Learning with digital media in a German vocational education and training system – an example of mobile skills-based learning in working processes

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1. Digital media in vocational education and training (VET) in Germany

The use of digital teaching/learning media in vocational training – both at the level of basic vocational education as well as advanced education – has been the subject of intense debate in Germany for many years. The two areas are considered separately because only basic vocational education is regulated by the government in Germany (cf. Hippach-Schneider, Krause & Woll 2007).

This paper introduces an example of the use of digital media in the context of vocational education. The KOLA research project "Skills-based learning with digital media in the workflow" develops proposals to support learning with the aid of digital media in the work process and increase cooperation among vocational learning venues. The following sections develop the example problem statement and aim (2), method (3), basic didactic assumptions (4), and system applications (5).

The first section presents a short overview and some background about the status quo concerning the use of digital media in vocational education in Germany. Generally, there are three key arguments used to justify the support for and use of digital media:

1. Promote general media skills for social participation

The aim of dual vocational education is to impart the vocational skills, knowledge, and qualifications necessary to engage in some form of occupational activity in a changing working world (Article1 of the German Vocational Training Act). This objective implies a general competency in the use of digital media for nearly every occupational field. In this context, the subject is considered a key competency. However, a general understanding of what skills are to be included has not been agreed. The central elements commonly used in describing media skills are:

a) Media know-how, specifically, a knowledge of the functions and forms of digital media
b) Media use/media management, specifically, the ability to use digital media in a competent manner
c) Media design, specifically, the ability to produce media content
d) Media rating/media evaluation, specifically, the ability to evaluate media content as well as to critically reflect on major issues in the context of the use of the media (e.g., data protection) (cf. Parola 2010).

2. Promote job-specific media skills

The job requirements have fundamentally changed in many areas of work because of the degree of digitalization. This is now commonly called – not incorrectly – the fourth industrial revolution (Schwab 2016). Consequently, the content of vocational education goes beyond the everyday uses of media to include subject and activity-specific skills in working with digital media.

3. Use as a teaching/learning aid

The third argument to be addressed is the use of digital media as teaching/learning media. The use of digital media in teaching/learning holds great promise. The often exaggerated requirements are rarely achieved and the intended application of media often lags behind the actual applications. A survey revealed that 65 percent of the training centers share the opinion that the use of digital media in education should be increased. Nearly as many (62 percent) expect it would result in better cooperation between the

companies, the vocational schools, and the venues where inter-company apprentice training occurs (Gensicke 2016, p. 42). Another key argument is the need to deal with the increasing diversity of the trainees/students (MMB Institute for Media and Competence Research & eCademy 2014, p. 5).

A key requirement for the introduction and wider use of digital media in vocational education is the pedagogic media competence of the instructors. The guidelines for instructor training at the vocational schools include appropriate provisions for developing didactic media competence, but these are not uniformly implemented. And, as these are relatively new requirements and many vocational school teachers completed their education prior to the introduction of the guidelines and, to increasing extent, career changers are working as vocational school teachers, it cannot be assumed that all teachers have the appropriate pedagogic media competence (cf. Wilbers 2012).

The availability of data about the use of digital media in the initial and advanced vocational education programs in Germany has until now been very fragmented. Comprehensive presentations and surveys for sub-issues have just been published this year (Gensicke et al. 2016, Schmid, Goertz & Behrens 2016). The conclusions show that the instructors and vocational school teachers have a rather reasoned and pragmatic view of digital learning. The use of digital learning media in the education system primarily follows "old" didactic concepts and methods; meaning, the potential of digital learning can hardly be realized. In particular, the potential of digital media to enable more equal opportunity and participation is insufficiently exploited. This situation may be explained by the lack of competence among instructors and the lack of time and financial resources (cf. Schmid, Goertz & Behrens 2016, p. 6). There are also clear differences between vocational schools and the attitudes of the teachers (Bach 2016). Although digital media is used in most vocational schools, comprehensive integration of digital media and a basic media competence among the teachers cannot be generally assumed.

According to a study of vocational training centers by the Federal Institute for Vocational Education, about three quarters of the enterprises now use desktop PCs with access to the Internet (Gensicke et al, 2016). On the other hand, the use mobile devices like laptops (48 percent), smartphones (45 percent) and tablets (28 percent) is much less frequent (ibid., p. 44). And, only 2 percent of the enterprises surveyed reported using new technologies like wearables, head-mounted-displays, or data goggles was observed (ibid., p. 45). There are also significant differences in the use of digital media in the various operating sectors of vocational education. For example, only 78 percent of the enterprises in the commercial and technical sectors use equipment with Internet access, while in the business and administrative sectors the figure is 95 percent. The biggest difference is noted between the service sector (100 percent) and the construction business (75 percent) (ibid., p. 46). Mobile learning is used by approximately one third of the enterprises, with the most common use of the technology, besides online forums and job-specific software, being to retrieve information available via the Internet (ibid., p. 53). Overall, the study shows that traditional media such as textbooks and written documents continue to dominate. In terms of digital media, subject-specific software and online information are the most significant and are still considered to be the most important (ibid., p. 49).

Regarding cooperation among learning venues, the study found that more than three fourths of the vocational school teachers (76 percent) and about half of the trainers (46 percent) are aware of the potential of digital media to improve the cooperation and networking between vocational schools and training centers (learning venues), but only about 49 percent of the vocational schools are taking advantage of this opportunity (cf. Schmid, Goertz & Behrens 2016, p. 28).

The Federal Ministry of Education and Research provides major funding for the research and use of digital media in vocational education and training. The program has been supported continuously for the past 16 years starting with the national funding program "NewMedia in Education" (2000–2006) and "eQualication in Vocational Education," an action program co-financed by the European Social Funding (ESF-Funding period 2000–2006). Follow-on programs "New Media in Vocational Education" (ESF-

Funding period 2007–2013) and the current program "Digital Media in Vocational Education" (ESF-Funding period 2014–2020) continue to fund this work. The annual funding for the "Digital Media in Vocational Education" program alone has been in the range of 10.6 to 12.8 million euros (BIBB 2016, p. 7ff).　A variety of scenarios have been and are being supported: virtual reality for construction equipment operators, game-based training for disaster and emergency response teams, augmented reality for media technicians, and digital competence balancing (Federal Ministry of Education and Research 2016).

2.　Problem description and aim

During the last few decades, the working world has witnessed an increasing dynamic (cf. Bünnagel 2012, p. 11). While jobs had always come with a lifetime guarantee before and workflows seldom changed, enterprises today are subject to a constant change process. In light of this development, the provision of purely specialized content to the trainee does not appear to be very useful. This is why dual vocational education today focuses more than ever on reflective competence development (cf. Riedl 2011, p. 30), which is intended to enable the trainee to be adaptable to change and to perform self-determined actions to a greater extent.

To provide the trainee with opportunities for such development, the participating learning venues of the dual vocational training system must be dependent on a common communication and cooperation. The teaching and learning cultures in the training centers, vocational schools, and other venues where inter-company apprentice training is conducted are very different. Furthermore, the spatial separation of the venues also plays a role (cf. Arnold und Gonon 2006, p. 103f.). These factors complicate the required dependency and can lead to the failure of the theory-practice transfer among the trainees (cf. Pferdt and Kremer 2010, p. 295).

In response to this problem, the research project KOLA - "Skills-Based Learning in the Work Process with Digital Media" was funded by the Federal Ministry of Education and Research (BMBF) with the purpose of strengthening the networking of various learning venues through the aid of a virtual classroom. This approach enables the implementation of teaching/learning process management throughout all of the learning venues. The use of digital media plays a key role in decoupling cooperation from time and space and opens a new range of action, integrated with previous real actions (cf. Unger 2010, p. 99).

An app and an online-platform were developed under the framework of this project. The app allows the trainee to digitally record their job activities and experiences. The online platform makes it possible for trainer and teacher at the participating venues to refer to these entries and address them at their own learning center. The system will be tested in training centers for the electrical trade in a German federal state (Saarland) during an evaluation period from October 2014 to September 2017. The individual sub-steps in the project are presented below from the requirements analysis to the present system.
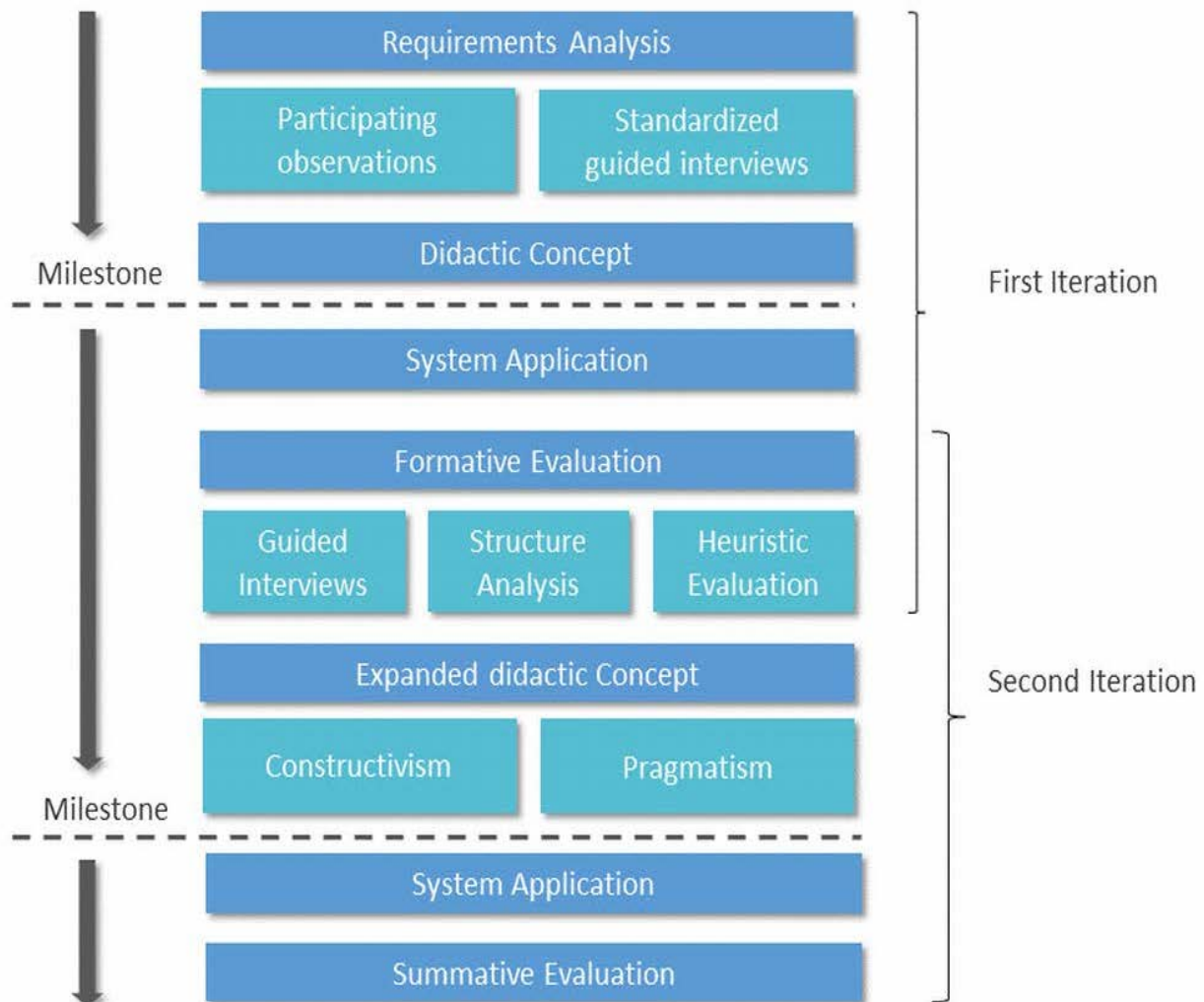
3. The path to digital learning in KOLA

Fig. 1: Project sub-steps (own graphic)

A requirements analysis was carried out in the spring of 2015. The aim was to identify the factors for each vocational training venue that either encourage or hinder workplace-integrated learning as well as workplace-oriented learning with digital media. The survey consisted of participatory observations and standardized guided interviews (cf. Przyborski/Wohlrab-Sahr 2010). Survey participants included those who took part in the first trial phase (specifically, trainees, teachers, and trainers).

Expanding on the findings this analysis, the technical system components (platform and app) were developed in parallel to the didactic concept that describes the central application scenarios well-grounded in learning theory. The system and application scenarios were tested in practice over the course of the first of two iterations. The first testing phase began in mid-2015 and ended at the start of 2016. This phase was followed by the formative evaluation.

The aim of the completed formative evaluation was to evaluate the KOLA system based on a concept from Döring and Bortz (2016, p. 991) which looks at concept, process, and outcome. The evaluation included the platform and app, implementation process, and embedding of the systems in existing structures. The evaluation also included a study of the structure of the documentation and the embedding of this documentation into a multiple learning venue setting, with more or less formal instruction. Important, on one hand, was the pedagogic-didactic quality criteria, oriented on a model of live sustainable learning by Arnold (2012). This included, for example, the support and empowerment of the trainees in

addition to constructive and value adding communication. On the other hand, we used criteria from Nielsen's (1994) usability research, for example, usability, practicality, and efficiency. The evaluation was governed by a qualitative approach with a data triangulation as shown in Fig. 2 below.

Method	Level	Approach	Focus
guided interviews	actor level	dialogical practical research	outcome and process
structure analysis	level of structure and content	qualitative content analysis according to Mayring	outcome and concept
heuristic evaluation	system level	usability research according to Nielsen	concept

Fig. 2: Data triangulation for formative evaluation (own graphic)

Supported by the formative evaluation, a didactic concept was revised and the system further developed. The current basic assumptions and the application scenarios, which serve as the starting point for the second iteration, are presented below.

4.　Basic Didactic Assumptions

The didactic concept establishes a general connection to the basic assumptions of learning theory – constructivism and pragmatism. Consider these two aspects as complementary approaches, with reciprocal foci on workplace-integrated learning as well as on workplace-oriented learning (cf. Sweet 2014), which is essentially fair to the individual learning and practical experience of the trainee. (cf. Fig. 3).
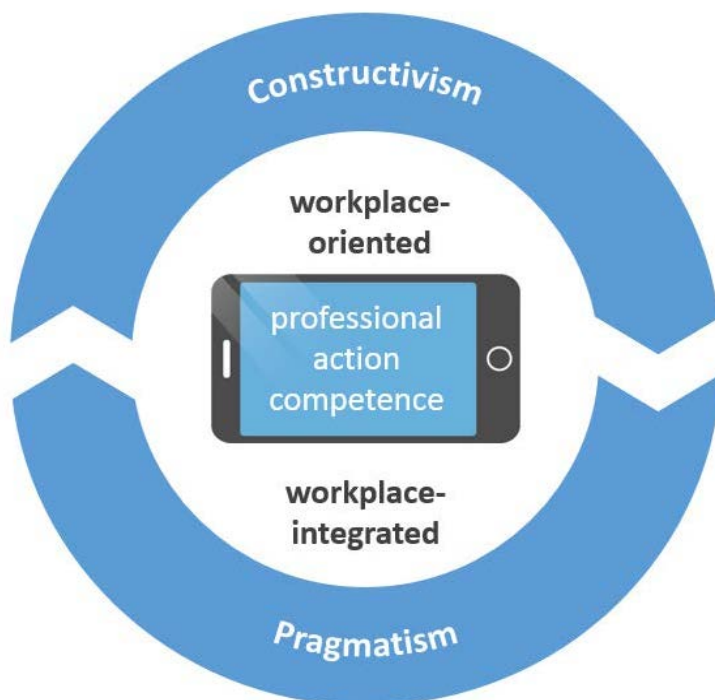

Fig. 3: Basic didactic assumptions in Project KOLA (own graphic)

The project refers to the three-part model of occupational competence from Schelten, which proposes that besides professional competence, personal and social skills are also important (cf. Schelten 2010, p. 172). In this context, these additional skills concern interactions with others (social) and successful personality development (personal) (cf. Riedl 2011, p. 39). Similarly, as a consequence of a dynamic

working world, increasing importance must be given to the so called meta-skills. These are needed as a basis for developing the basic self-critical and reflective attitude required to act in a working world that is characterized by constant change with self-determination in any new situation. Erpenbeck calls this the "conditions that make self-organized action possible" (Erpenbeck 1995, p. 8).

To realize such a multifaceted development, the goal is to promote both workplace-integrated learning as well as workplace-oriented learning with digital media. The approaches of workplace-oriented learning are mainly covered under constructivism. Constructivist approaches proceed from the assumption that methods like those of direct instruction are not very effective because teachers can never completely know or predict whether knowledge is reaching the trainees. The active and creative processes involving participation and self-design are missing from direct instruction. Constructivist approaches stress this active component (cf. Glaserfeld 2002, p. 220) and promote a case-based learning, oriented on situations encountered in occupational practice. The focus is especially on problem related cases that enable individual constructions on the basis of complex structures (cf. Kerres and de Witt 2004, p. 4).

The KOLA Project distances itself, however, from a standpoint that fully rejects direct instruction. In the area of vocational education, a middle way between teaching formats is preferred, one which allows movement between learner and teacher focused views related to the situation. The didactic concept takes a more moderate constructivist approach.

In the context of workplace-integrated learning, links can be formed to pragmatism as in the approach of John Dewey. Pragmatism understands learning as an active process and relies heavily on the experience of the actors (cf. Reich 2012, p. 71). Dewey attaches great importance to the conflict with real life situations, from which problem situations can be derived and used for purposes of reflection (cf. Dewey 2000/1916, p. 170). Pragmatism seems a suitable theoretical basis for the project as it puts real work situations in the foreground and, therefore, favors workplace integration over a workplace orientation. Furthermore, pragmatism advocates that learners themselves consider different opinions and view their own actions from several perspectives (cf. Kerres und de Witt 2004, p. 12f.).

5.　System application

The practical connection on the level of system use, which derive from the didactic assumptions about workplace integration and workplace orientation, are the subject of this section (cf. Fig. 4).
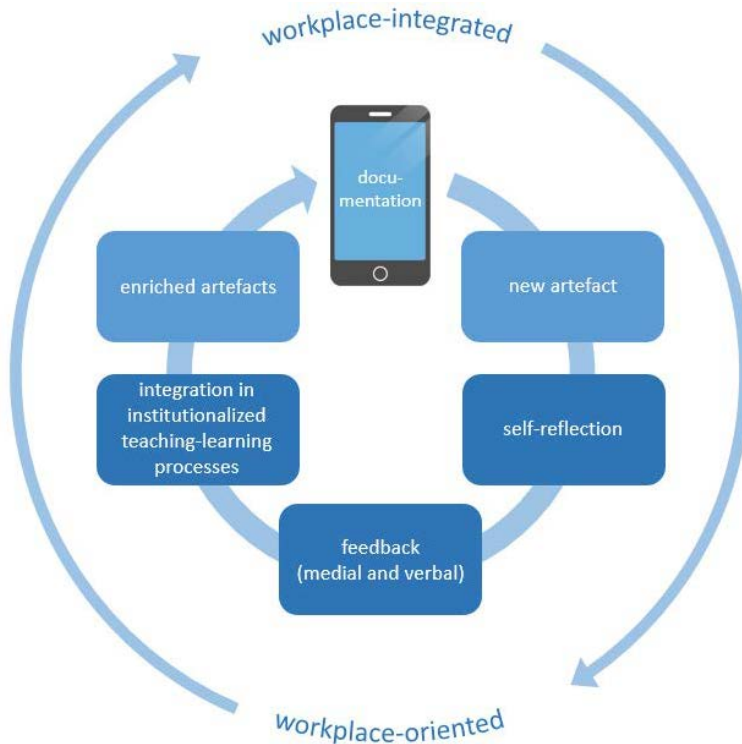

Fig. 4: System use in Project KOLA (own graphic)

The basic concept of workplace integration is to enable the trainees to capture the work accomplished, topics taught, and experiences gained at all three learning locations as a media product, that is, as text, images, and videos (cf. Rensing et al., 2016). For this to succeed, the system provides them with a template that is divided into sub-steps to facilitate the breakdown of complex work processes. Once the actions have been recorded, the trainees have the opportunity to use questions stored in the system for reflection to critically evaluate their own actions and view them from another perspective.

Workplace orientation usually takes place subsequent to discussion on the basis of documentation and self-reflection at all learning environments. Trainers and trainees have the chance to look at the recorded entries of the trainee and use them as food for thought for feedback sessions, or to address them in the institutionalized teaching/learning processes. For example, after the morning scheduling meeting, instructors who do not accompany the trainee to the construction site can discuss with the trainees how well they were able to complete the tasks and where remedial work may be beneficial using the photos, notes, and answers to the self-reflection questions. Teachers can use this documentation as a kind of practical example at some freely chosen time for more detailed classroom discussion.

For example, trainers can decide to focus on company documentation in the form of practical classroom exercises at some selected future time. The individual actors in the system can comment on the documentation and this serves the trainee again later as a template, for example, to be read in preparation for the next task, which may be more complex. The aim of addressing the structured documentation at other learning environments is to achieve a successful theory-practice transfer.

6.　Conclusion

In summary, the KOLA Project can clearly make a contribution to teaching/learning process management in a multiple-venue vocational education setting with the aid of digital media and mobile devices. In particular, with regard to developing the ability for self-reflective action in the future working

life, networking the experiences and activities gained from vocational training with the formal teaching/learning venues appears to be critically necessary. A setting, in which actual practice situations are systematically addressed, reflected on, and analyzed, contributes to the successful transfer of theory into practice. In combination with theoretical content, the KOLA project endorses the concept of documenting and integrating practice-oriented vocational training with the institutionalized teaching/learning process.

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