LTHs 7:e Pedagogiska Inspirationskonferens, 30 augusti 2012

Blooms taxonomy as a tool to align screencasts with intended learning outcomes

Per Warfvinge
Department of Chemical Engineering, Lund University
221 00 Lund
Email: per.warfvinge@chemeng.lth.se

***Abstract*—A set of 17 screencasts were evaluated in relation to verbs associated with different levels of cognitive processes, as defined in Blooms (revised) taxonomy. The eight verbs ranked by students as most relevant – ”describe”, ”define”, ”recognize”, ”summarize”, ”exemplify”, ”illustrate”, ”solve” and ”analyze” – to characterize the screencasts primarily represent low order cognitive processes. It is suggested that the methodology presented can be used to align instructional components with intended learning outcomes.**

***Index Terms*—screencast, vodcast, bloom, learning outcome, chemical engineering, reactors, kinetics**

I. Introduction

A screencast, or vodcast, is a digital recording of what is displayed on a computer screen, supplemented with a narrative voice. Screencasts are often used for instructional videos, for example to demonstrate software, but also in higher education. Screencasts is thus an asynchronous technology, available to the learner on demand. There is a wealth of evidence that students appreciate to have access to such digital resources, e.g. [3], and opens for adaption of instruction to individual learning styles [4].

The objective of this paper is to present a case study of how screencasts students and perceived screencasts, and – more importantly – how screencasts supported student learning in relation to the intended learning outcomes, using the revised Blooms taxonomy as framework of reverence.

II. Background

1) Course context: The empiric data stem from the course module Mass Transfer Processes in Environmental Engineering, offered in year 3 of an integrated, five-year program leading to a MSc in Environmental Engineering. The subject area was chemical reaction engineering, and the screencasts covered a three-week course section on process- and reactor calculations. Subject matters included mass balances, kinetics, ideal and non-ideal reactors and numerical methods.

Each screencast could be streamed from iTunes U[1] or downloaded from a website.

The seventeen screencasts were not recorded lectures, but a series of slides, typically 20-30, with a narrative voice. Many screencasts included problem solving examples, such as Matlab programming examples. Each screencast (typically 6-10 minutes) dealt with a specific section of the course compendium, and covered all theory and all methods that support the intended learning outcomes. The presentation of the subject matter in the screencasts was straightforward and formal, with several basic examples but with few analogies or additional perspectives. This was also reflected in the intended learning outcomes that contain ten verbs, where ”calculate”, ”suggest”, ”use”, ”identify”, ”communicate”, ”discuss” and ”set up” appear once while ”analyze”, ”perform” and ”solve” appear twice.

The third week of the course section ended with a mid-term exam on the course section.

2) Interpretation framework: Blooms (revised) taxonomy: Blooms taxonomy is a framework to categorize intended learning outcomes in (higher) education, as a result of teaching. The term teaching must be understood in a broad sense, encompassing (at least) organized classroom activities and resources suggested or provided by the instructor.

Although the revised taxonomy [1] has two dimensions, the cognitive process dimension is arguable the most essential. It contains six categories (Table I), often seen as stretching from lower order to higher order cognitive activities. Each category is attributed a set of verbs, often used to formulate intended learning outcomes. There is no universally agreed set of verbs for each category, and there is apparently a wealth of sets being used.

A. Methods: Data and statistics

Directly after the mid term exam, in the beginning of study week 4, a web survey was distributed to all students registered on the course, containing four questions:

1) How many podcasts have you watched?
2) I watched them on my:
3) To what extent do you find the following words relevant to the podcasts? with 24 verbs to evaluate on a four-level scale ”highly relevant”, ”quite relevant”, ”weak relevance”, and ”no relevance”.
4) Please give comments on the podcast and how you use them (open-ended)

[1]Videos L1–L17 on http://itunes.apple.com/us/itunes-u/mass-transfer-processes-in/id473930629 as of June 19, 2012

TABLE I
COGNITIVE PROCESS DIMENSIONS AND CORRESPONDING VERBS SUBJECT TO RANKING BY THE STUDENTS.

	COGNITIVE PROCESS DIMENSION					
	Remember	Understand	Apply	Analyze	Evaluate	Create
Descriptor	*Retrieving relevant knowledge from long-term memory*	*Determining the meaning of instructional messages*	*Carrying out or using procedures in a given situation*	*Breaking material into its parts and detecting how they relate to one another and the overall structure or purpose*	*Making judgments based on criteria and standards*	*Putting elements together to form a coherent whole*
Characteristic verbs selected	Define Describe Memorize Recognize	Exemplify Illustrate Interrelate Summarize	Generelize Choose Solve	Analyze Categorize Compare Prioritize	Criticize Evaluate Judge Relate	Create Combine Construct Develop Organize

Out of 61 registered students, 41 responded to question 1. Of these, 36 ranked verbs according to question 3, while 38 gave open-ended answers to question 4. All students responding to question 3 has watched at least one screencast.

A total of 24 verbs relevant to the context were selected for question 3 (Table I). The number was kept down in order not to discourage the students from answering. The data from question 3 above can be seen as 24 sets of discrete data. To test of two such sets (do not) come from identical, continuous distributions with equal medians, a non-parametric method – Mann-Whitney U-test – was used. As the test is based on ranking of data, responses can be assigned any numerical value without obscuring the statistical properties or conclusions.

III. RESULTS

A. Usage and platforms (questions 1 and 2)

Most students used their laptops to view the screencasts, mostly from iTunes U (data not shown here). About equal parts of the students viewed a maximum of five screencasts, a quarter viewing 11 or more (Table II). One out of six students (17%) viewed all screencasts. Some students indicated they viewed few because of slow connection.

B. Open-ended question (question 4)

Almost all, 38 out of 41 responding students provided some comments. Virtually all expressed positive views. The students use the podcast as complement and replacement for lectures, and they view them before or after. More specifically, the most frequent (>10) comment was that the podcast was used as replacement for lectures: "I used the podcasts when I was sick and not able to attend lectures.", and " I think it is very good to have the podcasts [] if you miss a lecture."

The flexibility offered by the screencasts was commented on by was several students: "Gives us an option to plan our own time", and "Saves us a lot of time which we can use to study and try to solve the problems instead!"

Students also used the screencasts for summary or to review: "First I read the book, then I used the podcast as summary.", "Useful reviews of the real lectures.", "I used them when I was studying for the mid-term exam", and "An extremely useful tool for combining with lectures."

Another frequent comment was that screencasts are good for reviewing since they can be paused and restarted: "Nice when watching in groups since you can always pause and discuss", "Since you can pause the podcast and replay it, it is easy to repeat something you didn't understand", and "Good to be able to pause and restart if there is something you did not understand immediately."

Students also recognized that screencasts fill a gap related to different learning styles: "It is appreciated that you devote time to adjust the teaching to all types of students", and "It was also good to go back and look at podcasts when repeating instead of reading the book since I learn easier by listening to someone."

One student expressed some concern: "The only risk is that some students only view the screencasts. Then you miss additional examples and deeper explanations."

Some students commented, in different ways, on the alignment between lectures, screencasts and the book: "You recognize the structure from the book", and "However, I did find that some lectures as podcasts was not at all equivalent to the live lectures."

Despite the positive comments, a majority of the students only viewed five or fewer screencasts: "Watched them at first but then only attended live lectures."

Finally, several students voiced a general appreciation: "Keep on doing them!", "Keep it up!", and "Great system, I wish more courses had them."

TABLE II
NUMBER AND PERCENTAGE OF STUDENTS THAT HAD WATCHED A CERTAIN NUMBER OF SCREENCASTS OUT OF 17 AVAILABLE, BASED ON ANSWERS TO " HOW MANY PODCASTS HAVE YOU WATCHED?"

None (0)	1-5	6-10	11-16	All (17)
4 (11%)	17 (41%)	10 (24%)	3 (7%)	7 (17%)

C. Ranking of verbs according to relevance (question 3)

When the students ranked the verbs, from highly relevant to no relevance, the verbs fell into three statistically well-defined categories, as illustrated in Table III. According to the Mann-Whitney U-test there is 95% probability that all verbs listed among the most relevant verbs were ranked truly differently

TABLE III
RANKING OF VERBS ASSOCIATED WITH DIFFERENT COGNITIVE PROCESS DIMENSIONS, ACCORDING TO THE VERBS' RELEVANCE TO CHARACTERIZE THE SCREENCASTS, BASED ON ANSWERS TO "TO WHAT EXTENT DO YOU FIND THE FOLLOWING WORDS RELEVANT TO THE PODCASTS?"

	COGNITIVE PROCESS DIMENSION					
	Remember	Understand	Apply	Analyze	Evaluate	Create
Most relevant verbs	Describe Define Recognize	Summarize Exemplify Illustrate	Solve	Analyse		
Intermediate group		Interrelate	Choose	Compare Prioritize	Relate Evaluate	Develop Combine
Least relevant verbs	Memorize		Generalize	Categorize	Judge Criticize	Organize Construct Create

by the students as compared to all the verbs listed among the least relevant ones.

It is obvious that the students favored verbs related to the least complex cognitive processes to describe the screencasts in the course. However, even within each category, verbs fall in more than one relevance class. For example, in the Apply category, "solve" was ranked highly (number 3) while "generalize" was ranked very low (rank 20).

D. Correlation to student performance

As mentioned, the survey was distributed the days after a mid-term exam (maximum score 30 points). Out of the 41 students that responding, 39 had done the exam. The students were divided into two groups, one that ha viewed 5 or less screencasts (20 students), and one that that had viewed 6 or more (19 students). The group viewing least scored higher on the mid-term exam (median 23 points) as compared to students viewing more screencasts (median 20 points). A Mann-Whitney U-test suggested no significant difference for $p < 0.4$, which means that there is only 60% probability that there is a real difference in performance between the groups.

IV. DISCUSSION AND CONCLUSIONS

The responses to the open-ended question, "Please give comments on the podcast and how you use them." confirm the conclusions from previous studies, e.g. [2], that for a majority of the students, screencasts provide a supplement to other forms of instruction rather than a replacement. However, the responses gave very little qualitative information on how the screencasts influenced the students' learning, how they helped to reach intended learning outcomes, or how the screencasts had helped to overcome learning thresholds.

The method to characteristics the screencasts in terms of verbs associated with Blooms taxonomy, provided much more useful insights in how these screencasts were aligned with the intended learning outcomes. Ranked as highly relevant by the students, the verbs "analyze", "define" and "solve" map more or less directly on the intended learning outcomes.

It was possible to find strong statistic evidence that the eight verbs ranked as most relevant – "describe", "define", "recognize", "summarize", "exemplify", "illustrate", "solve" and "analyze" are more relevant to characterize the screencasts than "memorize", "generalize", "categorize", "judge", "criticize", "organize", "construct" and "create". The methodology is very generally applicable and can be used to evaluate other instructional components. An entire course could be better understood by assessing the contribution of each component in detail. Ranking of verbs that are most relevant to describe lectures, tutorials, laboratories and seminars could provide a useful instrument to align instruction towards intended learning outcomes. For example, if students are expected to learn how to "criticize" this competence (verb) should be a descriptor of an activity in the course. This study shows that it is possible to find statistical support that a given activity serves its intended purpose to reach specific learning outcomes.

Among verbs associated with higher order cognitive processes, the verbs falling in the intermediate group (Table III), for example "compare", "relate" and "combine" are the "low-hanging fruit" in this particular context . With moderate efforts, the current screencasts could be modified to support learning of higher order cognitive skills, for example by discussing how to *compare* chemical reactors, elements of how to *relate* ideal and non-ideal reactors and examples of how to *combine* reactors to reach certain engineering objectives.

In hind-cast, however, it was clearly a mistake in this study not to secure that all verbs in the intended learning outcomes of the course were included in the set of verbs ranked.

Finally, there was an, albeit weak, negative correlation between how many screencasts the students viewed and their scores on the mid-term exam. Given the the students' enthusiasm over the screencasts, one could have expected clear-cut evidence that screencast-viewing students performed better, but this was not the case. This result highlights that student satisfaction in itself is not a guarantee for effective learning.

In summary, a remaining question regarding these screencasts is: Do they satisfy a need or merely meet a demand?

REFERENCES

[1] D.R. Krathwohl. "A revision of Blooms Taxonomy: An overview", *Theory into practice*, 41(4), pp. 212-218, 2002.

[2] F.F. Mullamphy., P.J. Higgins, S.R. Belward and L.M. Ward. "To screencast or not to screencast". *ANZIAM J* 51, pp. C446-C460, 2010.

[3] V. Parson, P. Reddy, J. Wood and C. Senior. "Educating an iPod generation: undergraduate attitudes, experiences and understanding of vodcast and podcast use". *Learning, Media and Technology*, 34(3), pp. 215228, 2009.

[4] N Saeed, and Y. Yang. "Using Learning Styles and Preferences to Incorporate Emerging E-learning Tools in Teaching", *Eighth IEEE International Conference on Advanced Learning Technologies, IEEE*, pp. 267-271, 2008.