出の目的を達成するために必要なデータを抽出することである。課題抽出の目的は、課題抽出の目的を達成するために必要なデータを抽出することである。</p>	<p>課題抽出</p> <p>課題抽出の目的は、課題抽出の目的を達成するために必要なデータを抽出することである。課題抽出の目的は、課題抽出の目的を達成するために必要なデータを抽出することである。</p> <p>課題抽出</p> <p>課題抽出の目的は、課題抽出の目的を達成するために必要なデータを抽出することである。課題抽出の目的は、課題抽出の目的を達成するために必要なデータを抽出することである。</p> <p>課題抽出</p> <p>課題抽出の目的は、課題抽出の目的を達成するために必要なデータを抽出することである。課題抽出の目的は、課題抽出の目的を達成するために必要なデータを抽出することである。</p>	<p>課題抽出</p> <p>課題抽出の目的は、課題抽出の目的を達成するために必要なデータを抽出することである。課題抽出の目的は、課題抽出の目的を達成するために必要なデータを抽出することである。</p> <p>課題抽出</p> <p>課題抽出の目的は、課題抽出の目的を達成するために必要なデータを抽出することである。課題抽出の目的は、課題抽出の目的を達成するために必要なデータを抽出することである。</p> <p>課題抽出</p> <p>課題抽出の目的は、課題抽出の目的を達成するために必要なデータを抽出することである。課題抽出の目的は、課題抽出の目的を達成するために必要なデータを抽出することである。</p>

Figure2 Sample of self-assessment (Analysis of needs)

The new element of rubric for performance assessment

As mentioned at literature review, Jonassen⁵⁾ quotes Elliott(1995)²⁾:

Elliott insists that performance assessment includes these elements.

- Learner must construct a response or a product rather than simply select from a set of predefined alternatives or answers.
- Assessment consists of direct observation or assessment of student behavior on problem-solving tasks.

To those, Jonassen add a third:

- Assessment of quality of the product or observation using a rubric, that is, a description of desirable performance.

We would like add a fourth, modestly:

- Assessment of quality of the product or observation using a rubric for cognitive domain for example problem-solving, the criteria and standards should be developed based on the sequence of activities what the learners should perform their required tasks to lead to their self-regulation.

Conclusion

We developed a procedure to extract the criteria for self-assessment based on outcomes of their continuous learning activities, and examined the effect of the self-assessment by using rubric.

By the results of the analysis, we introduced hypothesis that *self-assessments based a sequence of the learning activities using rubric are effective in advance promote learning*, and developed the method to generate criteria and standards of rubric from the products for the assignment.

The outcomes of this study are as follows:

- (1) By formative evaluation, the hypothesis as above, self-assessments using rubric for self-assessment based a series of the learning activities is effective to advance promote learning.
- (2) Based on this target course, we have developed a procedure of rubric development to introduce performance criteria and standards as self-assessment for problem solving. For example, to resolve the learning processes of the course into tasks based a series of the learning activities to place these tasks as the standards, then to present each middle product by each tasks as samples or anchors.

Further research is required in order to address questions about the components of successful online PBL using our rubric, and determine whether our rubric can promote development of learner's self-regulation.

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