EXPLAIN IT WITH VIDEOS – A NEW APPROACH IN BIOLOGY TEACHER EDUCATION

Doris Elster, Tanja Barendziak

University of Bremen, IDN Biology Education (GERMANY)

Abstract

BioScientix is an innovative teacher education course directed to prospective biology teachers of the secondary level. The goal is to offer an innovative learning environment at an early stage of their academic education [1]. In a “Community of Practice (CoP)“ [2] of scientists, science educators and media educators the teacher students develop “explain-it” videos about biological themes. The CoP has a blended learning structure [3], where face-to-face meetings and exchange via an e-learning platform are offered [4]. During the course the teacher students work in teams. They analyze different scientific contents in the field of ecology and cell biology and make didactical and medial transformations by writing a story boards and produce “explain-it” videos. At least they evaluate their self-produced videos in academic courses (peer evaluation).

The meta-evaluation of the course BioScientix is on two levels: 1) on the system level we analyze the affordances [5] and the arrangement of the learning environment; 2) on the personal level we investigate the participants’ professional development, their development of subject knowledge and pedagogical content knowledge (PCK). We use qualitative and quantitative methods to gather data: questionnaires (pre-post-design) and participants’ portfolios and videos and analyze them based on the paradigm of the Qualitative Content Analysis [6].

Within the last two years 41 ongoing biology teacher students participated in the BioScientix study program. They developed 17 “explain-it” videos. The findings of the meta-evaluation demonstrate an increase of subject and didactical knowledge of the participating teacher students. Most of them highlight the relevance of the BioScientix for the future career as teachers. In addition, the learning environment encourages students' interest and motivation.

Keywords: biology education, media, video, PCK, pre-service teacher education, empirical research.

1 INTRODUCTION

"Books will soon be obsolete in the schools. Scholars will soon be instructed through the eye. It is possible to teach every branch of human knowledge with the motion picture. Our School system will be completely changed in ten years" Interview with Thomas Edison [7].

This quote by Thomas Edison was stated as early as 1913. Even then, as a pioneer of his times, Edison recognised that books would be replaced by moving pictures in the communication of knowledge. It actually took more than ten years, but even in the last years there was a significant trend towards motion pictures. Thus, a survey of 249 Bremen students found that more than 60% use explanation videos to prepare examinations and presentations [8]. The majority of these are found on the "YouTube" platform. But explainer videos are not only for everyday questions; they are also useful for explaining complex academic subjects [9].

The aim of the project BioScientix is to embrace this trend towards motion pictures and give prospective teachers the abilities and tools to later create lessons that employ modern multimedia formats.

The project "BioScientix – Design of a learning environment to develop and broaden specialised didactical education" aims to develop, test and evaluates an innovative course in the introductory phase of the Bachelor in Biology programme. It is primarily oriented towards students with a teaching option. Specifically, the project involves the restructuring of the didactical introductory module Biology Education 1 (Theoretical and practical basics of teaching and learning in biology). It combines two partial didactic modules at an organizational level and creates a stronger reference to the subject-specific courses of the introductory phase that are run in parallel to it. The goal is to have students experience academic and social integration early in their study programme [1].

2 THE PROJECT BIOSCIENTIX

With the establishment of a *Community of Practice* [2] characterised by a flat hierarchy, students work within an interdisciplinary team supported by educational specialists, experts in the fields and media educators. They do research on their own in select subject areas, developing their own questions, in particular with respect to the content of introductory courses in cell and molecular biology, ecology and botany; they then prepare these as didactic and media teaching videos. Explanations that are true-to-fact and tailored to the target group are especially important. We assume that "a really good teacher is someone who is above all knowledgeable and who can make the material easy to understand for his students in both oral and written form" [10: 167]. Explanation competences themselves are what cause the future teachers the greatest challenges [11].

2.1 The phases of the restructured BioScientix Bachelor programme

In order to cut back on the discrepancy between the theoretical and technical educational content and later practical demands of teaching, the practical element of the bachelor module Biology Didactics 1 (a total of 6 CP) has been redesigned according to the principles of “inquiry-based learning” [12]. The following phases are included:

2.1.1 Phase 1. The information phase.

According to Huber [13] inquiry-based learning begins *"with presentation of the research process through example, visual demonstration and bringing it to light through discussion"* [13: 11]. In accordance to these challenges, the BioScientix module also begins with clarification of a technical content through examples (for example the process of apoptose or cell death), clarification through subject-specific teaching methods (identifying potential misconceptions) and opportunities for didactics through media. Exercises to help clarify the explanation process (e.g. Which visual or verbal representation declare the subject content in an adequate way?) follow, as well as technical information about how to prepare a storyboard, tips on cinematography, designing images and editing videos. As a supplement, the basics for evaluating the learning effectiveness of the videos are taught.

2.1.2 Phase 2. Planning phase and creation of the storyboard.

Students form collaborative teams and with the support of the CoP experts they come up with the first topics for potential explainer videos. As a part of this process, they make contact with different research groups, become familiar with the laboratories and identify possible questions. Following intensive (literature) research, they prepare a storyboard. They target group for this includes their peers or in other words fellow students from the first semesters. The storyboards are presented in plenary sessions and then, following thorough deliberation, they are revised again after from the perspective of the specialist discipline, subject didactics and media education.

2.1.3 Phase 3. Creating the explainer video.

In the next step, the students transpose the media of their storyboards and create explainer videos. These are not professional teaching videos, but instead 6-10 minute amateur videos using simple technology that are characterised by thematic and creative diversity and an informal style of communication. Hence, it is possible to create explanation videos as a part of the course without the need for a huge budget [8]. Finally, the videos are discussed in a session with the entire class and reviewed in terms of subject, teaching and media methodologies and then further revised.

2.1.4 Phase 4. Evaluation and reflection phase.

In the final phase, the students assume the roles of the researchers and evaluate their own videos in subject-specific and/or didactic courses. To do so, they develop their own survey tools (questionnaires) and independently analyse the collected data within their teams using simple statistics and qualitative analysis of content [6]. They summarise their results and knowledge in short evaluation reports and present the key aspects in a final session.

2.2 Sequence and team structure

The BioScientix course ran its pilot year in 2014/2015. There were 19 participants in the course. They developed a total of seven explainer videos in the fields of cell and molecular biology or ecology. The knowledge gained from the pilot phase was evaluated in a master's thesis [14]. The main survey took place in the summer 2015 semester with 17 participants. Again, seven videos were produced in

subjects including cell biology, ecology and botany. In WS 2015/16 seven participants produced three didactic videos. Figure 1 demonstrates the team structure and the process of video development.

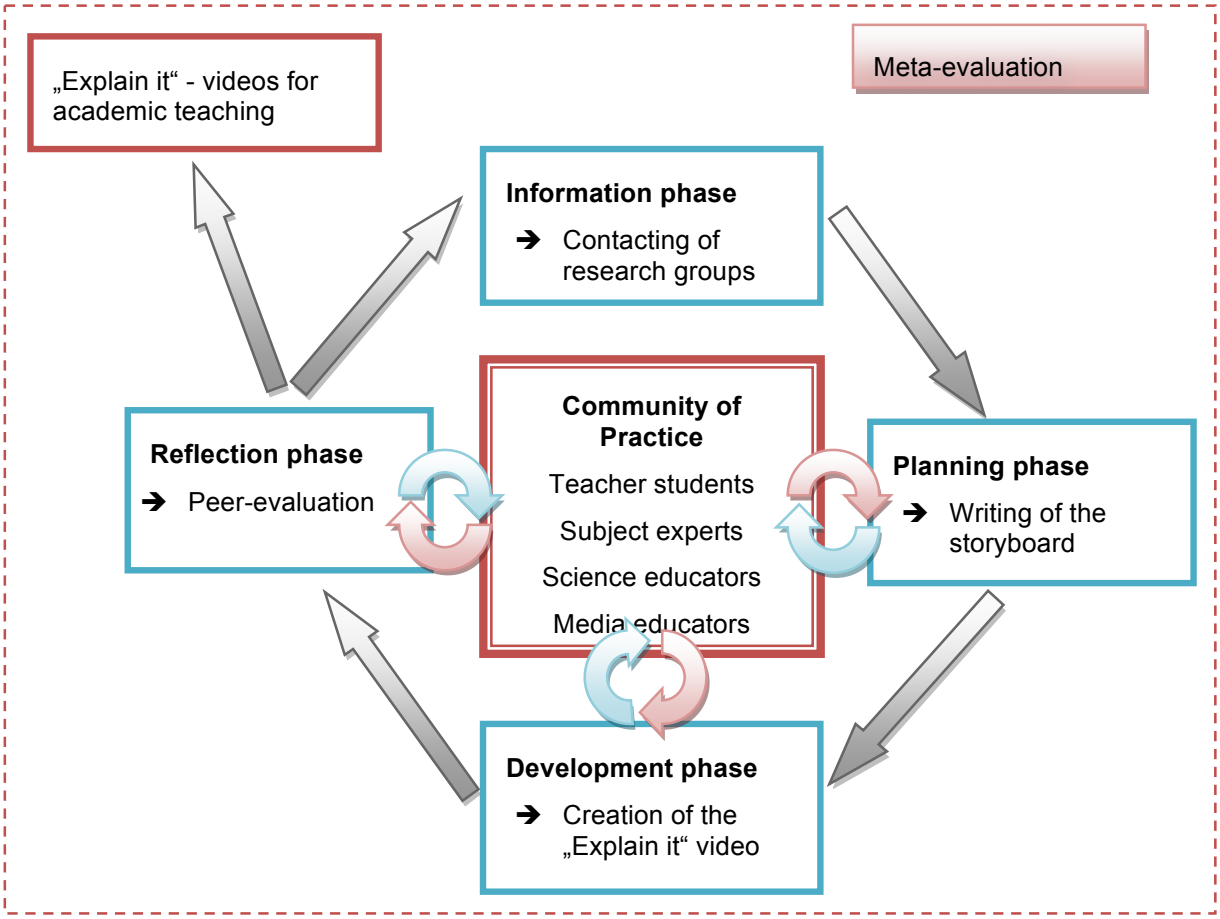

Figure 1. Team structure and process of video creation.

3 EVALUATION DESIGN

BioScientix undergoes formative and summative evaluation on three different levels.

1. Evaluation of the explainer video:

Students evaluate the explainer videos they developed in academic courses. Therefore, they develop questionnaires to investigate the effectiveness of the videos regarding the content, the didactical and the medial transformation. They present the videos in subject specific courses and ask their peers for a feedback and to fill in the questionnaire. Afterwards they analyze the questionnaires with qualitative methods and write a evaluation report.

2. Meta-evaluation for the professional development of the students:

The professional development of the students in terms of their subject-related didactic knowledge of the content is determined using a questionnaire (pre-post design) involving open and closed questions. In addition, reflection journals and evaluation reports by the students are qualitatively evaluated.

3. System evaluation:

The course also includes regular meetings of the interdisciplinary course team in which the storyboards and explainer videos are analysed and assessed. In addition, interviews with specialists are held to determine whether the videos can (will) be used in future courses or to generate more ideas for explainer videos.

4 FINDINGS

4.1 Evaluation of the explainer videos

Review of the evaluation performed by the students of their own videos shows that in general, these are considered effective tools for learning. The criteria for this assessment were primarily suitability of the subject and comprehensibility of the content. The survey also included items relating to "realisation in media pedagogy" and "realisation in subject didactics" that were evaluated using a 6-point scale. The students were also to evaluate their overall impression of the videos by giving it a grade. A detailed presentation of the results is beyond the scope of this article. Thus, suffice it to say that all videos were given average grades of 1.0 to 2.4 by peers in the areas to "realisation in media pedagogy" and "realisation in subject didactics". The average grades for overall impression of the videos were also largely positive and ranged from 1.4 to 2.2. In addition, the question was posed as to whether the students considered the explainer videos a useful complement to the lectures. Again, the values for each video varied, with 74-100% in agreement. Technical problems, in particular with respect to tone quality, were the most common reason for points deduced in the evaluation.

4.2 Meta-evaluation for the professional development of the students

Evaluation of the surveys using the pre-post design showed that the expectation of efficacy by the students for the design of the explainer videos had increased. The pedagogical content knowledge (PCK) of those surveyed had been positively changed. Those questioned recorded an increased self-assessed learning effect and greater confidence in producing the videos. Further, there was a positive change in the reflection behaviour of the students after being a part of the BioScientix project. To illustrate, below is an excerpt from one of the reflection journals:

"I feel that I have learned things in this seminar that I will be able to make good use of in my future career. In my view, the project has helped bring me one step closer to my educational professionalism". (R2_SoSe15; Stud. M.C.)

Despite the good feedback overall - the seminar was given positive recommendation by all students – there was opportunity to improve the seminar, for example, by enhancing the technical resources and more efficient time management. Further analysis indicated that to date explainer videos have been incorporated in courses too rarely and that students feel that videos are a valuable diversified alternative to lectures.

4.3 System evaluation

The interviews with the teaching staff were mostly related to the question of whether the explainer videos could also be integrated into lecture courses in the future. Some of the videos were successful in this regard. Unfortunately, as it was a pilot course, the lecturers did not deem all videos useable for university teaching. Even after intensive revisions, the expectations of all lecturers were not met. This was unfortunate but led to a restructuring of the next course. In the following session, the topics of the explainer videos had already been decided with the lecturers from the specialties so that they could better fit with the material of the courses. It was therefore very helpful that at the end, three of the experts queried provided suggestions for continuing joint specialised didactic projects. One example is the explainer video "Mycorrhiza" that had been incorporated into a Bachelor thesis.

5 CONCLUSIONS

The BioScientix project represents a contribution to realising the concept of more flexible design and adjustment of content of existing academic modules in the Bachelor programme of prospective biology teachers. Elements of inquiry-based learning make up a significant component of the required study credits for the module. Didactic research is an essential part of training future educators that until now has received too little attention in the Bachelor programme.

The BioScientix project hopes to promote inquiry-based learning especially among teacher students. It facilitates the training and enhancement of individual interests and competencies among the students through autonomous research priorities. A key aspect of learning through research is the independence of the learner. According to Huber [13], it represents both the goal and the means to achieve this goal. Specifically, this means that both the topics and the strategies of the research process are structured by the students themselves. In learning through research, the students must

persevere "with patience and logical consequence until a (positive or negative) result is achieved, sufficiently testing their knowledge and tools to solve the problem" [13: 9]. The goal of the students' work, like the researchers' work, are to acquire new knowledge. In working together though a research cycle, the students experience that science is a social process in which cognitive, emotional and social aspects are equally important and which proceeds from the initial curiosity through ups and downs to the solution of a problem and its presentation [13]. The aim of the restructuring of the Bachelor programme described here is to give students the opportunity for this active engagement with research of a learning efficacy in an explainer video they create themselves. The structure is oriented to the students and allows them to individualise based on their interests, learning style and social interactions. The teaching and testing formats are flexible and include portfolio testing and evaluation of the media they prepare. In this regard, BioScientix is an innovative course for networking specialist study and educational study with later realities of a career as a biology teacher.

6 IMPLICATIONS

Overall the BioScientix project can be seen as a success. Although the pilot course still experienced a few issues, we have learned from the initial mistakes and taken the criticisms to heart to continue to develop the project. Students had the opportunity to assign a grade to the BioScientix course in surveys. Even in the pilot session, there was a thoroughly positive response with an average grade of 1.9 given. This grade was improved on in the following session of the course, registering with an average of 1.7. The positive resonance for the BioScientix course is embodied well in the quotes below from the students' reflection journals:

"Overall, the creative work with the video was a completely new experience that I had never had the chance to experience before in my studies in biology. A totally new perception of the everyday workings of the university, in which you don't always have to follow protocols 1 to 1 and which I personally liked a lot." (R2_SoSe15; Stud. S.F.)

"I discovered my creative side in this course and was able to put this to use in creating the video. I had never prepared an explainer video before but was fully satisfied with the production and design. In today's times it is very important to work effectively with media. It is always a benefit to carry out these kinds of projects where you learn something new and useful." (R2_SoSe15; Stud. A.E.)

BioScientix can serve as a model and be carried over to other subject areas with a teaching option. The only prerequisite is the willingness of the academics, subject experts in each field and science educators, to cooperate.

ACKNOWLEDGEMENTS

We would like to thank all of the staff who have supported us in realising the BioScientix project. In particular, we thank Prof. Ursula Dicke who supported us as the FB02 Study Dean, Prof. Karsten Wolf and Verena Kratzer from Department 12 and Prof. Juliane Filser, Prof. Reimer Stick, Dr Jana Seeger, Dr Thomas Buse, Dr Marlis Reich, as well as all the other lecturers of Department Biology/Chemistry who made every effort to support us despite their busy schedules!

REFERENCES

[1] Barendziak, T., Elster, D. (2016). BioScientix – Erklären mit Videos: Forschendes Lernen in der Lehrerinnenausbildung Biologie. Resonanz – Zeitschrift für Studium und Lehre (1), pp. 14-20.

[2] Wenger, E. (1998). Communities of Practice. Learning, Meaning, Identity, Cambridge: University Press.

[3] Reinmann, G. (2005). Lernort Universität? E-Learning im Schnittfeld von Strategie und Kultur. Zeitschrift für Hochschuldidaktik 6, pp. 66-84.

[4] Elster, D. (2010). Learning Communities in Teacher Education. The Impact of e-Competence. International Journal of Science Education 32 (16), pp. 2185 - 2216

[5] Gibson, J. J. (1977). The Theory of Affordances. In R. Shaw & J. Bransford (eds.), Perceiving, Acting, and Knowing, Hillsdale: N. J. Erlbaum

[6] Mayring, P. (2003). *Qualitative Inhaltsanalyse. Grundlagen und Techniken.* Weinheim**:** Beltz

[7] NDTE (1913). The New York Dramatic Mirror, The Evolution of the Motion Picture: VI – Looking into the Future with Thomas A. Edison by Frederick James Smith, 09.July 1913, Column 3, New York, p.24.

[8] Rummler, K., & Wolf, K. D. (2012). Lernen mit geteilten Videos: aktuelle Ergebnisse zur Nutzung, Produktion und Publikation von online-Videos durch Jugendliche. In Suetzl, W., Stalder, F., Maier, R., Hug, T. (Hrsg.), Medien – Wissen – Bildung: Kulturen und Ethiken des Teilens, pp. 93-103, Innsbruck: Innsbruck Universitätsdruck.

[9] Wolf, K. D. (2015). Bildungspotenziale von Erklärvideos und Tutorials auf YouTube: Audio-Visuelle Enzyklopädie, adressatengerechtes Bildungsfernsehen, Lehr-Lern-Strategie oder partizipative Peer Education. MERZ, 1, pp. 20-25.

[10] Wellenreuther, M. (2005). Lehren und Lernen – aber wie? Empirisch experimentelle Forschung zum Lehren und Lernen im Unterricht. Baltmannsweiler: Schneider.

[11] Merzyn, G. (2005). Junge Lehrer im Referendariat. MNU, 58 (1), p. 4.

[12] Elster, D. (2013). INQUIRE for Students – How to promote inquiry based learning? In New Perspective in Science Education, Conference Proceedings 2013, Florence, March 14th-15th 2013, Florence: Libreria universitaria, pp. 337-341.

[13] Huber, L. (2009). Warum Forschendes Lernen nötig und möglich ist. In L. Huber, J. Hellmer, & F. Schneider (Hrsg.). Forschendes Lernen im Studium. Aktuelle Konzepte und Erfahrungen. Bielefeld: Universitätsverlag Webler, pp. 9-35.

[14] Flecken, A. (2015). Evaluation des Forschungsprojektes Bioscientix. In D. Elster (Hrsg.), Wir sind Master 2015. Ausgewählte biologiedidaktische Masterarbeiten durchgeführt an der Universität Bremen. Aachen: Shaker, pp. 1-10.