# Work Place Oriented Learning with Digital Media – Consequences for Competency Development

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*Abstract* — **Due to their increasing availability and prevalence, digital media allow for a relocation of learning to work processes and support work process oriented learning. This can be put into practice with the aid of different medial/ technological and didactical settings. Some examples are the application of mobile terminals, interactive platforms or Blended-Learning approaches. The paper sketches different project approaches and illustrates the theoretical-didactical basics for the respective learning approaches as well as their relevance for different sectors (automotive sector, construction sector) and target groups (skilled workers, trainees). The central question is how the learning potential of the workplace can be used for self-guided and guided learning and for competency development with the aid of digital media.**

*Index Terms* — **Work process orientation, learning with digital media, competency research**

## I. INTRODUCTION

### A. Current situation and state of research

Also in Germany, research is being decisively co-shaped by targeted and trend-setting promotion. In recent years, the Institute for Technology and Education (ITB), a central and autonomous vocational educational research institute at the University of Bremen, has worked on many projects, that originated in the context of supportive measures and focal points set by the Federal Ministry of Education and Research (BMBF). Three main fields of research with different approaches and targets have moved into the centre of attention:

*Work process orientation:* The relocation of learning into the real corporate work process is increasingly dominating shaping processes in the companies on the one hand as well as vocational educational research on the other hand. The reasons for this development are the direct usability of learning outcomes in the work process, the relevance of problem-oriented learning for skilled workers and the long-term value of acquired experience knowledge for the occupational practice. As compared to classical learning situations, the relocation of learning into the work process enables companies to increase the effectiveness and efficiency of corporate further training [1]. Due to the fact that also the employees benefit from this because the learning processes can be linked to work activities resulting in motivationally positive effects, learning at the workplace will continue to gain more importance in the future.

Vocational education meanwhile acknowledges the work process as an important "contents" for learning and for offering learning processes. In this respect, work processes are increasingly becoming subjects of vocational educational research with the aim to identify those elements beneficial for learning within the processes [2]. Frequently the design of a curriculum also takes place within the framework of these research and development activities [3].

*Learning with digital media*: Every innovation in the technological development of the digital media exerts influence on both the private and the occupational environments. From a pedagogical point of view, learning with the PC and meanwhile also with the aid of learning platforms has increasingly moved into the focus of didactical approaches. Likewise company work places without PC access are in decline. Finally the mobile digital media are more intensively used in the private life due to constantly available online access with the aid of smart phones and tablet PCs. The central question from a (vocational) pedagogical perspective is how these developments could be used for the shaping and the support of learning processes. The multifaceted use of digital media is taken for granted above all by the younger generations and calls for a critical debate. Apart from critical voices on this development, teachers and students discover a lot of new options for the use of pioneering technologies for innovatively designed learning processes. Further central research questions aim at the required media competency (on both sides) and the adequacy of the various media and Web2.0 functionalities for different target groups, learning approaches and communities of practice [4].

*Competency research*: Ever since the comprehensive international comparative studies on the performance of pupils, the paradigm change towards output orientation has taken place both in Germany and in international educational research. Along with these studies that mainly concentrated on academic characteristics and personality aspects, there was also a development towards the standardization of competencies for individual age groups and school subjects. Meanwhile competency research has also reached the field of vocational initial and further training, tries to identify learning achievements and legitimize pedagogical approaches with the aid of quantitative methods. The ITB is currently concentrating on the question how statistical-quantitative procedures can be linked with methods oriented to the description and the self-assessment of occupational skills based on individual work steps within relevant work processes. Respective research projects are currently taking place above all in the automotive sector, but also generally in vocational education and training courses.

As for the field of competency research, the rediscovery of learning during the work process also means a changed perception of classical learning targets. Thus the learning process no longer exclusively concentrates on analytical qualifications and behavior to be imparted in educational institutions, but primarily on the consideration of competency development. Although the term of competency encompasses knowledge, abilities and skills of a person, it is above all seen as a "disposition of self-organized acting" [5] which becomes visible in occupational situations. Against this background, the vocational educational research aims at the identification of typical work tasks along with the respective requirements and tries to analyze "which didactical value these tasks have for competency development" [6].

## II. SELECTED PROJECS: APPROACHES AND OBJECTIVES

With reference to the above mentioned research emphases, three projects with different learning approaches and target groups as well as with variations regarding the approaches and models for competency research will be sketched. Existing and expected results will be presented and conclusions will be drawn.

### A. Virtual learning on the building site: Vila-b[1]

Within the project Vila-b, a further training course for skilled workers of the construction sector on ecologic and climate-friendly renovation of old buildings was developed, tested in two pilot groups and evaluated with regard to the learning success. The project was carried through from January 2008 to December 2010.

*Learning approach and use of media:* The learning approach focused on a Blended-Learning approach. Specialist basic knowledge was imparted in the classical, form of seminars. A PC-platform assisted the preparation and reflection of learning tasks and self-organized learning with e-learning modules. As an innovative element, the use of mobile terminals was introduced, that ensured access to context-related data necessary for the work processes directly on the building site. These data had to be transmitted beforehand via synchronization from a PC within the framework of work planning. In addition it was possible to document information relevant for the entire work process – as a formal background for later billing and quality control, but also as a starting point for own reflections and thus for a consolidation of learning.

*Target group:* The target group was made up of experienced skilled workers of the construction trade with several years of occupational experience and an existing affinity for the use of personal computers. As these persons were experts for their work processes, the project focused on their further training for the use of ecological building materials and procedures, on their technical and physical basic knowledge and on the application of the new media for self-guided, work process oriented learning.

*Competencies:* The project considered the comprehension of *work process oriented competences* as a

basic factor. It was based on the assumption that a reflected coping with work processes due to the commitment of the individual in his or her work situation initializes the development of work process oriented competencies. This comprehension of competency includes experience-based know-how on the one hand. On the other hand it is evident, that the necessary skilled-analytical abilities in the sense of to "know-how-and-why-something-works" are objects of this expertise [cf. 7].

### B. expertAzubi – Exchange between trainees and experts

The project partners of expertAzubi are developing a learning and communication platform enabling trainees to make use of Web2.0 functions to support learning. This calls for a specialist exchange of expert and experience know-how between novices, i.e. young people (trainees) and experts (experienced skilled workers) on the platform. The core question is to which extent the affinity of young people for the use of Web2.0 in their spare time and the thus acquired media competency can be included into learning processes in a vocational context. The project has started in November 2010 and will be finalized in October 2013.

*Learning approach and use of media:* The project focuses on the realization of an online report portfolio (ReportOnline). The trainees are allowed to write their classical, formal activity reports on their PC. This aspect is innovative because the outline of activity reports can now vary after consultations with companies and authorities: Smaller projects or the description of acquired competencies with a reference to performed tasks could thus replace the classical, job-oriented documentations. Reflection questions will be included in the reports and may show the trainee's development seen from different angles.

The learning platform additionally allows for an exchange of opinions via specialist reports (similar to Wiki-entries), own videos (as on YouTube) or even images and drawings. This takes place in connection with classes in vocational schools or among work colleagues in the company and is supervised by the trainer or teacher according to the objectives and the respective tasks. The processing and presentation of specialist contents and (experience) knowledge forms the basis for the above mentioned, occupation-related exchanges between novices and experts on the one hand and is supported by a recommender-system, i.e. by recommendations for the respective user of the platform. In addition the self-generated entries can also serve for the design of one's own e-portfolio which cannot be accessed by others. In the sense of the pedagogical application approach, this portfolio can serve as a documentation of the individual learning objectives and development of the trainee. After his or her graduation, the portfolio could also be used as a documentation of one's own competencies and could serve as a basic document for job interviews. In addition the portfolio could also contain proof of acquired informal competencies, to be acknowledged by an expert (i.e. a skilled worker, a teacher or a trainer).

*Target group:* The users of this platform are first and foremost trainees of companies in North-West Germany. The region is marked by just a few big enterprises and a multitude of small and medium sized companies. The first experts (i.e. teachers and trainers) have already been

involved via their trainees in regional companies and vocational schools.

*Competencies:* The project expertAzubi concentrates on competencies acquired during the training course based on curricular learning contents in vocational schools on the one hand and by dealing with concrete work processes in the corporate learning environment on the other hand. So-called development tasks form the centre of competency research within the framework of the research project. These tasks represent typical, central tasks to be coped with in different training years and differ by their (progressive) requirements. The solution approaches for these tasks reveal to which extent the young people meet the expectations of (vocational) pedagogy with respect to their vocational and personal development. In addition the project tests how these competencies could be presented in portfolios. The project also seeks to find out which influence the Web2.0 functions of the expertAzubi platform exert on the competency development of the users.

### C. The collaborative diagnostic-network – KODiN Kfz

The project KODIN deals with an improvement of diagnostic processes in automotive workshops by a more intensive use of the car mechatronics' know-how. It aims at a networking of car mechatronics within the individual regions and the creation of structured communication networks with the aid of Web2.0.

*Learning approach and the use of media:* KODIN promotes a close relationship of learning and problem solving processes. In order to identify the structure of the learning of car mechatronics, thorough analyses were carried out in car workshops to find out details of problem solving processes. The car mechatronics' approaches form the basic structure of the design of the Web2.0 platform. The aim is to link the shaping and structuring of problem solving aids as closely as possible with the approaches of the diagnostic experts. This guarantees an increased chance to use Web2.0 tools. Theoretical approaches such as described by Anderson [8] who focused on the „Theory of Complex Cognition", will be taken into consideration.

*Target group*: The target group is composed of experienced car diagnostic experts. They are standing by to identify ways to solve difficult problem cases. On the other hand they support the development of a Web2.0 structure to process findings and information necessary for the solution of certain malfunctions in a way that other experts can make use of these data in case of similar problems. The car diagnostic experts closely cooperate with the developers of the Web2.0 platform when it comes to a structurization of support with problem solving.

*Competencies*: KODIN concentrates on the use of competencies of diagnostic experts in order to compile problem solving structures for new problem cases on a Web2.0 platform which in turn may be used by other car mechatronics as a support. The users are thus supported to further develop their problem solving competency and to communicate with colleagues. The diagnostic experts are encouraged to intensify communication with the aim to swiftly develop problem solving structures as soon as new problem cases arise.

### III.    PRESENT AND EXPECTED RESULTS

The project *Vila-b* evaluated the learning success resulting from further training in two strands: In the sense of a work process oriented competency comprehension the evaluation concentrated on experience-based know-how and specialist-analytical abilities required in the vocational context [cf. 7]. Interview instruments were being used for both areas, i.e. for the (vocational) specialist knowledge and for the proof of abilities for the successful performance of a central work process. The comparison of existing competencies at the beginning and at the end of the further training measure and the evaluation of the interviews on the further training approach and an assessment of the learning success by the participants revealed two strong points of further training: First: The participants in the construction sector like to learn in the "classical" form of seminars when it comes to teach technical and material basics and procedures. Second: It was a decisive success factor to include own and real work processes into the seminars. The presentation of self-performed work processes complete with leading questions and a reflection of the (individual) learning contents resulted in an eager exchange of experience knowledge even beyond corporate boundaries. In addition, the participants experienced a visible development of their (work process oriented) competencies.

The project *expertAzubi* concentrates on development tasks, i.e. challenges resulting from the biological and psychological maturing of an individual or based on social expectations for each individual [9] [10]. From a vocational pedagogical perspective above all the development tasks are of special interest as they relate to the occupation and on vocational education and training. The use of development tasks adheres to the findings of Gruschka [11] who formulates three general facets of development tasks: 1. Specialist learning, 2. Design of an occupational self-image as well as 3. Institutional integration. The evaluation of the project will focus on the relationship between the coping with these development tasks and the Internet and use of Web2.0. What are the needs of the young people during their training course? When is the influence of the new media overestimated? Another central point for the project results is the question to which extent new forms of the report portfolio – a typical instrument for the documentation of contents and specialist skills acquired during the training course – can be successfully used for the documentation of work processes and competences. The report portfolio is a compulsory documentation to be worked out by the trainees and controlled by the teachers. The project partners are convinced that the quality of learning processes during the training course can be sustainably increased by the integration of newly designed portfolios by using the new media. This can be realized by doing away with the classical form and by including images, video documentations, links to reflection tasks and experience reports.

After the predominant problem solving structures in automotive workshops have been surveyed, the project *KODIN* is about to be implemented in a pilot phase. The most important finding was that only 50 per cent of all malfunctions could be identified with the aid of the diagnostic devices supplied by the manufacturers. The other half was identified by qualified car mechatronics who applied their individual diagnostic strategies. The

communication structure between employees of different companies is so-far not very well developed. This situation will be clearly improved by the creation of regional-specific communities and by the use of KODIN problem-solving aids. Results and findings are not yet available and will be presented after the end of the pilot phase in about eight months.

## IV. OUTLOOK

The following points summarize an outlook to further research activities and questions:

*Networking of qualitative and quantitative methods for competency steps:* Above all statistical methods are recognized in competency research. The question is to which extent quantitative methods could be applied for work processes. The standardization of central occupational tasks towards typical processes with a certain number of steps was linked to work process oriented descriptions corresponding to the competency steps from a novice to an expert. The descriptions used in the project Vila-b correspond to the competency steps based on papers by Dreyfus & Dreyfus [12]. The automotive studies conducted so far by ITB focused on test-theoretical tasks and could not clearly empirically prove the model created by Dreyfus & Dreyfus. Thus a combined application of both approaches (test theory approach and work process descriptive model) for the description and the compilation of competencies are still to be investigated.

*Current situation and framework conditions:* There are various approaches to broaden competencies with the aid of educational and learning processes or within the occupational context by coping with work processes. In preparation for these studies it is crucial to strictly delimit the target group, to get to know the group by accessing the respective field of activities and by applying interview instruments and to focus on special features. The occupation per se, the age and the educational background of the persons along with the didactical shaping of initial and further training measures exert influence on the choice of the competency model and thus on the potential and/or presented learning success.

*Didactically adequate use of new media:* The new media offer new possibilities for the support of learning. It is important to note that media can only support learning processes, i.e. by making huge amounts of data and information available at any location through mobile devices, by motivational aspects or by the option of a stronger, more individual differentiation of learning pace and contents underpinning self-organized learning. In the meantime there are also options to show one's own development or strong points, e.g. by presentations of e-portfolios. The variety of application possibilities of the media and of Web2.0 has, however, not yet been adequately researched. Thus the application in the context of occupations and the sustainability of different media-assisted learning options will remain in the centre of interest for future research and project work.

## REFERENCES

[1] K. Illerins, "Workplace learning and learning theory", in: Journal of Workplace Learning. Volume 15, Issue 4, pp. 161-178, 2003.

[2] G. Spöttl, "Learning through the Work Process – Challenges and the Shaping of Skill Requirements.", in: G. Loose, G. Spöttl, Md. Sahir Yusoff, (eds.), "'Re-Engineering' Dual Training - The Malaysian Experience.", Frankfurt/M., Berlin u.a., pp. 31-44, 2008.

[3] G. Spöttl, "Curriculum Approaches and Participative Curriculum Development", in: R. Maclean, D. Wilson (Eds.): International Handbook of Education for the Changing World of Work, Bridging Academic and Vocational Learning, Netherlands, Springer, CCLVI, pp. 1627-1637, 2009.

[4] E. Wegner, R. McDemott, W. Snyder, "Cultivating communities of practice: A guide to managing knowledge.", Harvard Business School Press, Cambrigde, 2002.

[5] J. Erpenbeck and L. v. Rosenstiel, "Handbuch Kompetenzmessung", 2., überarbeitete und erweiterte Auflage, 2007.

[6] M. Becker and G. Spöttl, "Berufswissenschaftliche Forschung – Ein Arbeitsbuch für Studium und Praxis", Peter Lang GmbH, Frankfurt am Main, 2008, p. 27.

[7] G. H. Neuweg, "Könnerschaft und implizites Wissen – zur lehr-lerntheoretischen Bedeutung der Erkenntnis- und Wissenstheorie Michael Polanyis", Waxmann Verlag, Münster 3. Auflage, 2004.

[8] J. R. Anderson, "ACT. A Simple Theory of Complex Cognition", Vol. 51, No. 4, pp. 355-365, 1996.

[9] E. Erikson, "Identität und Lebenszyklus". Drei Aufsätze, Frankfurt am Main, Suhrkamp Taschenbuch Wissenschaft, 1973.

[10] R. J. Havighurst, "Development tasks and education", New York & London, 1972.

[11] A. Gruschka: "Wie Schüler Erzieher werden", Studie zur Kompetenzentwicklung und fachlichen Identitätsbildung in einem doppeltqualifizierenden Bildungsgang des Kollegschulversuchs NRW, Wetzlar, 1985.

[12] H. L. Dreyfus and S. E. Dreyfus, "Mind over machine. The power of human intuition and expertise in the era of the computer", Oxford, 1986.

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