Viewbrics: Formative Assessment of Complex Skills with Video-Enhanced Rubrics (VER) in Dutch Secondary Education

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Abstract. To learn complex skills, like collaboration, learners need to acquire a concrete and consistent mental model of what it means to master this skill. If learners know their current mastery level and know their targeted mastery level, they can better determine their subsequent learning activities. Rubrics support learners in judging their skill performance as they provide textual descriptions of skills' mastery levels with performance indicators for all constituent subskills. However, text-based rubrics have a limited capacity to support the formation of mental models with contextualized, time-related and observable behavioral aspects of a complex skill. This paper outlines the design of a study that intends to investigate the effect of rubrics with video modelling examples compared to text-based rubrics on skills acquisition and feedback provisioning. The hypothesis is that video-enhanced rubrics, compared to text based rubrics, will improve mental model formation of a complex skill and improve the feedback quality a learner receives (from e.g. teachers, peers) while practicing a skill, hence positively effecting final mastery of a skill.

Keywords: video; rubrics; (formative) assessment; complex skills; feedback; mental model; technology-enhanced assessment; 21st century skills

1 Introduction

Complex generic skills, such as collaborating, presenting and being information literate, are gaining increased attention in Dutch secondary education. These skills and others, although not new in their nature and disposition, are even at both national and international policy level renamed and their importance further emphasized under the label '21st century skills'. 21st century skills are generic complex skills (and associated knowledge and attitudes) which are generally seen as necessary in order to live and work in the future and to contribute to a knowledge society. Complex skills consist of constituent subskills which concertation require high cognitive effort and concentration [1][2], and prolonged repetitive practice in order to master them. Complex generic skills are not specific for a domain, occupation or type of task, but important

adfa, p. 1, 2011.

for all kinds of work, education and life in general. These skills are applicable in a broad range of situations and many subject domains [3].

Many primary and secondary schools are struggling with how to teach and evaluate students' performance on these complex generic skills in their daily educational practice [4]. Although these skills are seen as important by both policy makers as well as teachers and school managers, few countries have developed teaching methodologies and assessment policies for them. Project-based education, wherein multiple domains (like chemistry, physics and biology) are combined in the project, is often used to address these skills It is then assumed that when learners need to use these generic skills during the execution of a project, they will automatically acquire these skills. However, as in many cases no specific instructional support is given towards skills' acquisition, it is highly unlikely that students will actually master such skills during project-based education. Dutch teachers are aware of the importance of acquiring complex generic skills by their pupils and they do in fact pay attention to them in their educational practice, however not very explicitly, structurally and on a regular basis [5]. What is needed is to structurally support the learning process towards pupils' complex skill's mastery. One of the instruments to support a skills' acquisition is an analytic assessment rubric [6].

An analytic assessment rubric is a textual description of the different mastery levels of a skill (represented by learning objectives) by means of (a set of) performance indicators [6]. Such indicators specify aspects of variation in the complexity of a skill (e.g. presenting for a small, homogeneous group compared to a more complex presentation for a large heterogeneous group), constituent sub-skills and related performance levels [7]. An analytic rubric is a suitable instrument to structure teachers'/peers' timely and informative feedback while practicing a skill, but also to clarify and make expectations about the strived-for mastery level(s) of a skill clear in advance to the learner. This helps learners at the start and during their learning activities to envisage the targeted mastery level of the skill [8]. The target mastery level of the skill depends on the educational level, e.g. a rubric for a skill in lower secondary education will be different compared to one in upper secondary education. By using analytic assessment rubrics actors (e.g. learners (amongst each other), teachers, experts) can communicate about the requirements, expectations of skill's mastery levels [9] and in this way monitor skills progress and eventually adjust the teaching-learning process [10]. This enables learners, while practicing a skill, to pay extra attention to the aspects of a skill that they didn't master yet very well.

Currently the targeted mastery level of a skill is often expressed by means of a text-based (analytic) rubric. However, many aspects of this targeted behavior refer to motoric activities, time-consecutive operations and processes that are hardly captured in text (e.g. body posture or use of voice during a presentation). In addition, the context in which the skill is practiced is important for its learning, as it implies and generates implicit knowledge (tacit knowledge, 'knowing how'), which is interwoven with practical activities, operations and behavior in the physical world [11]. Therefore, text-based rubrics only have a restricted capacity to clarify the targeted mastery level of a skill and to assess shown behaviour [12]. However, these restrictions can be overcome with video-enhanced rubrics (VER), which will be developed and stud-

ied within the Viewbrics-project (www.viewbrics.nl). A video-enhanced rubric (VER) is the synthesis of video modelling examples and a text-based analytic rubric in a digital formative assessment format. Supposedly, video-enhanced rubrics can foster learning from observation of (good/bad) video modelling examples [11] [12][13], thus supporting mental model formation, when combined with textual performance indicators. For example, looking at positive effects of video-modelling examples only, Van Gog and colleagues found an increased performance of task execution when a video-modelling example of an expert was shown[16] and De Grez and colleagues found comparable results while learning presentation skills[17].

Furthermore, text supposedly leaves more space for personal interpretation of the performance indicators of a complex skill than video, which probably negatively influences mental model formation of a skill and is detrimental for feedback consistency of assessors. When teacher trainees compare their own performance with video-modelling examples they 'overrate' their own performance less during self-reflection than without these examples and had an improved insight in their performance compared to the targeted mastery level of a complex skill [18]). Overarching research on mastering complex skills [1] indicates that both modelling examples, variety of application context as frequent feedback positively influence the learning process and skills' aquisition. Finally, video modelling examples also capture 'know-how' (procedural) knowledge and may also include 'know-why'(strategic/decisive) knowledge, which can be used during practicing a skill as well as while providing feedback.

The idea of developing and testing the effect of video-enhanced rubrics with modelling examples also grew from experiences in daily educational practice in a previous project (PREATY). Here students indicated that, although they had rubrics to support them, they were still not yet sure of what was exactly expected from them when they mastered a complex skill. This was shown in the kind of questions they asked, like 'what should I do exactly?''to what should I pay attention to? ' as well as in an insufficient ability to underpin their assessment of peers performances while practicing 'presentation' skills. After offering several video-modelling examples of presentations in combination with the rubrics, students seemed to gain in fact more insight in what exactly was expected from them.

To summarize, we expect that the use of video modelling examples (illustrating 'good' as well as 'bad' behavior in context) with information in different modalities (moving images, sound), combined with text-based rubrics, would better foster a more concrete and consistent mental model of a complex skill amongst students and teachers than solely using text-based rubrics, leading to improved quality of feedback given by teachers or peers during skills training, and subsequently resulting in more effective or efficient skill mastery. These expectations are not only grounded in combining several (previously uncombined) research perspectives, but was also inspired by previous practical experiences with students' using rubrics to assess each other within the PREATY-project.

2 The Viewbrics project - Participatory research and design (R&D)

The Viewbrics project (www.viewbrics.nl) is a three year research and development project, which started September 2015. In this project we study whether a combined use of video-modelling examples with text-based rubrics indeed more positively effects the mental model formation of, the feedback on and the mastery of several complex skills by students in Dutch lower secondary education when compared with text-based rubrics. This will be done for three complex transversal skills: 1) presenting, 2) information literacy, 3) collaborating. These skills were chosen while they vary in the way they are practiced, e.g. in the number of actors providing feedback and timing of feedback moments (e.g. feedback on a presentation will be given after a performance of this skill, whereas feedback on collaboration will be given while pupils still collaborate), as well as because they are often implicitly offered and practiced in combination with other learning tasks in Dutch secondary education, however not yet in a structured and explicit manner, receiving separate attention [5], p.103).

In the project a cyclic, participatory research and design (R&D) approach is chosen, in which teachers (from different disciplines), students and researchers collaborate in a core team. The team is supplemented with additional design expertise, like e.g. script-writing, multimedia, programming and interface experts, when needed. For the validation of the three rubrics and the video-modelling examples a broader group of teachers and students will be involved (e.g. by means of a MOOC on formative assessment).

The core team designs and develops rubrics with video-modelling examples for presenting, collaborating and information literacy skills, based on general as well as specific multimedia design principles as well as scientific literature of and existing text-based rubrics for these complex skills. Intermediate results are discussed in joint focus group meetings. Furthermore, a digital 360-degree feedback and assessment instrument is developed, based upon the final version of the validated rubrics, which secondary schools can use to provide formative feedback on students practicing complex skills and monitor students' progress on mastering the skill. This will be accompanied with instruction and workshops for teachers and students on formative assessment, feedback and the use of assessment rubrics. For research purposes several instruments will be developed by the core team: 1) design guidelines (grounded in theory) for video-enhanced rubrics with modelling examples 2) an analytic framework for feedback quality, which will be used to compare the feedback quality between different research conditions, 3) questionnaires, interviews and a coding scheme for analyzing teachers' as well as students' experiences with the use of video-enhanced rubrics.

The cyclic, participatory R&D process is structured in four phases, three phases dedicated to design-oriented research in which different (groups of) actors (researchers, teachers, students) are involved in developing and testing (with broader stakeholder groups) different versions of the (theory-and practice informed) video-enhanced ru-

brics with the video-modelling examples ('raw' recordings at school => scenes acted by pupils => scenes acted by actors) and the digital 360 degree feedback instrument. In these phases also two lab experiments are foreseen. The first experiment will study three alternative designs of a VER and the second experiment will look at effects of alternatively a text-based rubric, video-modelling and a VER on mental model formation and on the working memory of a student. The fourth phase is dedicated to an empirical study with the validated video-enhanced rubrics.

A quasi-experimental design will then study the effectiveness of the video-enhanced rubrics (VER) on students' behavior for the three complex skills , where the experimental group receives VER and the control group only text-based rubrics. This study will take place in three secondary schools, where generic skills will be implemented in different domains (e.g. Science, linguistics).

Table1 provides a schematic overview of the research design.

Table 1
Research design of empirical study

Intervention-condition:	W	O1	$\mathbf{X_{1...n}}$	$O2_{1...n}$	O3	N= min. 60 (across different schools)
Control-condition:	W	O1		$O2_{1...n}$	O3	N= min. 60 (across different schools)

W =	workshop on formative assessment, providing/receiving feedback and use of rubrics and digital 360 degree assessment instrument
O1 =	- measure of performance level of students on the skills presenting, collaborating and information literacy by means of text-based rubrics and control variables (e.g. gender, age) (pre-test)
$X_{1...n}$= interventie	- use of rubrics with video-enhanced rubrics while practicing the skills (in the control condition the same text-based part of the rubrics is used, however without video modelling examples)
$O2_{1...n}$ =	Measure of feedback quality (consistency, concreteness and as perceived) received while practicing a skill
O3 =	- measure of performance level of students on the skills presenting, collaborating and information literacy by means of text-based rubrics and control variables (e.g. gender, age) (post-test)

Both groups receive instruction in advance about providing feedback, the use of rubrics and the digital assessment instrument for assessing own or peers' performances. In both groups the feedback is provided through the digital assessment instrument by one or more peers and their teacher. The initial performance level on the studied complex skills is measured in both groups, as well as the performance level at the end of

the study by means of the developed (text-based part of the) assessment rubrics by two raters. Feedback effects in both groups are measured in terms of:

1) ***Consistency of feedback****:* the difference between assessors' (self-,peer-and teacher/expert feedback) assessment of the same performance. The assumption is that if the mental model of a skills is more consistent between actors, than the assessment similarity is higher. We expect a higher consistency of feedback in the video-enhanced rubric condition compared to the text-based rubric condition.
2) ***Concreteness of feedback:*** number of times that in the free space for feedback and in additional interviews is referred to concrete behavioral aspects and the practical application of a skill. We expect more concrete references in the video-enhanced rubric condition compared to the text-based rubric condition, due to a richer mental model.
3) ***(Perceived) feedback quality:*** feedback quality of the textual feedback provided by actors as measured through indicators in an analysis framework as well as in 10 sampled interviews (with 5 students and 5 teachers) per condition.

The initial and final skill mastery levels of students participating in this study will be measured by using the text-based analytic rubrics, so that we can determine whether the final mastery of the skills differ between both research groups.

Next to the (co-)constructed scientific and practical knowledge developed in this project, the project also has several practical outcomes, relevant for (Dutch) lower secondary education. It delivers validated and re-usable video-enhanced rubrics for three (very different) complex skills, that are expected to be more effective for learning a skill than the currently used rubrics. Additionally, a digital 360 degree assessment instrument is developed for three skills that can be easily customized by teachers. Furthermore, guidelines and instructions for conducting formative assessment and providing feedback, use of (video-enhanced) rubrics and the digital 360 degree assessment instrument are generated, which will be used in workshops and an online masterclass for teachers training. Similar workshops will be designed for students. All final outcomes will become available through the project website.

3 Conclusion and future research

The research and development activities of the Viewbrics project are currently in the first phase of the project, where the rubrics of three complex skills (collaborating, presenting and information literacy) and the accompanying video-modelling examples are developed (grounded in theory as well as practice) in a video-enhanced rubric (VER) and tested with stakeholders. Rubrics as well as the video-modelling examples will be adapted and further developed and tested in the near future, finally resulting in the test of effectiveness of a VER in the last phase of this study.

Although there is research available on formative assessment, the use of rubrics, modelling examples and the use of multimedia for learning respectively, research on the combination of these concepts to learn complex skills is rare. Moreover, Dutch secondary education is in the process of a transformation, where generic complex skills will receive more emphasis and are integrated with learning and applying domain-specific knowledge. Video-enhanced rubrics may become one of the instruments providing teachers with some structure to deal with this change in their daily educational practice.

Concluding, the results of this study are expected to fill a gap in current scientific research as well as in (Dutch) educational practice. Future research and development results will reveal whether video-enhanced rubrics (VER: the synthesis of video modelling examples and a text-based analytic rubric in a digital formative assessment format) will indeed have the expected positive impact on mental model formation, feedback quality and final mastery of a complex skill.

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