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35.1 Inquiry-Based Learning with Digital Media: More Questions Than Answers

How can academic teaching and learning be shaped in conformity with recent reforms in higher education and education policy? What role could digital media play in implementing research-oriented concepts? If you ask yourself questions like these, you will quickly find a wide range of existing concepts and approaches in institutions of higher learning and grapple with a vast number of scholarly and practice-oriented publications in Europe and the U.S. (Hillen and Landis 2014). The current challenges range from adequate spatial or technical infrastructure, e.g., the open accessibility of information and knowledge in libraries to the individual critical handling of technological developments, to name but a few. These challenges are more likely to arise due to a more open and largely problem-oriented form of teaching, and are not necessarily related to the use of digital media. How, for example, do students manage to pursue their own (research) questions during their studies and throughout their studies? Are there any new opportunities for implementing research-oriented teaching or inquiry-based learning through the use of digital media?

The present article therefore takes up the difficult task of systematizing the discussions in such a way that they are of scholarly and practical value. The use of digital media is without a doubt an essential development that has occurred in the last two decades, confronting higher education institutions with new and unprecedented challenges, regardless of whether they are engaged in inquiry-based learning and teaching or not. In the German-language discourse, two developments are central to an integrative understanding, the

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latter being more the focus of this text: To begin with, federal and educational developmental programs succeeded in politically placing inquiry-based learning on the agenda again (e.g., Huber 2014; Reinmann 2015b) and in systematically (re)implementing it in institutions of higher learning. Secondly, many of the ideas and concepts being pursued aim at the parallel use of media, which is why there is an increasing conceptual merging of inquiry-based learning and technology-enhanced learning (TEL), understood as inquiry-based learning using digital media. At all stages of the (empirical) research process, digital media therefore serve the purpose of helping to achieve the learning objectives and in developing problem-solving strategies or extensive scientific skills, in addition to specialist knowledge. While tools are often initially introduced by faculty, it is likely that students will come back to these tools on their own as their knowledge and experience increase, or that faculty will make other, more complex tools available. What appears to be a logical consequence of the practical justification is slowly becoming interconnected in the related scholarly communities: thus the discourses on inquiry-based learning at the university are mainly conducted in academic teaching and learning, organized in Germany by the German Society for Academic Teaching and Learning (Deutsche Gesellschaft für Hochschuldidaktik). Questions as to the *appropriate* use of media tend to instead focus on representatives of information technology or technology-enhanced learning, which are usually established in the Society for Information Technology (Gesellschaft für Informatik, e-learning specialist group) or in the Society for Media in Science (Gesellschaft für Medien in der Wissenschaft, GMW).

35.2 Appropriate Media Use: Views on Technology-Enhanced Learning

In a TEL view, media are understood to be digital tools that support teaching and learning. These may be digital resources that are provided for learning, but they may also help improve communication and collaboration in courses (cf. Hillen and Landis 2014). Within specific subject cultures, as witnessed in the social sciences, digital media also support the collection and evaluation of data, or are the subject of theoretical engagement (e.g. Dürnberger 2014, p. 248 et seq.). Thus, almost every subject culture would be allowed to develop its own media usage strategy. In TEL, however, despite the everyday practices of its researchers, the departmental media strategy did not place value on assessing either the amount of media used or whether it was even used. Instead, the importance of media in attaining these practices is considered to be based on the learning objective of the course. Accordingly, the “education problem” (Kerres 2012, p. 276) will first be clarified before the use of media is specified. Thus, the planning of the course is somewhat decoupled from the respective technological development (Schulmeister 2007, p. 393). Before the *actual* use of media can be clarified, the learning objectives of a course must be determined. Modules and curricula provide a basic orientation for the context of higher education. The

personal attitude of the instructors is also crucial in determining how learning ultimately can *and* should be achieved using media.

An important insight concerns the use of media by students themselves: Today's instructors must assume that in addition to the media offerings formally planned for the course, additional tools will be used by the students. These are used to allow students to organize themselves, to share and/or collaborate (e.g. self-initiated student groups on Facebook, instant messenger services such as WhatsApp, or pictures on Instagram). Such *modified, highly individual usage habits* can be found in all current media usage studies and can be determined independently of the respective subject cultures. What is difficult and what must be accepted is the following: It can be difficult to plan a course with them, because they are informal in nature (Hofhues 2016).

The organization within which the courses are offered has an indirect impact on the way media are used. Thus most universities and higher education institutions in the German-speaking world rely on classroom teaching, i.e. on the regular, personal transfer of knowledge on-site. The courses should, at best, be *enriched* with digital media. Such courses are referred to as “blended learning” (see Box 35.1) because they combine learning in the classroom and learning online. At the same time, along with distance-learning, online or open universities, there are also other types of higher education institutions that interpret higher education instruction differently, and sometimes more “medially” for specific target groups. It is likely that digital media will cover the entire spectrum of the transfer of knowledge, from communication of knowledge to collaboration and shared reflection.

Box 35.1: Blended Learning

One keyword repeatedly used in the context of technology-enhanced learning is “blended learning.” The literal meaning of the word is “mixed” learning: In blended learning, classroom teaching – i.e. teaching components that are offered on-site at the educational institution – is mixed with those parts of the teaching that take place outside of class. For the sake of simplicity, it is common to differentiate by percentage which teaching content is presented in active class attendance, and which is presented online, e.g. a typical teaching format might involve completing tasks online, but first preparing and discussion the tasks during a face-to-face lesson. The online portion in such a blended learning format should amount to approximately 10–20%. If the “silver bullet” of inquiry-based learning as proposed by Huber (2009, 2014) is implemented and supported by a digital journal (e-portfolio), the online portion could increase to 50% or more. Learning would take place entirely online when both the communication of the contents and the processing of tasks, (peer) feedback and exams etc. are conducted online, as would occur at online universities based in the United States or as is the case in Massive Open Online Courses (MOOCs).

If knowledge acquisition outside of class attendance is to be promoted, it is currently likely that a learning management system (LMS) will be used. Ultimately, an LMS is a digital platform that serves to organize courses, and is also used as an information resource for instructors. For example, PDFs and links can be posted or other learning materials made available. An LMS could also be used to support the social exchange between students and instructors or to facilitate the collaboration of peers in forums or groups. This would then happen in an online classroom setting, fully excluding the public. Instructors could just as easily use openly accessible media if, for example, the scientific community is to be included in the course as providers of feedback. Social networks such as Facebook, blogs or communication services such as Twitter are used for such purposes. Individual or group reflections can also be triggered by means of digital media, e.g. with e-portfolios, which have taken up the portfolio method of collection and visualization of learning processes as a tool. The latter are mainly implemented for university-level degree programs that have a high practical portion, and where theory-practice transfer should be supported. These include not only dual degree programs, but also teaching certification (for an overview, see Meyer et al. 2011; Miller and Volk 2013). What all examples have in common is that the tools used ultimately refer to the learning objectives pursued in the courses. It is only with the inclusion of the learning objectives (see above) that it becomes possible to plan the use of media precisely for the purposes pursued (provision of resources, peer feedback, etc.).

35.3 Technology-Enhanced Learning in Higher Education Institutions: A Design Triangle

From one point of view, Reinmann (2015a) states that instructional design *should* constantly include media. On the one hand, this has always happened, for example by using blackboards or projectors. On the other, this view is new because the integration of digital media in the 2000s in particular has suggested special treatment. It is therefore best to use a design triangle for the concrete planning of the course and to ask the following against the background of the respective learning objectives:

- To what extent does the use of media serve to *impart* teaching content?
- To what extent does it support the *empowerment* of students – in other words, how much do they enjoy participating in class and how motivated is this participation?
- And how can students be *supervised* with/via digital media?

It is a widespread fallacy that media use per se would involve students more in their learning processes in the sense of the often described *shift from teaching to learning*, or that it would even enable inquiry-based learning. Recent developments in virtual identities, mobile applications (apps) or response systems (mobile audience or classroom response systems, better known as clickers) in teaching tend to follow simple attestations

and thus a model of *drill and practice*. The crux of the matter: media-based tests or clickers are very popular in subjects related to the natural sciences because they help to test specialist knowledge with appropriate brevity, and because they *supposedly* break up frontally organized (mass) courses with smaller interactions. In this context, Mayrberger (2012) would speak of a pseudo-participation of students in their learning processes. It is therefore all the more important to use a research orientation as a general setting for teaching, which ultimately provides both students and instructors with the framework within which they *can* learn, teach and become researchers.

35.4 The Relation of Inquiry-Based Learning and Digital Media: Digital Turns in Academic Teaching and Learning

How can inquiry-based learning be realized? What added value does the potential use of media generate? Examples of the implementation of inquiry-based learning in practice are as varied as those known for the use of media for study and teaching (see above). In the widely adopted writings of Huber (2009) and Wildt (2013), references are made to learning throughout the first degree course (“student lifecycle”), questions are raised about the transition from school to college, and from college to work, or ambiguity in terms of the student lifecycle in terms of the use or (public) presentation of student research results among colleagues is discussed.

When it comes to students *pursuing their research questions themselves*, it is likely that digital media can (or do) serve all of the purposes outlined above. These are needed at various stages of the research process in order to specify research questions, to process these questions and, ultimately, to answer them. If inquiry-based learning is understood not as an individual, but as a shared cognitive process and interpreted collaboratively, digital media often function as communication device for (substantive) collaboration and the creation of teamwork, for the interaction between learners and instructors, and for the interaction between peers. In addition, media can become its own research domain and students can create related research questions that become possible only with the advent of digital media (e.g. research via the Internet) or methodically (e.g. big data). They also offer insights into “research workshops” (“Werkstätten des Forschens”, Anastasiadis 2015, p. 260) away from physical classrooms (e.g. virtual laboratories, cf. Vogel and Woitsch 2013). If more receptive learning in the sense of an *engagement with research results* is addressed, it is clear that, according to this perspective, digital media are primarily needed as an information resource and, if necessary, are used to evaluate the information (for example via comment functions). The boundaries between receptive and productive inquiry-based learning are already fluid in these examples, however: Commenting or mutual, media- or technology-based questioning of content is stimulating, and both could be precursors for own research questions, which in turn are also recorded with media (e.g. in wikis). Other tools that are typical for the subject can also be used

(SPSS in social sciences, for example). This applies when data is repeatedly evaluated for practice purposes, and an exchange occurs.

Especially in the case of inquiry-based learning, it is no longer clear whether the use of media merely supports research-oriented teaching, or simply facilitates “research *as learning*” (Dürnberger 2014, p. 254, emphasis in original). What was once merely technical media would, from this perspective, become more of a space for communication, action and even experience (Hofhues et al. 2014). Accordingly, in the future, it would be possible to ask more about the possibilities of student appropriation of *their* (educational) spaces *for* research, and less about whether and with what digital media research is being conducted. The fact that digital media are part of these educational spaces is already a matter of course. At the same time, however, any (learning) locations with their specific infrastructure would become relevant, and these would be taken over by students in research practices.

35.5 Inquiry-Based Learning with Digital Media: Conclusions and (Basic) Conditions

It is probably the different traditions in higher education and technology-enhanced learning (TEL) that continue to make TEL and inquiry-based learning almost exclusively separate in institutions of higher education. It certainly pays to bring design approaches together conceptually, especially if one understands this overview as an attempt to integrate media into academic teaching and learning. The article primarily clarifies the premises under which digital media are generally important in teaching and learning. The TEL perspective was changed in favor of a higher education perspective, and it was assumed that different ways of using digital media are created depending on the type of game of inquiry-based learning. *But what are the challenges if inquiry-based learning and media-based learning actually combine two forms of learning?*

As striking as it may sound, the first answer to the last open question is just this simple: If one wishes to implement inquiry-based learning and media-based learning at the same time, it is important that two *challenging concepts* be planned and implemented in tandem. Dürnberger (2014, p. 261) points out with regard to inquiry-based learning with digital media that the simultaneity of technology-enhanced and research-based concepts can also overwhelm students. Taken in isolation, each of these forms of learning already places high demands on learners, who could also express themselves with frustration (ibid.). It can hardly be denied that instructors as well as students are called upon to combine two forms of learning: inquiry-based learning with TEL. It is more important for instructors and students to deal explicitly with uncertainties, vagueness, boundaries or disruptions to teaching and learning, and to make these an educational opportunity for both students and instructors. Also, the *educational spaces* that result from the interplay of the forms of learning are both diverse and stimulating, as well as fragile and uncertain in their outcomes (cf. Murtonen et al. 2017): Conceptually, inquiry-based learning always brings with it the possibility of non-success (failure), without having addressed or even dealt with

specific challenges of using or dealing with digital media. Instructors and peers who help “[to] teach and [to] learn the adventure of research” within the learning process thereby become all the more important (Anastasiadis 2015). Like TEL, inquiry-based learning therefore relies on mutual commitment and responsibility.

A research orientation should therefore also be regarded as a *university-wide strategy* related to academic study and teaching, which is relevant for any media use of universities and institutions of higher learning. This would counteract skeptics, for example, who sometimes suspect an end unto itself behind the use of media, and who do not see its service to research (Oelkers 2015, p. 78). *Consistently* research-oriented study programs would focus on (time) periods for student research that are often not provided for in current curricula (Hofhues et al. 2014).

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