Professional development of PE teachers based on technology

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Abstract
The view on teacher training in Germany shows that so far little has been done regarding the anchoring of digital education technologies. Dealing with authentic professional tasks and problems raises the need of a deeper exploration of theoretical concepts and didactic models. In this paper a digital learning arrangement is presented which takes the specificity of teacher training in the subject of physical education (PE) into account. With the aim of breaking up prototypical patterns of action and ensuring trans-active knowledge development, it is apparent that the usability of digital learning in particular offers a decisive criterion for quality and acceptance.

Key words: Blended learning, physical education (PE), vocational competencies, prototype action structures.

Introduction
Digital educational technologies and learning offers have changed education and learning enduringly, especially in the last 20 years. Beside this fact, there has been a considerable increase in educational policy interest in integrating the different characteristics of digital education technologies in the existing educational landscape (Borchert, T., Seidel, Schneider & Karapanos, 2017; Erpenbeck & Sauter, 2016). In addition to the technological advances and the resulting possibilities for the design of technology-supported learning arrangements, these developments are closely linked to the findings and results of Hattie’s metastudy Visible learning (2009). However, the study attributed these technology-supported learning arrangements a low effect related to learning success (technology-assisted learning at home \(d = 0.16\), web-based learning \(d = 0.18\), computer support \(d = 0.19\)). The use of interactive learning videos (combination of computer-assisted teaching and video technology) was associated with a medium to high effect \((d = 0.52)\) on learning success. In contrast to these results, professional development “is more likely to change teacher learning \((d = .90)\). But these learnings have fewer effects on teachers’ actual behavior \((d = 0.60)\) and teachers’ reactions concerning the professional development \((d = 0.42)\). Moreover, there is even less influence on student learning \((d = 0.37)\)’’ (Hattie, 2009, p. 120). These results are in line with the international comparative study TALIS (OECD, 2009). TALIS showed that a lot of what has been discussed in teacher training has no or little influence on the direct professional activities of teachers. Gimple and Wahl, 2015 (p. 292) attributed this to “forgetting, the retention of habits and a lack of support to transfer the training impulses in teaching”. In this context, Hattie (2009, p. 120) pointed out that professional development has a high impact on student outcomes when “powerful ideas formed the basis of new practice”. As a consequence, there has been an interdisciplinary and international discourse about the success factors of teaching and learning processes beyond the scope of school. However, related developments in the field of vocational education and
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training have led to an educational reimport of the discussion about sustainability of teaching and learning processes in school.

Based on this situation, questions arise as to how professional knowledge from teacher training can be preserved for the participants and be made available in the sense of professional knowledge on demand. It must also be clarified how this process can be supported by digital learning offerings and educational technologies. This article places a particular focus on the organizational-didactical and technical questions concerning the use of online learning arrangements and supportive equipment in teacher training.

Theoretical framework

It appears that teacher training is exposed to ongoing restructuring efforts, which are primarily influenced by educational policy reforms (e.g., educational standards and competencies, discussion about inclusion) and a constantly changing school landscape (Rösken, 2008). After 20 years of transformation caused by the creation of international and national education plans (e.g., European Qualification Framework/ German Qualification Framework), changing educational guidelines (KMK, 2004), and core curricula (e.g., Klieme & Leutner, 2006), for most teachers teaching is still a private matter which “is rarely questioned or challenged (Hattie, 2009, p. 1). Furthermore, the practice of teaching at school is mostly dominated by fond habits of knowledge transfer in the sense of the “Nuernberger funnel” (Erpenbeck & Sauter, 2016, p. 42). Notions of how competency-oriented teaching and testing work hardly exist (teaching less than testing), which essentially indicates a lack of knowledge about needs-oriented and participant-centered teaching and learning methods (e.g., Hattie, 2009; Stibbe, 2011). Accordingly, the following phrase is valid more than ever from the teacher perspective: Curricula come and go, what remains is the lesson!

With regard to this, the present paper refers to the construct of subjective theory (e.g., Dann, 1990). Subjective theories describe the cognitive-emotional knowledge of an individual and fulfill the “functions of explanation and prediction” (Mogliacci, 2015, p. 25). Groeben (1990) declares that teachers’ subjective theories can explain doings and behavior. Gimple and Wahl (2015) distinguish between subjective theories of lower, middle, and broader reach. The term ‘reach’ accentuates the differences between subjective theories with regard to their proximity to action and complexity to the teaching process. Subjective theories with a lower reach are closely linked to the process of action but are less reflective; theories with a middle and wider range are highly reflective but only loosely linked to the processes of action (Gimple & Wahl, 2015). The ability to reflect on one’s own thinking and behavior is one of the outstanding evolutionary achievements. Reflection is the ability “that allows us to step out of the stream of immediate experience” (Glaserfeld, 2015, p. 153). Following this, reflective learning processes require teachers to mediate between pedagogically relevant knowledge gains and their own biographically acquired forms of consciousness and forms of interaction. In this context the triad of professional knowledge, vocational competencies and occupational field (Tasks, Structural Characteristics) itself becomes especially relevant (Fig. 1). According to Messner (2007), vocational competencies have a double reference: on the one hand they refer to the occupational field of action in the teaching profession, on the other hand to the content-related knowledge on which the competencies are based.
Combe and Kolbe (2004) consider reflexivity as the key competency of professionalism; therefore, an increase in reflexivity is accompanied by an increase in professionalism (Reh, 2004). It is currently in vogue to speak of reflective practice or a reflective turn (also in the context of sport) (e. g., Schön, 1983; Serwe-Pandrick, 2013). However, the topic of reflection is already contained in earlier concepts for PE by Kurz (1977) and especially by Ehni (1977). Humboldt’s formulation (1795, 1907) is essentially classical in his essay on thought and speech, “The essence of thought consists in reflecting” (1907, p. 581).

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Digital educational technologies offer diverse integrative learning arrangements to enable the nearly independent acquisition of knowledge and competencies (Reinmann, 2008; Borchert, Fritzenberg & Schlöffel, 2017). The biggest advantage in the context of professional development is the connection between classical learning methods and the excellent possibilities provided by the internet and technological innovations (Borchert, 2016). According to Borchert and Schlöffel (2017), the integration of new technologies in the field of professional development of PE teachers allows the preparation of didactically relevant questions in such a way that they are compatible with PE teachers’ subjective theories. With the acronym EQUEL (internet-based quality development of PE teacher training), the tool marks “the interface between professional competency development and reflexive teacher training” (Borchert, Seidel, Schneider & Karapanos, 2017). For this purpose, the methodological, didactical, pedagogical, and media design was carried out in close consultation with the theoretical considerations. Leading orientation points are the potentials of the use of educational videos as well as the possibilities of digital learning offers and new education technologies (Borchert, Fritzenberg & Schlöffel, 2017).

Basically, the analysis of authentic video sequences of sports lessons within the framework of teacher training is in focus. By means of theoretically founded reflection criteria, it is intended to enable PE teaching staff to expand their role as teachers by means of alternative ways of thinking and action. In addition, PE teachers should be qualified to deal critically with their own actions as well as the actions of others. It is to be noted that two particular characteristics mark the specificity of PE in the ensemble of school subjects: On the one hand, its unique content as an exercise subject with special forms of stress and strain as well as its marked methodological and organizational openness in the practical implementation in sports halls,
sports fields, swimming pools, cross-country and special trails, together with the open countryside, are crucial. On the other hand, its regulated competitive behavior in the context of victories and defeats characterized by competition, diverse movements with body contact, tactical movement behavior and fouls as well as a pronounced emotionality are central features of PE. The use of special equipment and materials reinforce the dominant features of the subject (Borchert, Seidel, Schneider & Karapanos, 2017).

In line with the aims of the PE core curriculum, EQUEL is not intended to generate any encyclopedic knowledge of action for different educational situations in the form of sample solutions or recipes. Instead, the main focus is on the internalization of a differentiated perception of teaching processes and their theory-based reflection, the discussion of relevant topics (e.g., accident prevention in PE, competence orientation, critical situations), as well as the framework conditions for PE. The primary focal point is the permanent linking of the educational content with the PE teacher’s subjective theories. According to Gimple’s and Wahl’s (2015) considerations on how to modify actions, the EQUEL tool follows a modular blended learning scenario:

Module 1 aims at the biographically acquired policy-making structures of PE teachers. The processing of these structures takes place in an attendance phase which is carried out by a PE coordinator (appointed by the government) and consists of two separate teacher training appointments. This attendance phase is coupled with a three-week online learning phase (virtual presence). In the attendance phase, the participants (n < 20) are familiarized with the idea of EQUEL, the video plug-in, and the hard and software. Each PE coordinator receives an accompanying script which guides them through continuing education courses and provides all necessary information (e.g., access to the Moodle course, preparation of teaching videos, providing and commenting on the video). The first phase of the course takes place at a school, facilitated by a participating PE coordinator. This enables authentic videotaping in a regular course of the PE coordinator in advance of the PE teacher trainer. The raw video material is prepared for the teachers’ training session and used to increase the awareness of one’s own actions. This productive irritation is intended to break up prototypical structures of action by PE teachers. As each PE teacher has highly individual action structures, typical/critical situations of PE lessons are identified using the example of one of the participating individuals. Later, this example is used for reconstruction of action structures of the other participants. For this reconstruction process, the feedback of the observing participants and the reflection of the observed PE teacher are included. In the four-week online learning phase, PE teachers are given access to the video material of the advanced training as well as other video vignettes in Moodle. This aims to identify further prototypical structures of action and make them recognizable to PE teachers. Via annotations in the video vignettes as well as a commentary function the PE teachers have the opportunity to express themselves in concrete teaching situations. Furthermore, they have the possibility to interact with each other and stay in contact with the supervisor. In the context of computer-assisted collaborative learning processes (CSCL), individual groups of PE teachers receive predefined work assignments which must be completed by the next phase. The objective of this is the acquisition of sustainable knowledge and competence during content-related, organizational-moderating and social-communicative activities (Carell, Jahnke & Reiband, 2002). In this way, the problems addressed in teacher training can also be dealt with further through the lessons (e.g., problems while assembling and dismantling sports equipment).

Module 2 consists of a one-day attendance phase as well as a three-week online learning phase (transfer phase) and is based on the annotations and comments in the Moodle course. The discussion focuses on expressed annotations and comments as a central topic. The aim of
Module 2 is to develop professional action alternatives for typical/critical situations of PE lessons (identified by the participants in module 1). This is realized through close linking of theory and practice. Relevant knowledge is taken into account and correlated with the individuals’ own structures of action in phases of subjective appropriation. Similar to module 1, the attendance phase in module 2 is carried out at a school by a participating PE coordinator in order to generate authentic video material. In addition, the attending teachers have the opportunity to contribute their own video material to the teacher training. In the subsequent virtual learning phase, the participants can upload this video material to the Moodle platform in order to expand their repertoire of professional problem solving as well as the enriching of their subjective theories with scientific considerations (Gimple & Wahl, 2015).

Module 3 consists of a three-week virtual learning phase (transfer phase) characterized by micro-teaching structure (reminder: micro-teaching d = 0.88; Hattie, 2009). It is aimed at the cooperative exchange of knowledge and experiences between PE teachers and self-created PE video vignettes. This is accompanied by a four-hour final attendance phase. In this last part of the teacher training sequence jointly developed ideas can be tested with a selected group of pupils (Karapanos, Borchert & Schneider, 2017). In this way, elaborated subject theories are supposed to be transformed and replaced by ‘quick thoughts’ and structures of prototypes which guide behavior (Wahl, 2013). According to Vygotski (1987), it is about the organization of different processes as well as their coordination and possible synchronization in the field of tension from “zones of the current performance” to “zones of the next development” of PE teachers (Vygotski, 1987). In order to ensure that PE teachers work in this type of PE teacher training to foster their subsequent development, the premises of a successful scaffolding are given direction (McKenzrie, 1999). This is the provision of clear directions, the clarification of purpose, the provision of a pathway for the learner, and the offering of assessments to clarify expectations.

Technical implementation

The overriding goal of EQUEL was to create an open source tool which is compatible with the already existing media infrastructure (requirements) in Germany. Although differences exist between the 16 federal states of Germany, use of the open-source learning platform Moodle is very widespread. At the beginning of the 2017 school year a Moodle plug-in was subsequently launched (Borchert & Schlöffel, 2017). The development is aligned to an iterative design process which follows the requirements of the participatory design (Halskov & Hansen, 2015) and is based on the Oregon Software Development Process (Schümmer & Slagter, 2004). The design process involved all those groups of people who are confronted with design decisions in the final system as users (Borchert, Seidel, Schneider & Karapanos, 2017). This applies primarily to the practicing PE teacher as well as to the PE coordinator and the involved supervisor (Seidel, 2014). The Moodle plug-in consists of a video database and a specialized video player for video analysis and annotations.

The video database makes it possible to upload and store video vignettes in the file system of the server or in the Moodle database. For each video, predefined metadata are defined according to the Dublin Core Meta Data Set and supplemented by automatically extracted technical metadata (e.g., video length, audio codec). An essential feature of the database application is context-related metadata describing the educational context. These descriptions were initially oriented towards classifications defined in the curricula, such as movement fields (e.g., run, jump, throw; moving in water), subject-related competencies (e.g., move and act, use methods), and pedagogical perspectives (e.g., performance; health). Furthermore, different PE venues (e.
The second component of the plug-in allows the users to play back videos and create annotations. All related features are based on Vi-Two – a JavaScript framework for interactive videos. The player allows the user to adjust the playback speed, repeat segments in a loop or zoom in the picture. Thus, the user is able to pay more attention to certain details and better understand volatile situations as well as visual details in the video. The plug-in supports various types of time-dependent or time-independent video annotations (Seidel, 2015; Borchert, Seidel, Schneider & Karapanos, 2017).

Different hardware and software were used for the technical production of the video vignettes. The data acquisition was realized by a digital single-lens reflex camera DSLR (Canon EOS 70D) with a Walimex wide-angle lens (Pro 14mm 1: 2.8) as well as a GoPro Karma Grip Hero5 Black. The GoPro Karma Grip in particular enables fluent recording and stabilized videos and is used predominantly at close range (<5 meters). The DSRL is operated either with a directional microphone (Rode Video Mic Pro) or with a wireless microphone (Sennheiser EW 100-ENG G3) in order to ensure a corresponding audio quality, especially in the sports halls. The editing of the videos was initially realized with a computer and a corresponding video-editing software (e. g., Final Cut Pro X). However, video editing is usually done with the standard software on the PC or tablet (e. g., Windows Movie Maker, iMovie). The hardware is transported together with additional accessories (tripod, charger, card reader, memory cards) exclusively in a GPS-tracked hard case (Peli Case 1560 trolley). The production equipment was used for video graphic recording of authentic PE lessons and the creation of up to 65 video vignettes. The objective is to equip schools in Germany accordingly and enable them to create and upload their own video material (in compliance with the Federal Data Protection Act).

**Perspectives, fields of application**

A look at the half-life of innovative and temporarily successful e-learning projects in the field of education raises the question of how radically computer-based strategies should be implemented so that they remain as a visible tool in the teacher training landscape. This applies in particular to future teachers and the contribution to the training of competencies in the field of vocational education and training of PE teachers. In view of the curricular integration as well as the assumptions regarding compatibility, there are good opportunities to change the learning culture through this tool. However, in the field of PE teacher training, EQUEL is mainly concerned with the needs of participants and educational policy decisions. For technology-supported knowledge development this essentially means that, in addition to the content-technical and didactical preparation as well as the organizational strategy development, the acceptance and usability of the learning offers must be taken into consideration. In terms of acceptance this can be achieved by reverting to classical social psychology behavioral theories (e. g., Venkatesh, Morris, Davis and Davis, 2003). This is notably the case if the contents of teacher training provide a direct link to everyday (teaching) life and to the needs of the participants (Ganz and Reinmann, 2007).

Much more important is the usability as an attribute of human-computer interaction and an outstanding quality and acceptance criterion of interactive systems. The negative impact of usability issues on the learning experience and outcome is undeniable (Aberdour and Smith, 2006, p. 14) “The cost of poor usability is high. It includes unsatisfied, ineffective learners and ineffective e-learning initiatives, learners who find an e-learning program hard to use“. This is,
above all, of more interest than the fact that the constituent prerequisite for successful collaborative learning processes is the active participation of the individual. The long-term use of virtual collaborative learning processes essentially depends on the artifacts (annotations, comments) of the users. By combining a blended learning arrangement and the advantages of video vignettes, EQUEL meets a multitude of requirements for the usability, the usefulness (Karapanos, 2015) and the sustainability of digital learning arrangements (Karapanos, Borchert, Heise & Schneider, 2018). Accordingly, the PE teachers are able to access the content even after the training session and to integrate it into their lessons.

Considering the premises for digital learning offers (Preußler, 2008), a formal evaluation of actual effectiveness needs to take place. For this purpose, specific criteria have to be operationalized which meet all the formulated learning objectives, the assessment, and the learning set-up as a whole.

Regarding the strategy of the German conference of the ministers of education and cultural Affairs (KMK) on “Education in a digital world” (KMK, 2016), EQUEL can be used as a tool for different topics and settings. Its content openness allows its use in the context of development of technology-supported knowledge on accident prevention and safety promotion in PE (DGUV, 2016). Furthermore, for in-service PE teachers it supports the development of specific competencies concerning work in inclusive settings (Bringmann and Friedrich, 2017). Using video-based casework in particular, the requirements of the United Nations Convention on the Rights of People with Disabilities (2008) can be implemented better than before. This can also be taken into account through the demands for a stronger professionalization of PE teachers working in inclusive settings (Tiemann, 2015).

Referring the governmental funding program Quality Campaign Teacher Education (funded by the Federal Ministry of Education and Research) EQUAL meets several central problem objectives: a) profiling and optimizing the structures of teacher education at universities (also through digital learning offers), b) quality improvement of practical relevance in teacher training, c) improving professional guidance and guidance for students in teacher education and d) development of teacher education in relation to the requirements of heterogeneity and inclusion. These goals can be achieved through the versatility of EQUAL in different stages of teacher training at university and school.

References


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