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RESEARCH ARTICLE

Towards a Didactical Design Using Mobile Devices to Encourage Creativity

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Abstract

Mobile devices (iPods) were used to investigate whether technical devices can support students in terms of group co-ordination and work organisation. The investigation involved a postgraduate course in industrial design at a German university. During one phase of the project, spread over some weeks, the student task required collaborative work connected to the corporate practice of an industrial firm. However, the implementation of the iPod project was deemed a failure. In this article we outline the study and give explanations as to why the mobile device usage did not seem to support learning. The project failure arose from limited 'anywhere–anytime didactics' and an apparently incorrect interpretation of the students' needs. This has led to the formulation of a new 'creativity-supported didactic' to enhance learning with mobile devices which can be used in further work.

Keywords: higher education, creativity, collaborative learning, mobile technology, digital didactics

Omnipresence of mobile devices

Unlike the 'laptop era', mobile devices including smart phones, tablets and touch pads are available almost everywhere. These devices are small and provide permanent online access; a person can quickly and easily communicate using them without having to study lengthy manuals. Almost every student has at least a smart phone. The mobile device era does not stop at the door of the seminar room so the pressure rises on how to handle this 'ubiquitous online presence' in formal teaching (Jahnke *et al*. 2012). For example, during lectures and courses, students often 'Google' to see if what has been said is correct or not. They may of course be following up other interests as well.

Given this new situation, we have been wondering how best to use its potential for the promotion of learning. Our questions included the following:

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- What might be appropriate instructional designs for teaching and learning that address this new situation?
- What are the options, challenges and potential for using mobile devices so that they support the teaching–learning arrangements?
- What learning goals can be supported and promoted?

Triggered by ongoing technical improvements and the widespread dissemination of mobile devices, teachers are faced with the challenge of re-thinking the current understanding of learning in universities. This paper presents a university course that used mobile devices but the project itself failed. From the experiences gained, a new form of learning with mobile devices has been developed, which we call a 'creativity-supporting didactic'.

Theoretical frame: Digital didactics

There is no single definition of mobile learning available. Rather, it is a shimmering field where various different approaches have been put forward to yield definitions. Some people focus on the technology (technology-centred approaches), while others take, variously, the flexibility of learners, the mobility of the learning spaces and the virtual environment into consideration. Still others emphasise the experiences of learners with mobile devices (e.g. Sharples *et al*. 2005, Sharples 2006, Pachler 2007, Traxler 2007).

A starting point for reflection on teaching and learning using mobile devices is that of Laurillard (2007) who discusses pedagogical forms for mobile learning. Her approach provides the basis for an appropriate instructional design where the educational goals include a plan of how the learning objectives can be practically implemented. Laurillard draws on Kolb's learning cycle (Kolb 1984), in which learning follows a four-step model: (1) undertaking a concrete experience; (2) reflecting on the observations that are made; (3) accompanying reflection with an abstract conceptualisation; and (4) an active experimentation by the learner. The principles underlying this well-known circle support university teachers and instructors in their role as *learning-enabler and designer*, needing to ask the question of whether their didactical design is developed so that it helps students through a series of questions (2007, pp163–164):

1. Do the students have access to the relevant theory, ideas or concepts?
2. Are the students able to ask questions of (a) the teacher and/or (b) their peers?
3. Are the students able to offer their own ideas to (a) the teacher and/or (b) their peers?
4. Can they use their understanding to achieve the task goal by adapting their actions appropriately?
5. Are they able to repeat the practice using feedback that enables them to improve performance?
6. Are the students able to share their practice outputs with peers for comparison and comment?
7. Can they reflect on the experience of the goal–action feedback cycle?
8. Are they able to debate their ideas with other learners?

International associations of instruction and teaching such as the Professional and Organisational Development Network in Higher Education (POD) and the Staff Educational Development Association (SEDA) confirm that 'active learning' is one of the most promising ways to learn (Stahl 2006). Active learners develop a deeper understanding of the learning content and develop skills such as critical thinking and new knowledge,

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and demonstrate the generation of new ideas that is one aspect of creativity. 'Active' here means that the students become representatives or advocates of their own learning processes. They 'produce' knowledge rather than operate exclusively as consumers. In Toffler's phrase they are 'prosumers'.

An appropriate instructional design includes options and opportunities for active collaborative learning that supports the co-construction of new knowledge, "an active process of constructing rather than acquiring knowledge" (Duffy & Cunningham 1996). The assumption is that mobile devices can provide a new level of active learning, where participation, collaboration and communication among and between learners and teachers are supported *through* the instructional design. This perspective transforms learning from a teaching-centred approach to one where knowledge is articulated through a learning-centred approach with goals that support reflection and creativity. Learning is then demonstrated by the ability to solve problems, develop new ideas with others and create new actions. This can be subsumed under the sixth level of 'creating' claimed by Anderson & Krathwohl (2001) in their revision of Bloom's (1956) taxonomy. The learning outcome is visible in the changed behaviour of learners (Biggs & Tang 2007), there is a change from surface learning to deeper learning, what has been described by David Kember (1997) as a "conceptual change" (Figure 1).

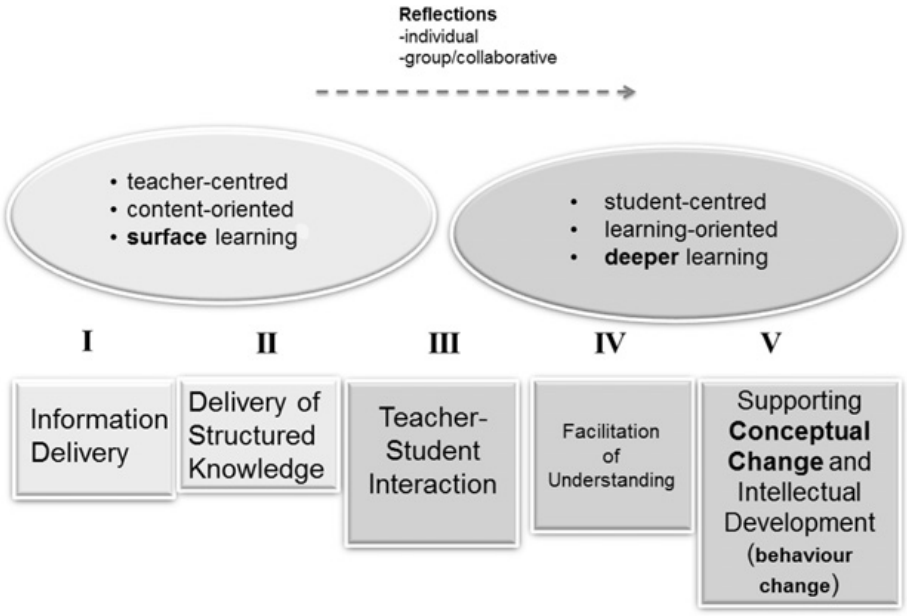

Figure 1 From surface learning to deeper learning (conceptions of teaching adopted by Kember 1997, p264)

The term 'didactical design' follows from the German concept of Didaktik as developed particularly by Klafki (1963, 1997). A range of clarifications and extensions can be found in recent work (Fink 2003, Hudson 2008, Lund & Hauge 2011), which stresses the differences between teaching concepts and learning activities and calls them respectively 'designs for teaching' and 'designs for learning'. From this point of view, a didactical design includes teaching objectives, the *plan of how to* achieve those objectives in such a way that the learners are able to develop competencies and skills that the teachers hold out. The designs also involve different forms of feedback and assessment to assess the learning progress of the students (seeking the 'constructive alignment' of Biggs & Tang 2007). According to a study by Bergström (2012), process-based assessment is the most effective method for fostering learning. However, in reality it is not commonly found in higher education settings

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for whom summative assessment alone is the more common assessment routine. Indeed, much of the background for deciding on assessment arises less from research evidence and more from the views of pressure groups, whether from governments, think tanks, or the media. Unlike instructional designs on their own didactical designs carrying a holistic charge also address the design of potential and desirable social relations. The latter include teacher–student interaction and student–student interaction, which we call designs for social relations (see Figure 2). Didactical designs are holistic in scope.

Figure 2 Ideal of a digital didactical design

Returning to our theme of mobile technology and learning, *digital* didactical design is a more advanced model that integrates educational technology and educational apps. To each of the four design levels referred to above the design question for the particular case study reported here is: "How can the iPod and other mobile devices support such an activity?" The implementation of new technology in education seeks to rethink the existing underlying didactical concepts and communication patterns (Jahnke & Kumar in press, Jahnke *et al.* 2012). Information and communication technologies (ICT), particularly in their mobile forms, can play an important role in making learning visible. In a case study Mårell-Olsson & Hudson (2008), illustrate different types of digital portfolios including traditional online applications for stationary computers or laptops through which students develop the ability to "collect, organize, interpret and reflect on their own individual learning and practice, and become more active and creative in the development of knowledge" (2008, p73).

By examining the use of iPods in higher education, we assume that under the right conditions including the full development of a digital didactical design the iPod or other mobile devices can significantly enhance teaching and learning. The guiding research questions are:

- What are the right conditions (to enhance learning)?
- What elements can be designed; to what extent and how?
- What is the quality of learning (surface to deep learning) when using iPods/iPads?

Research methods

We conducted a qualitative study in order to explore the potentials and challenges of using mobile devices in higher education through a mixed methods case study (Bryman 2008). This involved:

- A quantitative questionnaire before the course to test the knowledge held by the students.
- Participant observations during face-to-face meetings.

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- A group interview with the students.
- Attending meetings and conducting an interview with the university teachers.
- Data analysis of the app 'Evernote' (to see how the students used it).
- Data analysis of the materials which were uploaded to the learning management system of the university.

('Evernote' is a project management application that enables users to bring together a wide range of ideas and resources including images, video and audio resources. Individuals can use it to develop portfolios and it can be used in group work. This particular app operates across a range of platforms and is available for PC and Mac.)

The case study was conducted on a course in project management at a German university.

Description of the case study

The postgraduate course entitled 'Industrial Project Management' has been developed by the Department of Factory Organisation of a university in Germany. The course is composed of two discrete but follow-up courses: Industrial Project Management I (IPM1) and Industrial Project Management II (IPM2; see Jungmann 2011). In IPM1, the students deal with some of the fundamentals of industrial project management. The second course (IPM2) builds on this knowledge and focuses on a project conducted in a company. In this paper, we analyse this second course (IPM2).

IPM2 – teaching and learning objectives

The university course IPM2 is offered to students on a master's programme in logistics, industrial and mechanical engineering. In summer 2011, the course IPM2 sought to achieve following learning objectives (Liebscher & Jungmann 2011):

1. To deepen students' theoretical knowledge about the nature of industrial projects.
2. To develop methods and tools for planning and conducting industrial project management.
3. To apply and transfer such knowledge to typical business situations in the project context and its practical application.

According to Bloom's taxonomy of learning objectives as modified by Anderson and Krathwohl (2001), the learning objectives above can be summarised as in Table 1.

Table 1 Learning objectives (adopted by Jungmann 2011)

Learning aims	Students
Remembering	... know the basics of industrial project management ...
Understanding	and understand them
Applying	... apply methods/tools of project management to the handling of professional situations
	... apply communication skills and presentation skills adequately
	... work in a team, applying time management, self-organisation
	... apply techniques of scientific work
Analysing	... develop a critical-reflective attitude towards their own and others' thoughts and social actions
Evaluating	
Creating	... develop new solutions to a problem unknown to them

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Course context and organisation

The course began in March with an introduction and concluded in July 2011 with a final presentation. Twelve students, all male, participated. Their age ranged from 23 to 26. The course applied a project-based learning approach together with a strong emphasis on an inquiry-based teaching and learning approach. The course involved three main phases:

1. an *introductory* basic workshop, four days (March 2011);
2. a nine-week phase of the *project* (May to July 2011), in which the students worked on a project on corporate practice (see Jungmann *et al*. 2010); and
3. a *final presentation* in which the students presented their findings to teachers and business representatives (July 2011).

An external lecturer who was a project manager in the particular industry and a university teacher were responsible for the course while a third teacher was responsible for the implementation and evaluation of the mobile devices. The company managers were also involved and attended the final meeting.

Students' project setting

The company selected for the practical application met the criteria for student support and learning development. It was a medium-sized company (about 6,500 employees) in the security technology industry (e.g. how to build burglar-proof doors and locks). The general project assignment for the students was marked by both the teachers and company personnel. The students' task working as a group was to develop a plan for project management of a particular innovation.

Students' participation and teacher assessment

All 12 students formed a single project group. They had already taken part in the first course IPM1 – thus they should have learnt the basic knowledge required for this task. Some of the students also knew each other from the first course which catered for a broader student intake. The students were assessed through several activities including the ability to conduct the project and also performance on the final presentation. At the end, all twelve students achieved a pass grade.

The plan: supporting learning byte use of mobile devices (iPods)

The IPM teachers felt that achieving co-operation between group members in the project setting was a *key challenge* for the student group. The teaching aims (see Table 1) had specific realisations through the use of mobile devices:

- *Project planning, conducting and controlling*: students plan a project to solve a problem of a company and the mobile devices help them.
- *Documentation and reflection of learning*: for example, writing a project report (Where do we stand now? Where are we going?).

Mobile devices were used on IPM2 to assist students with areas such work organisation and co-operation. The provision of selected applications such as the Evernote app was an example of this. The app was introduced to enable the students to support their communication, to document their work processes (co-ordination and co-operation) and results, to share and reflect on their (self-)organisation and collaboration. The teachers assumed this was important for the project planning and management since the students

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needed to co-ordinate themselves within the group but also needed to arrange meetings with the leaders of the business company. The app could enable them to do these things.

The Apple iPod Touch 4 was selected for the IPM2 project. The devices were distributed to the students on a loan basis, if the students did not have their own or similar devices (e.g. iPhone). The advantages of the iPod included:

- No need for the students to do any programming as there were sufficient free apps available from Apple to support learning.
- No additional charges as telephone charges and internet access was free.

The disadvantagewas that while the university campus provided free Wi-Fi access there was no free access outside the university and phone calls could be conducted only via Wi-Fi using the app 'FaceTime'.

Results – learning with mobile devices: an unsuccessful attempt

From the university teachers' point of view, the learning objectives were achieved. The students' project outcomes were presented as mentioned above. The feedback to the students was positive. The company and the teachers assessed the student group as 'better than usual'. The grades were given on a scale from 1 to 5 with 1 as the highest grade although each grade number had subdivisions. No student achieved less than 2.0 while two students were awarded a mark of 1.0. The other nine students received marks between 1.0 and 2.0. Statements regarding the development of skills such as teamwork or collaborative development were not included in the assessment. The project marks depended only on achieving solutions to the project questions and no consideration was given to learning processes in the marking criteria.

For iPod use the results were surprising. The students:

- made little or no use of the iPod;
- preferred to meet face-to-face rather than use the iPod.

Student explanations for not using iPods

In the group interview and during individual conversations between students and the tutor with responsibility for the use of mobile devices, it became clear what seemed to inhibit the take up of the mobile devices:

- The devices were too weak for prolonged student use.
- Without Wi-Fi (when off-campus), the students could not work on the project.
- There were no problems in setting up project co-ordination and then in maintaining face-to-face communication so there was no reason to use the iPods.

However, student responses at a deeper level showed they would have liked to experience a different form of support through technical devices particularly for handling the collaborative creative problem-solving process, which they found difficult. A shared student comment was:

> It was very difficult to find out (a) what the problem of the company was; (b) how we (the students) wanted to proceed with the development of problem-solving; and (c) how the mobile device (iPod) could be useful in assisting us (the students) to develop creative new ideas and solutions for the project.

The potential of the iPods was not matched with the students' needs in this case. The iPods had been presented as a means of supporting low level organisational and communication

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needs when in fact they had higher level needs that the devices could not support. They were interested in devices to support e-creativity, getting new ideas and collaborative problem-solving processes, all of which needed to be fostered in detail.

Didactical designers' explanations for students not using iPods

From a didactical designer's point of view, there is a different explanation for the students' non-use of the devices. The instructions and assessments within the course were only focused on the professional knowledge and content required as one of the four competence areas (see Figure 3). The other three aspects of competence development – social, method and personal competency (Erpenbeck & Sauer 2000) – were not included in the didactical design or at least not explicitly included. Nor were they assessed by the project.

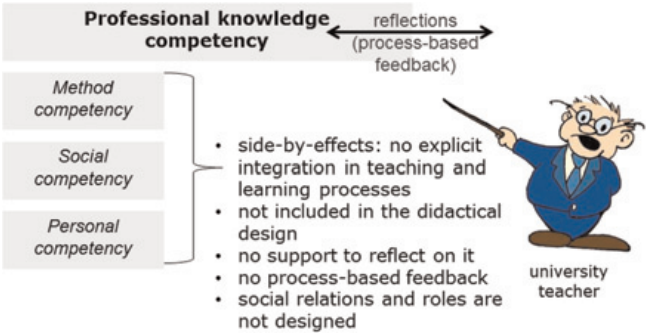

Figure 3 Didactical design – a weak focus on the use of mobile devices

But when the teaching aim is to support co-operation and collaboration, the aspects of social competencies need to be addressed as well. This was not the case in the course of IPM2. Instead those skills were only implicitly developed as a *side-effect* but neither assessed nor supported by the instructional design of the course. The didactical design affected how the students used the iPods. When it was clear to them that only the solution to the project problem and the subsequent project management was being assessed, then there was no reason why they should use the mobile devices.

Researchers' explanations for students not using iPods

From a researcher's point of view, there were two problems. First, the media-didactical approach was not consistent: In addition to the iPod use, there was also a learning management system (LMS) but it was not clear to the students when to use the LMS, when to use the iPods and how both could be integrated to enhance learning. The second challenge was the provision of a suitable socio-technical instructional design when introducing technical devices.

Learning enhanced by mobile devices needs, like all teaching–learning scenarios, a suitable socio-technical didactical design. The failed attempt here shows that the collaborative problem solving was not sufficiently integrated into the didactical design. This is demonstrated in the above at one particular point: The teacher-designed collaboration acted merely as an information exchange medium. But the students had to solve the problem in small groups, which did not require the use of iPods. The collaborative creative problem-solving process was not involved in the didactical course design. The support of student learning through the use of mobile devices required a collaborative learning process with the co-construction of new knowledge but this was not included as a didactical requirement. Instead the learning process was defined only through the medium of information exchange.

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The following topic was not considered sufficiently in the designof the course: "How can students be supported in the development of new solutions in their collaboration in order to encourage learning as creative, when the answer to a problem is not known and when there is more than one solution possible but no one knows what the best solution might be?" (Jahnke *et al*. 2012). For this purpose – to plan and conduct a project in a collaborative problem-solving process – collaborative creativity is required and needs to be specified through appropriate questions.

The unsuccessful use of movile devices in this course makes clear that the technology was not in support of the learning goal called 'creating' (see Figure 4); the teaching aim was not integrated into the instructional design.

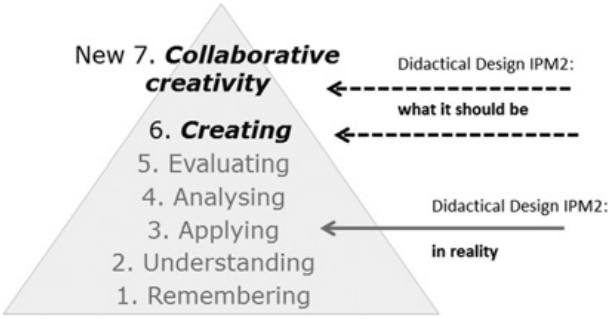

Figure 4 Gap in didactical support in collaborative creativity

The level of 'creating', which incorporates the features referred to above: handling the unkown; working with partial knowledge; handling multiple potential solutions to a problem; was not supported at all. The reflections required for the course addressed individual learning and group work but not at the level of creating and collaborative creativity. This higher level of reflection was absent. Specifically, the students lacked support in:

- Their creative problem-solving process, for instance in a situation where professional knowledge is required but so too is creativity in order to seek solutions and test potential solutions to problems in a creative way. This is a competence that goes beyond professional knowledge.
- Their collaborative learning, for instance in a situation where collaboration is required to find a solution to a problem but the problem cannot be solved. How do you foster collaboration to handle an apparent absence of creativity and how do you provide emotional support?

Discussion – learning to be creative through using mobile devices

The unsuccessful case described above raised a new question: How can learning in the context of mobile device usage support student collaboration where such collaboration leads to the generation of new ideas? The challenge for such a didactical design here is that the students are challenged to work out a new solution to a problem that to date has had no solution (Sonnenburg 2007). When set as a necessary learning objective both individual and group creativity is required in addition to content and professional knowledge (Csikszentmihalyi 1996, Brodbeck 2006).

On the IPM2 course students were given a real problem set out in descriptive terms by the company management team. Since the students had learnt the basics of project management methods on IPM1 this aspect required little further support but students now had to turn a problem description into a deliverable project outcome. Much more support was now required for 'learning to be creative' when linked to learning outcomes associated with problem-solving approaches. In such a creative learning approach students must learn

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to reflect on the learning task, the project contract, the company processes as well as learning itself. Then they need to reflect on how they can reach a solution and conclusion. They also have to learn how to pursue several potential solutions concurrently and also how to handle a situation where there is no new solution that can be adopted. Didactical support can be expressed as questions:

- How can a student group find a solution to a problem no one has yet solved and how can a didactical design support students in such a situation? What is an appropriate design for creativity? What are the right conditions for promoting creativity?
- How can creativity be developed through practices of co-operation and collaboration?
- How can students be helped to generate new ideas?
- Recognising, collecting and evaluating ideas that arise: How can students learn to agree on a solution, make compromises, strengthen their own view and weigh and compare their ideas against those of other group members?
- What creativity techniques are useful?

In sum, these questions are really about how can creativity become part of effective group work learning.

The potential of mobile devices in supporting creativity

Since creativity is not 'connected' to a particular physical space or time, and is often not available as a simple commodity a process approach such as on-going use of mobile devices provides one opportunity for supporting creativity as defined here. Using mobile devices can create conditions conducive to creativity and creativity techniques can also be offered. These techniques can then be used when learners are ready to deal with, for example, managing new ideas. The point is they can use the mobile device to respond instantly, such as when they are in the supermarket or on a train.

Developing a creativity-supporting didactical design for mobile devices

Practical support for creativity in higher education is usually focused on an open concept of creativity so that the multiple paths can be readily followed up. Based on an inquiry conducted with university teachers we put an initial question to them: What do they consider creative achievement of their students to be and how did they 'perceive and observe creativity expressed by their students'? As a result, an initial outline of a social construction of creativity has been created (Jahnke & Haertel 2010).

One result that we can offer here is a tentative framework to foster creativity in teaching and learning. This six-facet model can be used for reflection and guidance to support the integration of creativity in teaching and learning in higher education. The initial inquiry found that university teachers held diverse views, as one might expect. However, there was sufficient overlap in views to support the outlines of a first step for a creativity-focused didactics supported by mobile devices. Such a holistic didactic approach includes the following three perspectives:

1. *Creativity levels perspective*: The question is, what levelof creativity exist among a student group and which levels on the typology do the teachers wish to reach. This is followed by the question of 'how' the levels of creativity can be didactically designed so that learners can be creative.
2. *Implementation options perspective*: If it is clear to the teacher what kind of creativity level s/he wants to focus on in the course, the second question is how the didactical plan can be translated into reality, ie how to implement goals that support creative learning processes initiated by the students.

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3. *Role(s) of the mobile devices perspective*: The third perspective is one of how the mobile devices and the 'apps' may be used so they also carry and support the creative learning processes of the students.

Perspective 1: creativity levels

Table 2 sets out some different understandings of creativity in teaching. This diversity of creativity was outlined in a previous study (Jahnke & Haertel 2010). Their six-facet model covers various aspects of creativity at different levels.

Table 2 Creativity facets (adopted by Jahnke and Haertel 2010)

Facet of creativity	How the university teachers perceive/obeserve their students' creativity
6. Developing original entire new ideas	When the students produce totally new ideas that I as a teacher never knew and never saw before.
	This is difficult, teachers can only enable the possibility of the arrival of new ideas.
	When my students learn from mistakes to get totally new ideas.
5. Multi-perspective, a new culture of thinking	When they change their perspective.
	When they get multi-perspective.
	When they break through routines and patterns of habits.
	When they take a different attitude.
	Reduce prejudice.
	When students integrate provocations.
	Deal with ambiguities.
	Perpetually scrutinising.
4. Learning by producing something	When students create something.
	When they create products.
	When students conduct research-mode/inquiry-based projects.
	When they conduct aid and outreach projects, e.g. planning a congress.
3. Curiosity and motivation to learn	When the students are curious about the topic.
	When they ask the right questions.
	When they are engaged and motivated to learn.
	When they use their own experiences and connect it to the given topic.
	When they show me interesting ways to pose questions or problems.
	When they establish a link from theoretical topic to practice.
	When they use metaphors or humour to visualise the theoretical field.
2. Organising learning autonomously	When the individual student set the acquisition of knowledge in motion.
	When the students take the responsibility for steering the processes of their own learning.
	When they make own decisions.
1. Self-reflective learning	When the learners 'construct' knowledge themselves rather than adopting it.
	When students conduct an internal dialogue.
	When they break out of a receptive posture.
	When they think critically.

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Perspective 2: implementation options

Implementations can be made in the following four areas:

1. Designing the learning assignment – where in the learning process is creativity required? (e.g. what has to be done in a creative way or what can be described as routine when searching for solutions to new problems? Is the learning process offered sufficiently creative, does the the task require sufficient creativity or should there be a mix of creative approaches with routine, content-based approaches?)
2. What instruments might promote creativity (e.g. creativity techniques; reflection techniques)?
3. Designing the social context (e.g. group size, individual/groupwork; individual and collaborative creativity).
4. Designing the course and designing the gap between assignments and examinations (e.g. when the in-course assignment is creative but the written examination is fact and content-based. If the examination determines the module outcome there is no need for the students to prioritise creativity.)

For IPM2 this means considering at what points in the learning process, creativity is required, what kind of creative efforts should be made by the students and how these creative processes can be supported by the use of mobile devices. A creative achievement in IPM2 is, for instance, (a) the differentiation of the problem and (b) developing a solution in the form of a workable concept for the company. The assignment only provided the access to the company and the broader lines of the problem in general. The project brief would also require such creativity to be included in the assessment.

Perspective 3: role(s) played by mobile devices

Mobile devices and specific apps can support some of the creative processes for students (Carell & Schaller 2010), such as:

1. *Stimulator*, if they stimulate creative thinking and the 'access' to the problem on an emotional level (e.g. import images/films for giving inspiration; production of acoustic impressions of sounds supporting inspiration).
2. *Tools*, which support co-operation and relevant functionalities (e.g. the joint collection of information).
3. *Creative tools*, to support creative thinking of the individual and the group (e.g. joint brainstorming, analysis, assessment and evaluation of new ideas).

These three perspectives – creativity elements, implementation options and different roles for mobile devices – provide a basis for developing a didactics which enhances creativity in learning with mobile devices.

Conclusion

This paper outlined a university course where teaching and learning was supported by mobile devices (iPods) – but the innovation did not succeed. The iPods were used either rarely or not at all. A limited 'anywhere–anytime' didactic and a restricted support for learning that focused only on goals for learning content led to this failure. The brief study reveals that despite the strong 'noise' about using mobile devices within a project-based learning approach, it is not sufficient to implement mobile devices just to support student co-ordination and co-operation. It is not enough to use iPods or other mobile devices to develop professional knowledge. In the digital age, students are well equipped to make contact with each other or conduct meetings if they wish to do so. Instead of a focus on

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technical infrastructures (anytime–anywhere), the creative processes need greater emphasis. For this, a creativity-supporting socio-technical and didactical design is necessary. Further research on the combination of mobile learning and creativity in teaching and learning (e.g. iPad didactics) is necessary to understand to what extent and in which ways didactical designs might inform the use of mobile devices most effectively.

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