

# LEARNING AND TEACHING WITH MOBILE DEVICES AN APPROACH IN SECONDARY EDUCATION IN GHANA

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## ABSTRACT

While many developing nations find Internet-based e-learning unsuitable for their needs (lack of technology as well as of accessibility), mobile learning methods – specifically those involving the use of mobile-phones for both formal and informal learning – hold great promise for them (Grimus et al, 2013b). This article examines the chances and challenges of the use of mobile devices to support improvement and transformation of education in a Senior High School in Ghana. It draws attention to the local situation in a field-study looking at infrastructure, development of material and support. A model for teacher training was designed to facilitate teachers' attitudes and abilities for implementation of mobile learning. The article figures out how mobile devices can be integrated in learning and teaching on the specific background of a school in Ghana. Based on our results we conclude that teachers and students want to use mobile devices in learning. Their perceptions are positive and they developed courses for specific subjects available for eReaders and mobile phones. The results and feedback from two workshops encourage us to propose this model as an example for integration of mobile devices for learning in other regions of Sub Sahara Africa.

## KEYWORDS

Mobile devices, didactic potential, content-creation for small screens, collaborative learning.

## 1. INTRODUCTION

Although the education system in Ghana has witnessed various policy reforms with the aim of ensuring universal access to improved quality education for all children it is evident that progress towards the implementation of ICT in education in Ghana has been slow for several reasons, e.g. high cost of information and communication infrastructure, lack of technical expertise (UNESCO 2012, Grimus et al, 2013a) There is growing concern in Africa about the use of computers to support learning, but the general state of pedagogical integration of ICTs in Ghana is low (Yianda, 2010) 'Computers and mobile technologies are revolutionizing what we know and how we know it, and hence what we learn and how we can learn it'... 'we should however be careful not to obscure the nuances and differences between individual devices and technologies and the various ways in which different cultures and societies adopt and adapt them'. (Traxler, 2010, p.15) Traxler points out that ethics, behavior, fashion and language are expressions of identity, community and nature and the use of mobile devices has therewith an increasing impact with implications for the working of education institutions. (Traxler, 2010, p.9)

The general idea of the study is to explore how secondary education in Ghana can benefit from new developments in mobile technologies together with new didactical approaches. (Huber, 2012) A research project was designed to help teachers at Senior High Technical School in Ghana to use ICT for professional development (1st workshop) and to develop content for mobile learning with teachers and students in a follow-up event (2nd workshop). The aim is to provide students a possibility to access learning material on their own mobile phones whenever they demand it and to produce content particular to local demands. Mobile phones use a small screen and are limited as an input medium. This makes structuring content even more important (Huber and Ebner, 2013). Delivering knowledge 'chunked' means that content is structured and connected in very different ways from common lectures and books. (Traxler, 2010, p. 14)

The project is designed on small scale, based on the environment and specific needs of the school in Keta. It runs without external funds, but has a strong focus on the practicability in the field. The overall research goal is to develop a model for integration of mobile devices at Keta Senior High Technical School in Ghana, to empower teachers to activate similar adoption in other schools.

## 2. METHODOLOGY

*Objectives of the research:* The study tries to carry out on-site conditions for using mobile technologies for teaching and learning in Ghana. The major research questions are defined as following:

1. How can mobile learning strategies be implemented in the field?
2. How can this experiences help for further strategies on learning and teaching in Sub Sahara Africa (SSA)

Therefore the study looks in particular to following areas:

- How can teachers contribute to implement mobile learning?
- Preconditions and necessities to be addressed to enable mobile learning.
- Can access to digital content be improved by using mobile phones?

*Research Methods:* The research work was conducted as an on-site field study with qualitative interviews and quantitative questionnaires, carried out during two workshops (September 2012 and 2013) for teacher-training in Keta, Ghana, at Senior High Technical School (KETASCO, <http://ketasco.com/>). Data collection was executed in two cycles (anonymously).

- Online-surveys: In September 2012 only teachers from Keta region participated, in September 2013 teachers and students from the school took part.
- Post-workshop-feedback (surveys after both workshops).

## 3. RESEARCH STUDY

The school is expelled in rankings for a high standard of education, looks back to a long tradition, and is participating in different competitions in the country (e.g. sports, robotics). The campus (boarding school) is situated close to the sea and Keta Lagoon in the south of Ghana, hosting a Junior and a Senior High Technical Secondary School (SHSS) with about 2.800 students and 101 teachers. Each class holds about 40-60 students. Most of the students of SHSS, aged 15-20 years, live at the campus, so do many of the teachers, which provides the chance of informal contact of students and teachers besides school time.

From a technical perspective there is one computer-lab (about 15 PC's, WLAN and a projector) with MS Windows as operating system and MS-Office on board. Internet is only available in the computer lab and the bandwidth is low, which causes problems when more persons try to connect to the Internet at the same time; the connection is unstable.

### 3.1 Research Study 1: Basic ICT-Skills for Teachers- Digital Literacy for 21<sup>st</sup> Century

The 1<sup>st</sup> Workshop was scheduled for two weeks at the end of school vacation in September 2012 (10 days, 50 hours). At that time final exams are finished, teachers are available without competing lectures. A government program was put into place just few months ago, where teachers were given laptops for free; the timing fit nicely with the project.

*Aims of the workshop:* The main objective of the workshop was to equip teachers with computer and Internet-skills to integrate digital media in teaching and therewith to support the learning and teaching process. New didactical approaches and methods should be developed, adequate to environment and culture of the region, as well as learning material for this purpose. The workshop addressed the use of digital technology and communication tools in teaching, pedagogical aspects, and to enhance personal skills in digital literacy. The course focused on motivating teachers to explore new methods in using office-tools, e.g. presentations: structuring text, visualization by integration of images, diagrams and tables, to explain facts offered otherwise mainly in textbooks and photocopies, or even only available in one book on the table of the teacher.

*Topics of the workshop:*

- Pedagogy and didactics: How to enhance teaching and learning by using ICT for preparation and in class teaching. Integration of collaborative learning by using digital devices in subject-teaching.
- Computer- and Internet-skills to develop learning materials, presentations, assessments.

- Integration of presentations in class-teaching: layout of worksheets and posters (structure, integration of tables and images), spreadsheets (visualizing data in diagrams).
- Evaluation of open online resources (OER)
- Link-lists for self-conducted learning
- Development of a digital portfolio as an example to recap learning outcomes.

*Participants:* The workshop was designed to take 15 teachers who are encouraged to pass their learned skills on to students and colleagues afterwards. For registration the teachers completed a pre-training survey (basic computer-skills, subject of teaching, expectations of the training). Teachers of KETASCO were addressed as the main target audience, finally few teachers from other schools participated. Two thirds of the teachers used their personal laptops, half of them were the donations of the above mentioned 'free laptop for teachers' project.

### **3.2 Research Study 2: 'Teach to Learn – Learn to Teach'. Integration of Mobile Devices to Improve Learning Outcomes**

The outcome of the first workshop together with the discussions at the ministry of education for further developments in education in Ghana ended up in the decision to continue the project with a follow-up workshop. For the second workshop a better infrastructure was proposed. An extension of the course should allow more time for individual projects and practice. The 2<sup>nd</sup> Workshop was scheduled with duration of three weeks in September 2013, 60 hours course-lessons and additional guided practice: 10 days teacher training, 5 days (third week) students and teachers work together; practical issues.

The workshop focused on learning and teaching with integration of mobile devices, addressing the development of digital content and guidelines for best practice. 'Mobile devices affect many aspects of the process by which knowledge, ideas, images, information and hence learning are produced, stored, distributed, delivered and consumed'. (Traxler, 2010, p.13) Low cost and affordable mobile phones in Africa are developing a new conduit for learning. Instructional design suitable for desktop computers does not transfer well to mobile phones. (Batchelor, Botha, 2009) To elaborate on a topic a deeper insight may be gained by creation of micro-content, e.g. adjusting material which is available online or in books for local demands, integrating images, figures and graphs. Ethics and cultural aspects gained during the first workshops were considered.

*Aims of the workshop:* Teachers integrate learning with mobile devices at Senior Technical High School to improve learning outcomes. With regard to the didactic and pedagogical potential the creation of digital portfolios, presentations and content-chunks leads to self-directed learning, learning by doing and by experiences. Teachers are encouraged to transfer their new didactic/pedagogic insights to students and colleagues. This can shift teaching methods to more efficiency in knowledge-achievement and learning.

*Topics of the workshop:*

- Didactical methods: Evaluation of digital learning material e.g. Open Content, OER; Licenses; Creative Commons; Simple English Wikipedia, etc. and possibilities for integration in teaching.
- Creation of locally relevant digitized content for subject-teaching; upload of micro-content (epub, pdf) to mobile phones.
- Integration of collaborative mobile learning methods: Cloud (drop-box) for micro-content development, feedback and reviews.
- Hands on: Development of a personal digital portfolio; specific tools, e.g. ABC platform for transformation of content into eBooks: <https://ebook.tugraz.at/> (Nagler et al., 2012), test of output with mobile phones (NOKIA E5-00) and eReader; peer-review.
- Guidelines: 'Best practice – mobile devices for learning'.

*Participants:* 20 teachers from KETASCO registered for the course (basic computer and MS-Office-skills were requested, a personal laptop appreciated), in the third week additional 13 students participated fulltime, while 5 teachers had left the course. A student of KETASCO assisted in technical and organizational aspects, his support was highly appreciated and contributed to the success of the workshop.

## 4. RESULTS

### 4.1 General Results

*Pedagogy:* Different methods of pedagogy in class teaching (Ghana / Europe) were figured out. In Ghana methods of teaching are dominantly frontal; memorization of text is common practice. Even in SHSS ICT is only taught in specific ICT-classes, tests in ICT are carried out in paper writing. The results of the online-surveys during the two workshops indicated that mobile technologies and digital devices are rarely used in educational context so far.

It can be pointed out that teachers highly appreciated methods of group work and cooperation, which they experienced during the workshops (see feedback of the workshops in 4.2 and 4.3). Peer-review and different modes of interaction were also introduced in the courses.

*Infrastructure:* Frequent power outage impairs the work in the computer-lab (PC's and router).

*Online Survey:* With regard to the online-surveys it has to be mentioned that in September 2012 only teachers participated in the survey, while in 2013 teachers and students were encouraged to participate. Although the numbers are low the percentage is given in addition, to allow easier comparison of the results in the specific groups. In table 1 and table 2 data of ownership and types of different devices are figured out.

Table 1. 'Which of these devices do you own?'

Ownership	Teachers 2012		Teachers 2013		Students 2013	
	n=36		n=18		n=43	
Mobile phone	31	86%	17	94%	40	93%
Computer (desktop or tower)	20	56%	9	50%	13	30%
Laptop or Netbook	27	70%	12	67%	15	35%
Tablet	5	14%	2	11%	2	5%
Digital Camera/Video	14	39%	4	22%	5	12%
Other (Kindle, iPod)	2	6%	3	17%	4	9%

Table 2. 'Which type of mobile phone do you have?'

Type of mobile phone	Teachers 2012		Teachers 2013		Students 2013	
	n=31		n=17		n=40	
Smart-phone	15	48%	8	47%	15	38%
Feature-phone	4	13%	2	12%	9	23%
Common (basic) mobile phone	12	39%	7	41%	13	33%
Don't know	0	0%	0	0%	3	8%

As it is seen in table 1 and 2 there is only a slight difference in the data of teachers in year 2012 and 2013. While ownership of mobile phones of teachers and students show nearly similar high rates there is a considerable difference with regard to the ownership of computers and laptops or notebooks. Furthermore it is from interest that only seven teachers (56 in total) do not own a computer or laptop, compared to another ten having at least more than one. In contrast only about one third of the students own a computer, another third a laptop. It is definitely possible for the majority of teachers to develop content with a computer or laptop, while most of the students have access to it when it is available on mobile phones. Mobile devices allow to access content even during power-outages. Table 3 shows teachers' and students' possibilities of Internet access with mobile phones.

Table 3. 'Do you have Internet access with your mobile phone?'

Availability of Internet-access	Teachers 2012		Teachers 2013		Teachers total		Students 2013	
	n=31		n=17		n=48		n=40	
Yes, always	24	77%	11	65%	35	73%	31	77%
Yes, but only when Wi-Fi is available	4	13%	2	12%	6	12%	4	10%
No, can't access the Internet	3	10%	4	24%	7	15%	5	13%

In table 3 a difference to access the Internet with mobile phones can be pointed out only in the small group of teachers in September 2013. This may be due to the small number of the sample, but looking at the total numbers of teachers and students no significant difference can be figured out: 85 % of teachers and 87 % of students can access online content at least when Wi-Fi is available.

## 4.2 Research Study – Workshop 1

*Outcome:* The first workshop addressed basic ICT literacy with a focus on pedagogy. Although the participants had answered a pre-questionnaire with regard to ICT skills it turned out that this ranged from difficulties in saving a file to basic skills in video-editing; most common was text-processing and use of Facebook. Few teachers expressed the use of www for preparation of their lessons to some extent. All teachers used mobile phones for phone-calls, although most of them could access mobile Internet only few used it. As a possible reason was figured out that less than a third were familiar with basic Internet skills. It was difficult for them to create a portfolio, to extract keywords from a presentation or to formulate short statements on ICT related topics with own words. Finally 14 teachers fulfilled the requirements (course-attendance, portfolio, worksheets and presentations) and received a certificate for successful completion.

The *course-feedback* was targeted to how the workshop changed teachers' views of teaching in classroom practice. They were asked to review on how they have benefited by improving ICT-skills and didactical methods. Unfortunately a virus-attack followed by power-outage did not allow saving the feedbacks on pen-drives, only three of private laptops could be received. Some statements with regard on teaching are given as examples: '... can offer better guidance to my students and on how to use search engines and ICT tools more effectively', '...integrate the new skills in subsequent teaching: how to produce better documents in Word, Powerpoint and Excel to meet professional standards and to improve learning outcomes', 'the use of digital literacy methods in teaching would have positive impact on the cognitive and affective domains of the learners'.

In a follow-up *online survey* concerns of teachers' perceptions towards future developments for learning with integration of mobile devices were requested. A five-point Likert-Scale is preferred for the reactions of the perception in the research. For each of the statements there is an obligation to be classified with one of the five categories: I strongly agree / I agree / neutral / I do not agree / I strongly disagree. The answers gathered were graded between 1 and 5 points, giving five points to category 'I strongly agree' and one point to the category 'I strongly disagree'. The average gives an overall perception of the item specified.

In table 4 teachers' perception of having material available on an own mobile device are given, on similar questions for teachers (T) and students (St): 'Would you agree that having course material available on your mobile device would be beneficial for teaching?' (T) ..... 'would be beneficial for the learning process?' (St)

Table 4. Comparison: Teachers and students perceptions of course material available on mobile devices.

I strongly disagree		I disagree		neutral		I agree		I strongly agree		Answers total		Course material	Average	
T	St	T	St	T	St	T	St	T	St	T	St		T	St
1	0	0	2	1	3	8	14	19	12	29	31	Slides	4.52	4.16
1	0	0	0	3	2	5	16	19	13	28	31	Lecture Notes	4.46	4.35
1	1	0	3	3	3	9	11	15	11	28	29	Quizzes	4.32	3.97
1	0	0	1	2	1	9	16	15	10	27	28	Link-List	4.37	4.25
1	0	0	1	4	2	8	14	16	13	29	30	eBooks	4.31	4.30

The findings can be interpreted that both, teachers' perceptions (average 4.4 points) as well as students (average 4.2 points) towards availability of different course material on mobile devices are highly positive. The result shows clearly that banning mobiles at school – which is common state – cannot be a realistic long-term solution.

*Challenges:* Infrastructure and equipment in the computer-lab did not meet the expected requirements: Frequent power-outages and lack of Internet-connection heavily affected the workshop. This was also the mostly complained issue by the participants. The PCs' were not well maintained and full of viruses; due to disconnection of the Internet no updates were possible. Hence the proposed topic 'Basic Internet-skills and best-practice – Internet for learning and teaching' could not be performed to the extent as planned: It was not possible to address main topics of the course-curriculum without Internet, thus some of the proposed activities had to be cancelled (evaluation of OER with regard to local demands; upload of micro-content; installation of free software).

After the workshop a meeting was held at the Ministry of Education in Accra with a delegate of the ministry, the headmaster and two teachers. The outcome of the workshop was discussed and a continuation of the project was proposed. Support of service and substantial improvements with Internet-connectivity were promised for the follow-up workshop, installation of solar-power and improvement of Wi-Fi-connectivity were discussed.

### 4.3 Research Study – Workshop 2

The second workshop focused on preparing teachers to understand how mobile technologies can be incorporated effectively into teaching and support students’ learning. To overcome the challenges recognized in the first workshop the second workshop was developed to focus on learning and teaching strongly by integration of mobile devices. In the second workshop it was recognized that a lot had changed in teaching after the first workshop: Teachers were more open-minded to new teaching methods.

For testing 20 mobile phones (second hand Nokia E5-00 smart-phones, 256k display colours, 10 days standby, Micro-SDHC 2GB included inbox) and 5 eReader (TrekSTor E-Book Reader Pyrus mini, 4,3” Digital Ink) were brought from Europe, together with an additional WLAN router to support mobile Internet access.

*Outcome:* Based on the experience (power-outages) during the first phase of the workshop the need of flexibility in planning lessons was clearly recognized. Teachers were open-minded to learn about benefits and practiced new didactical approaches by using mobile devices.


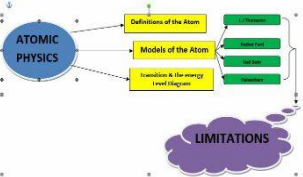
In order to rethink methods of learning and teaching the following thesis was proposed: ‘In five years all textbooks in Ghanaian Senior High Secondary Schools (SHSS) are provided as eBooks. Discuss in groups (2-3 teachers) possible consequences for a) teaching, b) learning, c) schools!’ The outcome was presented as posters on paper, due to power-outage at the time.

Students were introduced by teachers in creating a digital portfolio and use of a drop-box. The importance of development of guidelines by teachers together with students was clearly identified.

A final (anonymous) evaluation on three main issues, executed by four external examiners (teachers from other SHSS), approved the success of the course, the quality of the material developed, and gave positive feedback to the participants.

- Teachers portfolios: Assessment on the quality of reports, structure, achieved learning outcomes, keywords, take-home-statements and summary.
- Course-units developed by teachers and students (small groups, 1-2 teachers+ 1-2 students); specific topics, available on mobile devices. Assessment of course-structure, -design, appropriate for small screens, patterns of visualization, e.g. images.
- Guidelines – Best Practice-Posters. Assessment checked on completeness.

Courses were developed on the topics ‘Classification of Computer Hardware, Adolescence Pregnancy, Atomic Bonds, Adolescence Chastity, Projectiles, Projectiles, English Nouns, Law of Agency, Elements of Design, Demand, SET Theory’, just to name some. The screenshots below can give an idea of the eBooks. Image 1 illustrates the structure of a course-unit on the topic ‘Classification of Computer Hardware’ and shows the associated task. In image 2 the learning objectives of the course-topic ‘Atom Physics’ are displayed.

<p><b>Unit 5 - New Technology</b>                  UNIT 5 - MOBILE OR HANDHELD DEVICES                  KEYWORDS: mobile, smartphone, tablet                  Handheld devices- these integrate all the above hardware into one unit. E.g. tablets, PDAs, smartphones, etc.                  A mobile device (also known as a handheld device, handheld computer or simply handheld) is a small, handheld computing device, typically having a display screen with touch input and/or a miniature keyboard and very light.                  They normally have parts that combine the various functions of the computer hardware like input, output, storage and processing. (They are composite devices)                  A handheld computing device has an operating system (OS), and can run various types of application software, known as apps.                  Can easily be connected to the internet by means of Wi-Fi, Bluetooth and GPS.</p>  <p>Task: 1. Identify the two devices on screen. Talk to your friends in class and find out how many have these at home.                  2. Name five leading smartphone manufacturers and one latest phone from them. (hint: motorola, samsung, sony, apple, htc)                  Links: 1. The Howstuffworks website tells you more about the vast world of handheld mobile devices: <a href="http://www.howstuffworks.com/mobile_devices">www.howstuffworks.com/mobile_devices</a>                  2. <a href="http://en.wikipedia.org/mobile_devices">en.wikipedia.org/mobile_devices</a> discusses various types of hand held device and the technology behind them.</p>	<p>Chapter1                  Unit 1 - Input Hardware                  Unit 2 - Processing Hardware                  Unit 3 - Storage Hardware                  Unit 4 - Output Hardware                  Unit 5 - New Technology</p>	<p>Image 1.                  eBook :Classification of Computer Hardware.                  Image 2. eBook: Basics of Atom Physics.</p>
	<p><b>Introduction To Content</b>                  Atomic Physics                  LEARNING OBJECTIVES:                  To be able to fully:  <ul style="list-style-type: none"> <li>• Describe the structure of the atom</li> <li>• Understand the various atomic models</li> <li>• Know the limitations of these models</li> <li>• Draw and understand the energy transition diagrams</li> </ul>                 LEARNING OUTCOMES: [TASKS --- Definition and Explanation of some terms and concepts]</p> 	<p>Content and Objective                  Introduction To Content                  THE ATOM                  THE ATOMIC MODELS                  J.J. THOMPSON</p>

The course-feed-back to included 13 items for students and 15 for teachers. It was planned as online-survey, but due to power-outage it was conducted on paper. In table 5 examples of answers to open questions are given.

Table 5. Specific issues were questioned, answers of students and teachers.

Teachers (n=12)	Students (n=13)
Comments: Benefits	
Ten teachers reported 'new ideas for teaching'; 'appreciate the practical part and activities, teamwork'; 'appreciated working together with students'; 'benefits for learning by integrating what I have learned in the workshop'.	'learnt that I can use my mobile phone for more than just for gaming'; 'realized that I can do much more with my mobile'; 'makes learning easier'; 'can get more information on my own without having to contact my teacher'; 'easier sharing information with friends and teachers'; read eBooks'. 'aids my study-plan, getting information quick'.
Comments: Challenges	
'poor' Wi-Fi availability, 'devices and Internet-connectivity – costs; 'lack of mobile devices and infrastructure'; 'students are not allowed to bring mobile phones to class'.	'mobile devices at school are not allowed' (5 x), disruptive attention in class', 'rules need to be changed'.
Individual knowledge of 'how can mobile devices benefit in teaching and support students' learning'	
<i>Before</i> / after workshop: poor 4/ 0, fair 4/ 0, good 4/ 8, excellent 0/ 4.	<i>Before</i> / after workshop: poor 3/ 0, fair 9/ 0, good 1/ 4, excellent 0/ 9.
Comments: Like best'	
'practical aspect, hands on'; 'new methods of learning and teaching'; 'interactive nature of the workshop/ group work'.	'built new student-teacher- relationship'; 'practical aspects'; 'creating own content and presentations'.
Free comments	
'program should keep running'; 'opened my eyes to new ideas of teaching'; 'enhances teaching'; 'teachers need regularly continued professional development'; necessary for 21 <sup>st</sup> century teachers', need more of it'.	Students expressed high appreciation of co-working with their teachers and creation of content and presentations together.
Comments to 'like least,' teachers and students: frequent power outages, Internet disconnection	

Teachers were asked about their knowledge of pedagogical and didactical methods to integrate mobile devices in teaching and learning before and **after** the workshop: Results: poor 2/ 0, fair 6/ 1, good 3/ 6, excellent 1/ 5.

In the *online survey* (September 2013) concerns of teachers' and students' awareness and perception of learning and teaching with mobile devices were questioned. Two teachers and six students reported the use of 'free mobile content available on mobile devices', while 13 (72%) teachers and 25(58%) students 'haven't used it, but would like to do so'. A similar question as in workshop 1 (Table 4) addressed preferences for different types of material for mobile devices: 'Do you agree that having course material available on your mobile device would be beneficial *for teaching?* (teachers, T), '*...for learning?* (students, St). The outcome is similar to the results of the previous year and indicates that all items are highly appreciated (all >4 points, max. 5): Slides are rated with 4.6 points (T) and 4.2 (St); Lecture Notes: 4.6 (T), 4.3 (St); Quizzes: 4.2 (T and St), Link-List: 4.3 (T), 4.2 (St); eBooks: 4.4 (T and St). For details of the evaluation-method see online-survey in workshop 1.

The requirements for the final certificate of the workshop included fulltime participation in the workshop, a digital portfolio and course-content on a topic of the curriculum of the subject taught at school, available on a mobile-phone and eBook. Finally 14 certificates were handed over to teachers by the headmaster in the general assembly during the opening ceremony, together with awards for the best three in each category: course-content, portfolio, guidelines for best-practice.

*Challenges:* The most unpleasant experience was the frequent power-outages and the restricted bandwidth (Wi-Fi). It caused timeouts and uncountable restarts, e.g. uploads to the ABC-system (online-system for developing courses and convert them to eBooks). Although mobile Internet was installed the connection did not supply sufficient performance necessary for working in parallel groups (Huber et al., 2008).

## 5. DISCUSSION

While computer-labs and desktop-computers are scarce in schools in developing countries mobile networks, mobile phones and now smart-phones have the potential to question new approaches to learning and teaching (Traxler, 2011). Mobile penetration compensates the lack of infrastructure, which offers the chance to provide on- and off-line content for learning and knowledge-creation, accessible with mobile devices.

*Infrastructure:* In contrast to Europe ownership of a laptop or computer is not common with students in Higher Secondary Schools, while mobile-phones are predominant (chapter 4.1, table 1). Frequent power-

outages challenge learning-activities with computers. Internet in public schools is not usual, and if, it is only accessible in the computer-lab. Low bandwidth challenges teamwork in groups with timeouts in addition to power-outages. To avoid the problems by converting content to eBooks online, offline tools need to be installed.

*Benefits:* Incorporating students to create digital content together with their teachers has shown positive aspects with creative ideas in structuring content in ‘chunks’ for mobile devices. A drop-box was appreciated and frequently used as a tool for exchange and feedback. It is recommended to download content to inbox-SD Cards; Micro SD Cards in eBooks and smart-phones can hold a lot of content, hence learning material is available on mobile devices anytime. Mobile phones and eReader provide the opportunity to access content with mobile Internet or Wi-Fi in times of power off for a couple of days, while laptops have limitations due to the battery-life. It allows learning in the evenings, when students come together in their classes, without teachers, for individual learning in peer groups. A local mobile network could help with downloads to students’ devices.

*Pedagogy:* In his publication at the conference on ‘digital future’ Traxler pointed out that ‘mobile devices will soon support every pedagogic option including the didactic and the discursive, the individual learning and the social’. (Traxler, 2010) Frequent power outages require high flexibility - to switch suddenly from online research to tasks without computer/ Internet-access. At the same time it offers chances for more interactivity and group-work, for discussions and alternative tasks, even to get out of a class, take a photo with the mobile phone, relevant for the topic discussed or with respect to the local environment, and present it later to the audience.

To engage students in learning together with their teachers was experienced in the second workshop. Together they became familiar with creating digital portfolios and developing content for specific local demands, using a drop-box for cooperation and feedback. The courses created are contextualized and culturally sensitive. Students as well as teachers expressed high appreciation of co-working and inspiring interactions, which led to rethink the common tracks of learning and teaching.

*Guidelines - Best practice:* Schools worldwide have traditionally banned mobile phones in the classroom. According to the findings in the surveys it can be concluded that teachers’ perceptions of integration of mobile devices for learning are positive. In the workshop they experienced benefits and challenges together with students and developed guidelines for ‘good practice using mobile devices for learning’. The second workshop led to a better understanding of the issue than theoretical statements. A similar acceptance was found in the interview with the headmaster. In the opening ceremony of the new term the headmaster reported to all students and teachers about new trends coming up in education. He pointed out that this could help to become more critical thinkers, referred to new didactical methods and benefits by integrating mobile devices in learning and teaching. He proposed a reform of guidelines for use of mobile devices (mobile phones and eBooks) at school.

## 6. CONCLUSIONS AND OUTLOOK

The project in Ghana is on small scale and looks to develop a model for integration of new methods of learning and teaching with mobile devices. It was put in place to receive feedback on achievements and failures. The research provides first findings about teachers’ perceptions towards activities using mobile devices in Ghana. Infrastructure and organizational aspects, chances and challenges were experienced in real environment. Main issues of the research were infrastructure, topics and content of workshops on teachers’ professional development as a starting point for changes in education for the 21<sup>st</sup> century, where mobile devices play an important role in daily life and influence rethinking of methods and didactics of teaching. Content copied at school to Micro SD Cards integrated in mobile devices can help to avoid high costs for data access with mobile Internet. Although mobile Internet is slow and has low bandwidth mobile devices can be used to access content in clouds and during power outage.

We can conclude that teachers and students want to use mobile devices for learning. The perceptions are positive. Digital skills as well as didactical methods, necessary for developing content, were addressed, and as reported in the feedback, it can be resumed that the strategies were successful. The results can help to improve delivery of teacher- training and implementation of similar strategies in other schools in the region. Teachers are highly motivated to continue and build up a trainee group at school. At the time of writing a



group of students has started with development of micro-content for mobile devices. They are tutored by the assistant, who supported the 2<sup>nd</sup> workshop and who is in close online contact with the course-leader. Together we will try to close the gap between the course in 2013 and the follow-up course in 2014.

The experiences from two workshops encourage us to propose this model as an example for integration in other regions of Sub Sahara Africa with similar environment and infrastructure, and where similar challenges can be determined. Teamwork with students offered new insights as well for teachers as for students and can be recognized as a basis for further developments in teaching and learning. We hope that the expertise gained in the workshops will affect further developments. To assure the continuation in the developments a further workshop is planned for 2014.

It can be resumed that teachers are starting to take advantage of the opportunities of mobile phones for learning. In summary it takes time for fundamental changes and developing new insights to change traditional ways of teaching and learning towards learning with mobile devices, but it has already started.

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