The Potentials of Digital Media: Theoretical Observations on the Educational and Teaching Potential of Tablet Computers

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ABSTRACT

This article concludes that the logic of linear and inscribed media continues to predominate in schools, despite the advances in the use of digital technology as a pedagogic tool. With respect to both the interactionist-constructivist model of learning as well as the findings of educational theory and educational psychology, it is possible to identify two conditions of sustainable and motivational learning: Learning is deemed successful if media are used to allow learners to interact creatively with the learning material ('individual manipulation'), and if these media serve to foster learner interactions and social relatedness ('connectivity'). By analysing two learning media—the exercise book and the tablet computer—this study assesses these two criteria from the perspective of communication studies, asking what lessons might be learnt from them with regard to the conceptual potentials of digital media in schools. One result is certain: If tablet computers are used only for Internet research and as a passive reading device, the potential of digital media for teaching and learning remains unexploited.

CONSTRUCTIVISM AS A PERSPECTIVE

Simply equipping schools with digital media does not automatically improve teaching and learning. It is also necessary for teachers to draw on their professional experience to give them the courage, the freedom and the educational know-how to implement this technology in a didactic setting in accordance with their pedagogical expertise. Digital media carry potential benefits which can support teaching and foster learning. Yet, this potential remains unexploited if digital technology is used in the same way as non-digital media, for example if it only serves to replace a book, still the key medium of choice in schools and higher education even today.

In order to examine the conceptual potential of digital technology for teaching and learning in schools, it is helpful to take a brief look at the fundamental principles of educational theory and educational psychology. Recent models of learning which are shaping educational theory and media education are based on interactionist-constructivist approaches. Constructivist perspectives on learning can be traced back to the developmental psychologist

Jean Piaget (1973), who was the first to define learning as a subjective process of construction. According to Piaget, the outcome of learning should be understood as a constructed subjective "reality" formed by personal experiences. An individual then makes reference to this reality when confronted with new experiences. A learning process, and also learning in schools, is therefore to be seen as a self-regulated ("autopoietic") construction of experience (Maturana & Varela, 1984). One of the radical constructivist thinkers, Ernst von Glasersfeld (1997), noted that learners construct their own reality not only from their own subjective experiences, but also according to their own interests and personal criteria of usefulness and validity. This provoked some criticism from scholars, including educational theorists.

One strand of criticism, which challenges the use of constructivism as the basis for an educational theory, criticised its exclusive focus on individuals. Yet, individuals never think or act in isolation from their environment—this is particularly true for institutional learning such as that which takes place in schools. In any case, constructivist thinkers give scant consideration to learners' interaction with others as an explanation for learning (or, as they would put it: for the construction of experiences). This gap is filled by interactionism, which explains how individuals might be encouraged to learn by using language competence and social integration to stimulate interactions between individuals. Both perspectives – the individual strand of constructivism and the social aspects of interactionism – were successfully conjoined in the theory of self-determination (Deci & Ryan, 1993; 2000) and adapted for use in education theory after the identification of several conditions which determine sustainable and motivational learning: learners need to be generally willing to learn; they should be given an adequate degree of freedom for proactive learning ("autonomy"); the subject matter to be learnt should appear useful and applicable to the learner's present situation ("viable") and it should be compatible with the learner's knowledge base. Furthermore, learners should interact socially and network with their fellow students, as relatedness promotes stimulation and is also a prerequisite for feelings of competence during action. If these conditions apply, they increase the probability of intrinsically motivated learning. In a constructivist sense, one could also say: they serve as the basis for sustainably constructing experiences (in detail Knaus, 2013; 2015).

CONCEPTUAL WEAKNESSES IN DIGITAL MEDIA FOR LEARNING

To date, digital media and associated innovations have played a minor role in German classrooms (on impediments to using and integrating digital media in German schools, see Bos, Lorenz, Endberg, Schaumburg, Schulz-Zander, & Senkbeil, 2014; Petko, 2012;). Even when digital media are adopted, their usefulness is questionable because, due to conceptual weaknesses, technology has not yet adequately met the criteria mentioned above for sustainable and motivational learning (Knaus & Engel, 2015). This is largely due to the linear structure and "inscribed" inflexibility of teaching technology as well as to its insufficient or only temporary connectivity. This is a dilemma, as current digital media and tools could perform much better than this: Indeed, they can be *individually manipulated,* are open for *annotations* and, to a large extent, are highly *adaptable*. I will return to these features below. Due to the permanent *connectivity* available nowadays, they are able to provide various forms of

interaction and social relatedness in previously unknown quality and quantity (see also "communities of practice" or "communities of project").

THE EXERCISE BOOK – A NEW DISCOURSE NETWORK

Examining regular teaching media with regard to their capacity to promote learning reveals the tablet computer to be a manipulable, annotationable, adaptive and connected teaching tool. These functions make it highly appropriate for a learning environment. But, as it is mostly used in the same way as an "analogous" exercise book, its conceptual potential is limited. This is best explained using a comparison to analyse the two media. This comparison reveals the limits of the analogous and "disconnected" exercise book and highlights the additional value of digital media for teaching and learning, as long as their conceptual potential is not overlooked.

Tablet projects in German schools have repeatedly shown that teachers directly transfer conventional teaching concepts and traditional instructional media to new formats. Instead of reading a textbook, PDFs are viewed on tablets without the students accessing the potential that might be available to them by using digital media. This indicates that schools continue to rely on the book as their core conceptual medium. This might come as a relief to those who worry about an "end of the book culture" (Böhme, 2006), as it seems beyond doubt that books – or to put it more generally: linear and structured texts – will retain their cultural importance as a medium for storing and handing down knowledge for some time to come.

For this reason, the book might be regarded as the ultimate learning medium. It is indeed a most useful medium for readers; yet, as the perfect tool for learning, it is of greatest benefit to the author, as illustrated in the early 18th century by the philosopher Immanuel Kant in his essay *On Education* (Kant, 1899): "We understand a map best when we are able to draw it out for ourselves. The best path to understanding is to do."[1] (p. 80). Actively writing a text is therefore more conducive to learning than simply receiving it passively, by reading. A book, like all 'inscribed' media, contains knowledge that has been given a pre-arranged linear structure by the author. So it leaves little room for the reader to engage in any (self-) structuring. But if (self-) structuring is – as is assumed by constructivist models of learning – an essential prerequisite for the learning process, then text comprehension requires the re-activation of existing knowledge, internal perceptions and images. Only in an ideal situation is the content transferred ('constructed') into personal structures. Text production on the other hand requires more intense acts of construction.

As educationalists, however we are not only interested in storing knowledge, but also in motivating and fostering sustainable learning. In the same way as "form follows function" (Sullivan), technology follows pedagogical considerations in the context of learning and teaching. Although it is most likely that a simple absorption of information can be sufficient in certain phases of

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[1] Original: "Man versteht eine Landkarte am besten, wenn man sie selbst verfertigen kann. Das Verstehen hat zum größesten Hülfsmittel das Hervorbringen" (Kant 1960, p. 34).

learning, the potential for technology to support independent activity should nonetheless be acknowledged in and applied to pedagogical planning.

The computer scientist, Reinhard Keil (2006), refers to the human need to construct and create, stating that digital media not only affects us, but can also be influenced by us: "For the first time in the history of media, the object of perception can also directly become the object of manipulation"[2] (p. 67. Translated by author,). Here, Keil implies that digital media are changing from an inscribed system into a discourse network (see also Kittler, 1986 and Winkler, 1997; 2002). Historical models of such discourse media are, for example, the MemEx ('Memory Extender') by Vannevar Bush, an American engineer and inventor who developed the concept of a mechanical-analogous storage machine (Bush 1945, p. 5) as well as the manuscript that served to transmit and store cultural knowledge for centuries. In schools, the equivalent of the manuscript is the exercise book.

DISSOLUTION OF PRE-STRUCTURED LINEARITY

The unique characteristic of an exercise book is that learners not only absorb the content of a lesson—they also have the opportunity to *shape* it: they are able to mark, to annotate and edit the learning material. Considering the criteria of productive learning which are inherent to a constructivist approach to learning, an exercise book becomes a teaching medium that is of considerable use to learners—which does not come as any great surprise. But compared with a tablet, the exercise book has the conceptual drawbacks of an 'analogous' medium (Knaus & Engel, 2015), primarily the constraints of linearity and physicality. Since changing presentational modalities – complementing written text with images, video or audio clips – requires extensive effort when working with an exercise book, it can be assumed that this only rarely happens. But visual text supplements (Knaus, 2009) and multimedia illustrations have proven useful in enhancing people's comprehension of difficult subjects (Schnotz & Bannert, 1999; Tulodziecki & Herzig, 2004).

Digital devices also allow the integration of further media (i.e. photos, videos and animations) and other helpful tools for actively organising content within a unit. They are often available within a device or a platform. These tools contribute not only to connecting various medial elements, but to a large degree they also merge the subject matter with the resources. This allows the learner to produce, annotate and manipulate documents and other media with ease (as shown in Fig. 1). Digital tools are also highly functional and formally adaptive: together with individually developed applications or corresponding peripheral devices, they provide – in theory – an infinite number of opportunities for expansion.

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[2] Original: "Zum ersten Mal in unserer Mediengeschichte kann das Objekt der Wahrnehmung auch unmittelbar zum Objekt der Manipulation werden".
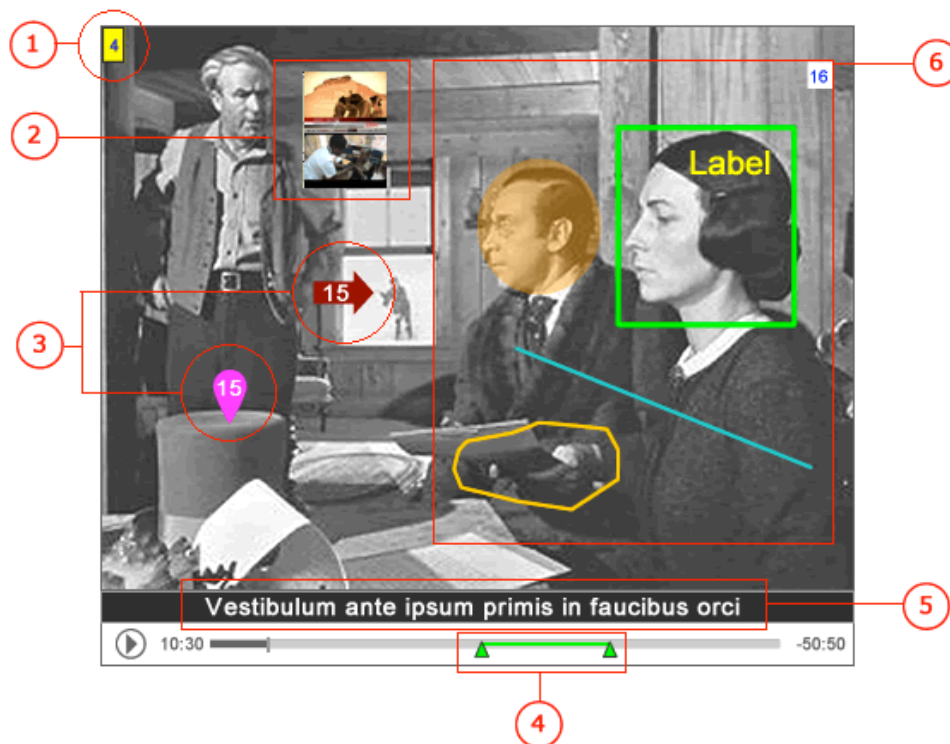
Fig. 1: Video Annotation System (Harvard Annotation Project 2010)

This implies that not only can the content or subject matter be created, but also the tool itself. Because of their connectivity, digital tools such as tablets also have access to the performance and storage potential of the Internet. Applications as well as web-applications already use the infinite resources of internet servers – the 'cloud' – instead of being restricted to the tool's own limited resources.

It is, however, essential to acknowledge that infinite resources, less control and limitless autonomy – particularly in the school context – might distract learners as these factors offer multiple choices. The more mature the student, the more extensively free activity may be granted while at the same time external control, structures or guidelines are gradually removed (see also the concept of 'Anchored Instruction' in CTGV, 1993). For sustainable and motivational learning in schools, both diametric strategies – internal regulation and external control – are required. Further prerequisites are time, a sense of the cognitive ability of the target group, curricular freedom, and the use of appropriate tools. Many teachers assess their students' capabilities realistically and have an intuitive feel for the interplay between the above-mentioned aspects; they apply them in the form of well-planned classroom management during certain phases of their teaching and reinforce these using traditional media. To date, however, the appropriate tools have often failed to adequately support the interplay between internal regulation and external control (Knaus, 2009): classroom teaching observation has revealed that learner autonomy is often given too little consideration when digital educational software and tools are used in classrooms, due to fixed, inscribed procedures (Knaus, 2017).

CONNECTIVITY CREATES NEW INTERACTIONAL STRUCTURES

Devices that a few years ago could only be acquired with special (mobile telephone) contracts – when the first smartphone came out it could only be purchased in certain countries in combination with an internet data plan or flat rate – have now become the technical norm: these digital devices are characterised by permanent connectivity. A permanent connection with the Internet means constant access to the net's services, resources and applications as well as an uninterrupted connection to the owner's *social* networks. This is true not only for virtual social networks but also for communications with peer groups or family members using various media, apps or collaborative web tools. To what extent do these means of communication, which are no longer bound by traditional limits of time or space, result in a new qualitative and quantitative social interrelatedness between individuals? Could these extended opportunities for social integration and relatedness be used in the classroom to foster the students' learning?

Using 'digital manuscripts', coded structures of knowledge can be conceptually connected; subject matter and learning content can be complemented and socially linked: the conceptual connection can either be limited to one document, or links, tags or meta-information can be used. It can be inserted in different types of document: texts, images, videos or combinations of these media. The social relatedness achieved by using digital media allows the subjective construction of personal knowledge structures to become transparent for others and enables us to engage in creative and collaborative participation—at least potentially. As technology creates networks and, thus, social relatedness, creative processes are no longer restricted to individuals but can integrate existing (Knaus, 2013) or spontaneously formed project groups ('communities of project')[3]. Further services that are able to support collaborative learning in schools include: Wordle, Tagxedo, CiteULike, Weblogs (i.e. Wordpress), Jimdo, Wikis and GoogleDocs. Personal observation of school media projects reveals how these creative collaborative networks contributed to motivational and sustainable learning within teaching and learning processes (Knaus, 2013).

MEDIAL REALITY IN GERMAN SCHOOLS

Tablets and smartphones are helpful tools for learning in schools. They fulfil the requirements for intrinsically motivated, sustainable learning, but only if they are implemented using a 'networked digital manuscript' which follows a teaching strategy (Knaus, 2016)—and if the learners possess the requisite abilities. Using tablets and smartphones in this way is possible because of their adaptability, their degree of conceptual formability, and the social relatedness of the learner. The latter is established by social networks which might lead to feelings of competence or experiences of self-efficacy respectively. But

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[3] While difficult to describe, readers can easily have personal experience when using collaborative web tools, such as *Etherpad*s, *Prezi* or ConceptMaps like *Coggle* with several other people.

technology does not change or improve anything *per se* (Knaus, 2013; Knaus & Engel, 2015); at best, it offers potential (Knaus, 2016; Krotz, 2012). The fact that digital tools have the described potential to foster learning and improve teaching does not mean that these opportunities are also exploited productively. Observations on the current practical use of digital media in German schools show that the logic of linear and inscribed media – one could also say: the key school medium, the book – continues to predominate. Will 'digital schools' only serve to foster learning and teaching by reading texts from a tablet rather than from an (exercise) book? This would be a waste of resources—technical as well as pedagogical.

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Template version: October, 2011