Dieter Mette, Bjórn Egbert

New Media as an Instrument of Modern Education : Opportunities and Current Challenges in School Education System and Teachers' Training Exemplified by Interactive Whiteboards and Tablet PCS

MUZEUM HISTORII POLSKI

Dieter Mette

Björn Egbert

NEW MEDIA AS AN INSTRUMENT OF MODERN EDUCATION – OPPORTUNITIES AND CURRENT CHALLENGES IN SCHOOL EDUCATION SYSTEM AND TEACHERS' TRAINING EXEMPLIFIED BY INTERACTIVE WHITEBOARDS AND TABLET PCS

Abstract

The current discussion about enhancing the quality of education and training in schools and universities is mainly focussed on answering the question: which ways of thinking and working, which learning strategies and methods may be considered modern and expedient in order to fulfil the standards and competence expectations that enable learners to get along in their working and living environment[1]. In this context it seems clear that object-related learning strategies themselves become the content of debate in class and have to be learned and implemented. Currently, this especially applies to the use of new media, which will be discussed in the following text. This paper is characterised by the close connection of educational objectives and contents as well as media in the meaning of educational instruments.

Key words: new media, competence, tablet PCs, smartphones, interactive whiteboards, school education, professional teaching

NOWE MEDIA JAKO INSTRUMENTY WE WSPÓŁCZESNEJ EDUKACJI – SZANSE I WYZWANIA W SZKOLNYM SYSTEMIE EDUKACJI I SZKOLENIA NAUCZYCIELI NA PRZYKŁADZIE INTERAKTYWNYCH TABLIC I TABLETÓW PCS

Streszczenie

Obecne dyskusje na temat poprawienia jakości systemu edukacji i szkoleń w szkołach i na uczelniach jest głównie skoncentrowany na rozwiązaniu problemu, które sposoby myślenia, pracowania, które strategie i metody uczenia się są uważane za współczesne i celowe w stosunku do spełnienia standardów i kompetencji, które umożliwiają osobom uczącym się dostosowywać się do środowiska pracy i życia. Wydaje się to oczywiste, że same zorientowane obiektowo strategie uczenia się stają się przedmiotem debaty w klasie i muszą być nauczane

---

[1] see D. Mette, *Typische Betrachtungsweisen von Technik als Inhaltselement technischer Bildung,* [w:] Deutsche Gesellschaft für Technische Bildung e.V. (red.), *Inhalte zeitgemäßen Technikunterrichts. Strukturierung und Präzisierung,* Offenbach am Main 2010, s. 73.

i implementowane. Szczególnie jest to widoczne przy wykorzystywaniu nowych mediów, które są omawiane w niniejszym tekście. Artykuł jest ściśle powiązany z treściami i celami edukacyjnymi, jak również media w znaczeniu instrumentów edukacji.

Słowa kluczowe: nowe media, kompetencje, tablet PCs, smartfony, tablice interaktywne, edukacja szkolne, szkolenia zawodowe

Introduction

The changes in cultures and societies caused by the so-called new media are obvious and affect the conditions of everyone's private, social and professional life so deeply that it has become a significant factor of the present. The users' influence on new media and also vice versa makes the examination of the interdependency indispensable. The analyses of changes in using patterns, motivations and situations which are connected to the use of new media contribute to recognising and evaluating opportunities and obstacles in this context. Therefore the newly posed question is: how do the ever changing possibilities and impacts of new media concerning new forms of information, communication and cooperation in the field of everyday culture have to be assessed?[2]. This also includes an examination of the role of new media in relation to educational processes.

Already before entering school, children discover their environment shaped by informational technologies and new media and interpret it according to their stage of development. For instance children prove themselves while skyping with their grandparents, watching their parents during phone calls, or while playing with tablet PCs. Their access to internet, computers and smartphones characterises the daily life of students in school as well as university.

In class these insights are seized, developed and sometimes even adjusted. It is obvious that educational systems have to offer every adult the possibility to acquire competences to safely and deliberately use and control informational technology, especially communicational technology in the context of general school education. These competences are a key to enable students to take part and orientate in their environment and to actively take part in shaping it as well as to take responsibility for themselves and others which was already stated by the European Commission in 2006[3].

Individuals in Germany, Europe and all over the world are fundamentally confronted with application-related aspects of informational technology and new media. Equally, teachers of all subjects are now asked to satisfy the educational demands described above while they also have to deal professionally with aspects of informational and communicational technology themselves[4]. By now, computers with internet access are

---

[2] see B. Egbert, A. Zapf, *Aneignungs- und Nutzungsweisen Neuer Medien. Intuition, Kreativität, Kompetenz.* „Technikfolgeabschätzung – Theorie und Praxis" 2015, nr 2. Im Erscheinen.

[3] see Europäische Kommission, http://eur-lex.europa.eu/legal-content/DE/TXT/PDF/?uri=CELEX:32006H0962&from=DE [08.08.2013].

[4] see J. Voogt, *Are teachers ready to teach in the knowledge society?,* [w:] R. Schulz-Zander, B. Eickelmann, H. Moser, H. Niesyto, P. Grell (red.), *Jahrbuch Medienpädagogik 9*, VS, Wiesbaden 2012, s. 19.

employed in class in nearly every German school, which is not limited to subjects like technology or computer sciences. However, the way computers are used varies considerably[5]. At present, the newest media employed in classrooms are interactive whiteboards and tablet PCs of manageable sizes. They seem to entail, besides the usual advances of digital media, further positive aspects for school development[6].

Yet, good lessons require more than the bare usage of the medium. In fact, the question is how didactical and methodological approved education can be realised through digital media. This development offers new opportunities that so far were not available for teachers when organising their classes. However, these opportunities are equally accompanied by remarkable difficulties or the feeling of being additionally strained. In the past it has been claimed that teachers rejected these tendencies preferring to teach with chalk, blackboard and pointer as it has been done 100 years ago. Already in 2010 and 2011 the BITKOM studies could mostly disprove this cliché, showing that the teachers were not opposing classroom digitalisation[7]. By now, new media have arrived in school education, but their full potential is rarely tapped.

This current challenge is also being discussed in teacher training, because throughout their studies future teachers need to be prepared to master with the requirements of school-related informational and communicational technology. In doing so, they will be qualified to professionally and responsibly handle and use the above mentioned technological devices and the corresponding software in different - but not arbitrary - situations in order to organise their classes.

Whereas it is generally stated that students may be considered as intense users of computers and online media, while this habit is not only limited to their free time but is especially established in the field of studies[8], future teachers still do not seem to be sufficiently prepared for handling and applying school-related informational and communicational technology.

According to the described initial situation, (different) aspects of new media usage in school education and teacher training are depicted below. Mainly, the employment of interactive whiteboards and tablet PCs will be dealt with, while the question is posed how education development and technological progress can benefit from one another.

[5] see D. Petko, *Hemmende und förderliche Faktoren des Einsatzes digitaler Medien im Unterricht: Empirische Befunde und forschungsmethodische Probleme*, [w:] R. Schulz-Zander, B. Eickelmann, H. Moser, H. Niesyto, P. Grell (red.), *Jahrbuch Medienpädagogik 9*, VS, Wiesbaden 2012, s. 29.

[6] see J. Schlieszeit. *Mit Whiteboards unterrichten. Das neue Medium sinnvoll nutzen*, Beltz, Weinheim und Basel 2011, s. 29.

[7] see BITKOM Research, *Digitale Schule – vernetztes Lernen. Ergebnisse repräsentativer Schüler- und Lehrerbefragungen zum Einsatz digitaler Medien im Schulunterricht*,
http://www.bitkom.org/files/documents/BITKOM-Studie_Digitale_Schule_2015.pdf [17.03.2015].

[8] see M. Grosch, G. Gidion, *Mediennutzungsgewohnheiten im Wandel. Ergebnisse einer Befragung zur studiumsbezogenen Mediennutzung*, KIT, Karlsruhe 2011, s. 1.

Focussing on opportunities and obstacles of new media usage in the context of teacher training and school education

Teacher training and school education based on educational approaches may be considered as the initial point of all conceptual and methodological efforts. Therefore it needs to be discussed how the competences intended in the learning process can be detected according to the outcome. The determination of the intended outcome relies on the challenges learning individuals have to face in their current and future living and working environment. Thereby, it has to be ensured that learning arrangements which allow the students to understand and reasonably use new media are applied in courses. It appears to be obvious that there should be no break between the students' living environment in which they are surrounded by new media and schools in which these tendencies have sometimes been broadly ignored.

Interactive whiteboards have been invented in 1986[9]. While their usage has been established in different countries such as England, the USA or South Korea, they only started to spread across the German educational sector a few years ago[10]. The same development can be observed with tablet PCs which are used increasingly in Estonia, Latvia, the Netherlands, Turkey, South Korea or the USA[11]. Results of the current BITKOM study depict that the standard equipment of German schools includes stationary computers (99%), projectors (98%) and digital cameras (91%). In contrast, interactive whiteboards are only available in 60% of the schools. With regards to the equipment with tablet PCs and e-book readers the numbers are even worse (tablet PCs: 18%, e-book readers: 4%). Yet, all school have internet access while even half of them provide access in every room[12]. Consequently, teachers as well as students are currently rating the standard equipment as rather moderate and indicate a need for improvement in order to integrate digital media more often in class[13]. In this context, the insight that teachers as well as students are not mistrusting the usage of new technologies is very important, because only 5% view it sceptically[14].

Interactive whiteboards – opportunities and obstacles

In many German schools whiteboards have been established. As a result, completely new potentials of educational work have showed. In class, whiteboards provide entirely new possibilities for visualisation. In contrast to traditional panel paintings a change of colour, form or position is always possible. Texts can be adjusted and moved at any time. Different tools and digital material are available and can be integrated independently on screen helping to adapt to the learners' needs[15]. Due to the fact that all objects on screen can be edited

---

[9] C. Kohls, *Mein SMART Board*, Kids, Erfurt 2011, s. 7.

[10] R. Irion, *Interaktive Whiteboards im Grundschulunterricht. Didaktische Herausforderungen für die Nutzung digitaler Tafeln bei der Gestaltung von Lernumgebungen in der Primarstufe*, [w:] R. Schulz-Zander, B. Eickelmann, H. Moser, H. Niesyto, P. Grell (red.), Jahrbuch Medienpädagogik 9, VS, Wiesbaden 2012, s. 175.

[11] see B. Wege, *Der Neue im Klassenzimmer*, DIE ZEIT N°30/2013, http://www.zeit.de/2013/30/digitaler-unterricht-tablet-pcs [10.03.2015].

[12] see BITKOM Research, s. 5.

[13] BITKOM Research, s. 5.

[14] BITKOM Research, s. 6.

[15] see U. Gutenberg, T. Iser, C. Machate. *Interaktive Whiteboards im Unterricht: Das Praxishandbuch*, Schroedel, Braunschweig 2011, s. 8.

flexibly and spontaneously, dynamic 'panel paintings' can be created on whiteboards. These help to illustrate complex contents and guide the learners' attention precisely using movable elements[16]. With regards to teaching methods like brainstorming and mind mapping, whiteboards offer interesting possibilities for traditional teacher-centred classes[17]. Ideas can be collected, reorganised, structured and added in only a few steps. Furthermore, audio or video files can be integrated which could have never been the case with traditional blackboards. Still, rules for working with blackboards also apply to the usage of whiteboards: good panel paintings allow students to take part in their creation, consider the rules of perception, link the medium to the educational process and improve the teaching quality.

Apart from the possibilities whiteboards provide in elaborative teaching contexts they can be used to support presentations by taking the role of classical projectors while they offer special features to adapt the presentations a lot better to the learners' needs. Usually, devices of most manufacturers are compatible with standard programs such as Microsoft PowerPoint. But only by using specific whiteboard software it is possible to do more than just showing on slide after another. This software allows an active integration of mental leaps or requests into the presentation and the realisation of the above mentioned teaching aspects. Thereby, the speakers can take a more active role than by working with a PC and a projector[18]. If interactive whiteboards are also connected to a documenting camera or to learners' PCs, presentations hold by learners will become a standard in educational processes. The possibilities provided by new media will only be fully exploited, if teaching institutions offer the possibility that teachers and learners can communicate for class preparation or during classes by using content management systems.

Nevertheless, using interactive whiteboards requires changing the ways teachers and students work and communicate in terms of class preparation as well as homework[19]. Class preparation and homework will change to the extent that files will be created and brought into the classroom so that they can be used during the lesson. Thereby, teachers are challenged to find or develop appropriate material. Serious deficits have been recorded because interactive whiteboards are currently only being established in teaching contexts and the required materials - depending on the subject - are often only available to a minor degree or connected to high costs. Another obstacle is the fact that standards for different board types are still missing with the result that material cannot be transferred freely.

The use of tablets in training and education – opportunities and challenges

Interactive whiteboards or projectors are still predominantly used in premises that are not equipped with personal computers for learners. This narrows down the didactical as well as methodological opportunities of using new media in training and education, as it hardly facilitates a serious orientation towards the learners. So far and especially in Germany, it is not usual for learners to consistently work computerised while being connected with whiteboards, which would enable bilateral communication and interaction. If learners are supposed to gain systematic and comprehensive access to informational and communicational

---

[16] J. Schlieszeit, s. 31.
[17] see C. Kohls s. 137 et seqq.
[18] U. Gutenberg, T. Iser, C. Machate, s. 28.
[19] J. Schlieszeit, s. 31.

media in the context of school education, the use of portable, personalised computers or tablet PCs becomes almost inevitable. The costs for providing tablets as well as a still inadequate infrastructure are factors that hinder the implementation of tablets in education and training. A complete wireless connection of internet, tablet PCs, interactive whiteboards and other media tools does only exist in exceptions (review above). Nevertheless, the sales of tablet PCs – also in the educational sector – are constantly increasing, while still fewer than 5% of German school classes are equipped with tablet PCs[20]. Similar to the above mentioned interactive whiteboards tablet PCs are a convincing supplement to conventional ways of working, which will be indicated as follows. For instance, tablet PCs can visualise complex contents by using simulations; courses can be adjusted to learners' needs, linear concepts of thinking and learning can be broken and learned asynchronously regardless of time and place, which enhances constructive teaching and learning[21]. Furthermore, already existing teaching materials can easily be recreated, audio and visual documents can be implemented, and it is possible to enable individual learning in terms of speed and order, which contributes to a cognitive activation and relief.

Nevertheless, it is important to point out that at first learners and teachers have to learn how to work with tablet PCs. As Voogt points out: *'Students are expected to be more actively involved in their own learning process, which asks for different teaching strategies and a change in the responsibilities that students and teachers traditionally have held within the learning process'*[22]. Further, it might be critically noted that currently the market is guided by technology and technicians instead of educationalists, and that current media tools contribute to technical rather than didactical factors. There are, however, even economic factors supporting the use of tablet PCs, for instance, in terms of decreasing printing expenses, as Lübke et seqq. point out[23].

Developing media competence as a didactical challenge at schools and universities
It is commonly understood among teaching professionals that developments of social, cultural and technological structures in terms of new media have an effect on learners' methods, learning habits and strategies, and that this requires pedagogical intervention. The recent BITKOM-study indicates for one thing that there is a strong demand for higher investments in technological equipment as well as standardisation of digital teaching materials and software among both future and practicing teachers. It also reveals that there is a need for comprehensive training in competent use of new media in school lessons[24]. Concerning social media and mobile learning we are facing new challenges concerning the design of physical as well as virtual classrooms. While there are numerous teachers already working with tablet

---

[20] review STATISTA, 2015, http://de.statista.com/statistik/daten/studie/157928/umfrage/absatz-von-tablet-pcs-in-deutschland/ [03.03.2015]; BITKOM Research.

[21] see C. Kohl, 2011, s. 9; M. Stadermann, R. Schulz-Zander, *Dimensionen unterrichtlicher Interaktion bei der Verwendung digitaler Medien*, [w:] R. Schulz-Zander, B. Eickelmann, H. Moser, H. Niesyto, P. Grell (red.), *Jahrbuch Medienpädagogik 9*, VS, Wiesbaden 2012, s. 53 et seqq.

[22] J. Voogt, s. 19.

[23] M. Lübke, F. Di Giusto, C. Müller Werder, D. Lozza, *Besser, schlechter, ändert nichts? – Tabletnutzung an der Hochschule,* [w:] K. Rummler (red.): *Lernräume gestalten – Bildungskontexte vielfältig denken*, „Medien in der Wissenschaft" 2014, nr 67, s. 102.

[24] see BITKOM Research, s. 22

PCs in their lessons and advertising its use, scientific examinations of tablet PC usage at university and school still remain exceptions. Even though it is often stated that using tablet PCs can have a positive impact on students' willingness to learn, it is not clear if the use of tablet PCs is more advantageous than traditional methods. Moreover, the effect of new media has to be evaluated depending on its context, which becomes obvious with a look at the results of Bardo Herzig's recent study on the effectiveness of digital media of the Bertelsmann Foundation[25]. According to that study, it is not possible to make general statements on the efficacy of particular devices or media supplies towards learners. Instead, new media may be viewed as influencing factors that can be used to fulfil educational objectives. Thus, it should be a major concern to develop, approve and evaluate practical action plans and didactical scenarios for various contexts, and to get teachers acquainted with these. The class-related application of new media requires competences from teaching professionals and learners which they cannot automatically acquire by handling the technology in their private lives. Occasionally, individual using habits might even hinder target-oriented work with new media[26]. Since availability of reliable soft- and hardware alone does not necessarily lead to target-oriented working, there are a number of – usually optional – opportunities for qualification[27] that are to promote the competences of teachers in terms of didactically motivated use of digital media and technology at schools and universities. These are, however, mostly concerned with the basic handling of the hard- and software and its individual functions, while the actual orientation towards explicit teaching purposes often comes off badly[28].

At this point, it is advisable to mention a positive trend in teacher training, according to which there already are various approaches within the German-speaking area (for further information, please review Hamburger eLearning-Magazin, 2014). The University of Potsdam, for instance, is offering a seminar called *Supporting Didactical Actions with Digital Media* (*Didaktisches Handeln mit digitalen Medien unterstützen*), where digital media do not only serve as teaching and learning materials but where students also reflect on the potential of media usage in relation to their own training. During their practical exercises it became obvious that for both, students as well as teachers, coordination and support of their self-organised tasks would be the greatest obstacle within the learning process[29]. Hence, for a competent dealing with new media in terms of educational training, there seem to be more relevant aspects along with research, structuring, presentation, evaluation and reflection, namely aspects of learning and teaching with and about new media. Furthermore, we have to consider volitional aspects within this context, since dealing with flexibility usually requires personal self-reliance and commitment[30].

---

[25] see B. Herzig, *Wie wirksam sind digitale Medien im Unterricht?,* Bertelsmann Stiftung, Gütersloh 2014.

[26] see U. Gutenberg, T. Iser, C. Machate, s. 43.

[27] J. Riedel, B. Grote, L. Henze, C. Albrecht, L. Schlenker, M. Schumann, J. Hafer, V. Castrillejo, T. Köhler, C. Börner, *Fit für E-Teaching. Diskussion von Empfehlungen für die inhaltliche, methodische und strategische Gestaltung von E-Teaching-Qualifizierungen*, [w:] K. Rummler (red.): *Lernräume gestalten – Bildungskontexte vielfältig denken*, „Medien in der Wissenschaft" 2014, nr 67, s. 434.

[28] see J. Schlieszeit, s. 63.

[29] see C. Brückner, M. Schuhmann, *Didaktisches Handeln mit digitalen Medien unterstützen*, [w:] *eLearning in der Erziehungswissenschaft*, „Hamburger elearning Magazin" 2014, nr 2, s. 13, http://www.uni-hamburg.de/elearning/hamburger-elearning-magazin-12.pdf [20.03.2015].

[30] review also M. Stademann, R. Schulz-Zander, s. 51.

Gerhard Tulodziecki points out, that future and practising teaching personnel have to be capable of (1) acting media-competent (handle media appropriately and choose as well as use them in a reflective way, …); (2) assessing the value of media for children and teenagers when planning, carrying out, and evaluating lessons; (3) analysing and evaluating existing media offers in terms of learning and teaching, developing own media supported contributions for teaching and learning processes, as well as analysing, preparing, implementing and evaluating teaching units and projects with media usage; (4) recognising media related educational tasks during lessons, project works and consultations; and (5) seizing and designing personal, equipment related, organisational and other school related conditions for media-educational tasks at school, and contributing to the development of a media-educational concept in the sense of school development[31].

Apart from these primary aspects, subject didactics are asked to undertake steps that relate new media to concrete teaching contents. This shall be illustrated as follows through an example from a subject called Economy-Work-Technology (Wirtschaft-Arbeit-Technik): technical sketches, circuit layouts, CNC-programmes, technical mechanics and so forth are aspects included in university studies as well as in school lessons, which can be produced, edited, simulated and presented via interactive whiteboards or tablet PCs. In contrast to the traditional work with blackboard or paper these technologies can easily adjust constructions and respective sketches to desired and target-oriented dimensions. Connected to a 3D-printer, technical constructions can even become physical. This is similar to the developments of switching circuits. Supported by adequate software circuits can not only be created during lessons, but it also possible to simulate their functionality and measuring values. Compared to physical building sets the opportunities that go alongside those new technologies are almost infinite, even though it has to be admitted that they do not promote psychomotor skills.

In the context of career and study orientation tablet PCs are suitable for researching job databases, for communicating with career counselling agencies, for creating photo-, video- and audio-supported portfolios of business internships, for accomplishing apprentice trainings, and for simulating job interviews that could not be realised to the same extent without using digital media. The same applies in an economical context of the subject Economy-Work-Technology. If it comes to projecting economical behaviour, business games and simulations are useful treatments for making decisions and inferring consequences.

Conclusion

The article's aim was to illustrate current challenges in a changing working and living environment through aspects of new media and to depict consequences for school education and teacher training that go along with it. By using the example of interactive whiteboards and tablet PCs, it was shown that teachers need both a profound knowledge concerning the educational content and a modern subject-related didactical repertory in which new media are supposed to play more than a secondary role. It is obvious that media-related insights as well

---

[31] G. Tulodziecki, *Medienpädagogische Kompetenz und Standards in der Lehrerbildung,* [w:] R. Schulz-Zander, B. Eickelmann, H. Moser, H. Niesyto, P. Grell (red.), *Jahrbuch Medienpädagogik 9*, VS, Wiesbaden 2012, s. 279, translated from German.

as subject-related didactical reflections need to correlate. From our point of view, this aspect characterises the main challenge we are facing while talking about new media and its role in educational processes. Neither learners and teachers nor people instructing future teachers must reject these challenges. Consequently, the point is to establish educational offers for new media usage in teacher training and especially to embed new media in subject-related didactics. Therefore teaching professionals should be enabled to recognise, understand and use the didactical potentials of new media responsibly according to their subject so that an added value will be achieved in school and university education.

Bibliography

BITKOM Research, *Digitale Schule – vernetztes Lernen. Ergebnisse repräsentativer Schüler- und Lehrerbefragungen zum Einsatz digitaler Medien im Schulunterricht,* http://www.bitkom.org/files/documents/BITKOM-Studie_Digitale_Schule_2015.pdf [17.03.2015].

Brückner C., Schuhmann M., *Didaktisches Handeln mit digitalen Medien unterstützen*, [w:] *eLearning in der Erziehungswissenschaft*, „Hamburger elearning Magazin" 2014, nr 2, s. 11-15, http://www.uni-hamburg.de/elearning/hamburger-elearning-magazin-12.pdf [20.03.2015].

Egbert B., Zapf A., *Aneignungs- und Nutzungsweisen Neuer Medien. Intuition, Kreativität, Kompetenz,* „Technikfolgeabschätzung – Theorie und Praxis" 2015, nr 2. Im Erscheinen.

Europäische Kommission*, Schlüsselkompetenzen für lebenslanges Lernen – Ein Euro-päischer Referenzrahmen*, Amtsblatt der Europäischen Union, L 394. http://eur-lex.europa.eu/legal-content/DE/TXT/PDF/?uri=CELEX:32006H0962&from=DE [08.08.2014].

Grosch M., Gidion G., *Mediennutzungsgewohnheiten im Wandel. Ergebnisse einer Befragung zur studiumsbezogenen Mediennutzung*, KIT, Karlsruhe 2011.

Gutenberg U., Iser T., Machate C., *Interaktive Whiteboards im Unterricht: Das Praxishandbuch*, Schroedel, Braunschweig 2011.

Hamburger eLearning-Magazin, *eLearning in der Erziehungswissenschaft. Hamburger eLearning-Magazin,* 2/2014. Verfügbar unter: http://www.uni-hamburg.de/elearning/hamburger-elearning-magazin-12.pdf [20.03.2015].

Herzig B., *Wie wirksam sind digitale Medien im Unterricht?*, Bertelsmann Stiftung, Gütersloh 2014.

Irion R., *Interaktive Whiteboards im Grundschulunterricht. Didaktische Herausforderungen für die Nutzung digitaler Tafeln bei der Gestaltung von Lernumgebungen in der Primarstufe*, [w:] R. Schulz-Zander, B. Eickelmann, H. Moser, H. Niesyto, P. Grell (red.), *Jahrbuch Medienpädagogik 9*, VS, Wiesbaden 2012, s. 175-196.

Kohls C., *Mein SMART Board*, Kids, Erfurt 2011.

Lübcke M., Di Giusto F., Müller Werder C., Lozza D., *Besser, schlechter, ändert nichts? – Tabletnutzung an der Hochschule,* [w:] K. Rummler (red*.): Lernräume gestalten – Bildungskontexte vielfältig denken*, „Medien in der Wissenschaft" 2014, nr 67, s. 102-113.

Mette D., *Typische Betrachtungsweisen von Technik als Inhaltselement technischer Bildung*, [w:] Deutsche Gesellschaft für Technische Bildung e.V. (red.), *Inhalte zeitgemäßen Technikunterrichts. Strukturierung und Präzisierung*, Offenbach am Main 2010, s. 73-82.

Petko D., *Hemmende und förderliche Faktoren des Einsatzes digitaler Medien im Unterricht: Empirische Befunde und forschungsmethodische Probleme*, [w:] R. Schulz-Zander, B. Eickelmann, H. Moser, H. Niesyto, P. Grell (red.), *Jahrbuch Medienpädagogik 9*, VS, Wiesbaden 2012, s. 29-50.

Riedel J., Grote B., Henze L., Albrecht C., Schlenker L., Schumann M., Hafer J., Castrillejo V., Köhler T., Börner C., *Fit für E-Teaching. Diskussion von Empfehlungen für die inhaltliche, methodische und strategische Gestaltung von E-Teaching-Qualifizierungen*, [w:] K. Rummler (red.): *Lernräume gestalten – Bildungskontexte vielfältig denken*, „Medien in der Wissenschaft" 2014, nr 67, s. 431-440.

Schlieszeit J., *Mit Whiteboards unterrichten. Das neue Medium sinnvoll nutzen*, Beltz, Weinheim und Basel 2011.

Stadermann M., Schulz-Zander R., *Dimensionen unterrichtlicher Interaktion bei der Verwendung digitaler Medien*, [w:] R. Schulz-Zander, B. Eickelmann, H. Moser, H. Niesyto, P. Grell (red.), *Jahrbuch Medienpädagogik 9*, VS, Wiesbaden 2012, s. 51-80.

STATISTA GmbH, *Absatz von Tablets in Deutschland von 2010 bis 2015 (in Millionen Stück)*, http://de.statista.com/statistik/daten/studie/157928/umfrage/absatz-von-tablet-pcs-in-deutschland/ [03.03.2015].

Tulodziecki G., *Medienpädagogische Kompetenz und Standards in der Lehrerbildung*, [w:] R. Schulz-Zander, B. Eickelmann, H. Moser, H. Niesyto, P. Grell (red.), *Jahrbuch Medienpädagogik 9*, VS, Wiesbaden 2012, s. 270-298.

Voogt J., *Are teachers ready to teach in the knowledge society?*, [w:] R. Schulz-Zander, B. Eickelmann, H. Moser, H. Niesyto, P. Grell (red.), *Jahrbuch Medienpädagogik 9*, VS, Wiesbaden 2012, s. 18-28.

Wege B., Der Neue im Klassenzimmer, DIE ZEIT N°30/2013, http://www.zeit.de/2013/30/digitaler-unterricht-tablet-pcs [10.03.2015].