



# Using Wireless Technologies for Context Sensitive Education and Training

## WP4 Product Training Using Location and Context Sensitive Technologies

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## Summary

The main focus of this document is to outline the work conducted in Work Package 4, Product Training Using Location and Context Sensitive Technologies, at Ericsson Education Ireland. A description of the training package produced is outlined, followed by the evaluation of this package with users and the conclusions that can be drawn from it.

## Introduction

The profile of the typical mobile device, and also user, has changed dramatically since 3G was first introduced commercially 10 years ago. Wideband Code Division Multiple Access (WCDMA) was the first 3G standard introduced commercially and was envisaged as the first step towards commercially available mobile broadband networks. This allowed network operators to offer data rich services to their customers, similar to what they were used to on a home or office PC.

The next phase step for 3G networks was the addition of High Speed Packet Access (HSPA), along the first evolution of WCDMA in terms of capacity and user speeds. The introduction of HSPA has caused “mobile broadband” to explode over recent years and opened up a whole new world of opportunities where consumers can now experience mobile broadband at data rates and prices comparable with fixed broadband.

At present there are over 400 Million WCDMA subscribers globally, which includes over 140 Million HSPA subscribers. At the time of writing, there are 290 commercial WCDMA networks in 120 countries and 274 HSPA networks in 115 countries, over 94.4% of networks are mobile broadband capable. (Source: <http://www.gsacom.com>)

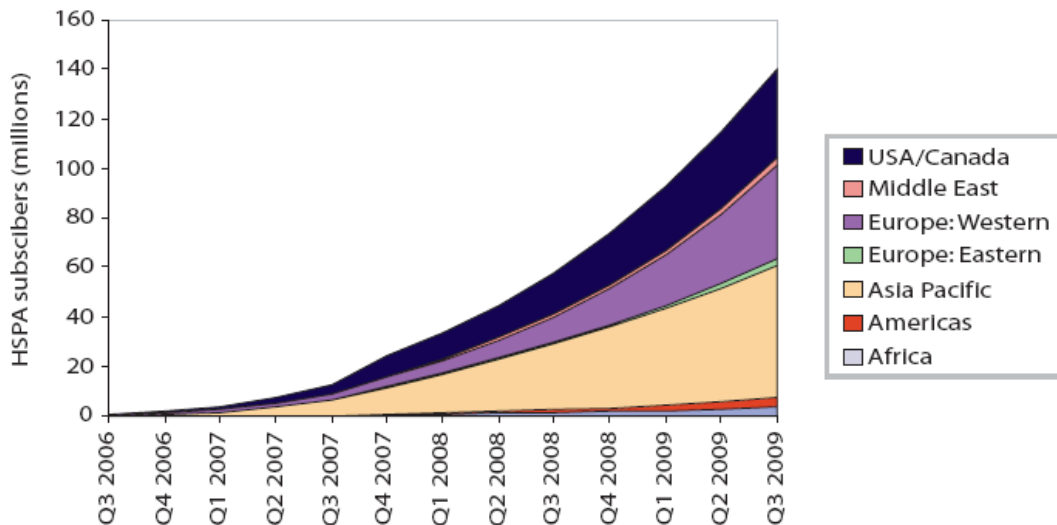


Figure 1: HSPA subscriber numbers July 2009

Mobile broadband access is being made on all types of mobile devices. Originally devices were pure mobile phones or pure PDA (mobile computers). Today, there exists a wide range of devices within this continuum, that mix traditional telephony with computing services, such as mail, calendar, but also with FM radio, MP3 players etc. PC and cell phone vendors are crossing into each others territory as phone and computer functionality converges, which can be clearly seen with the recent introduction of 3G wireless-enabled laptops. As well as Device Convergence, two types of convergence which should be considered are as follows:

- **User service convergence;** implies that there are common user service delivery capabilities with access and device awareness. This means that a multitude of services (person to person, person to content and content to person) can be provided to the same user over different access networks and to different devices.
- **Network convergence;** implies the consolidation of the network to provide different user services, with telecom-grade quality of service to several access types with an emphasis on operator cost efficiency.

All this means that it is now possible to envisage an audience for mobile learning content which is media rich, collaborative and always available to the user. Using established location detection technologies, training content can be developed for both context sensitive and location based delivery. Context sensitive education and training refers to training material which is directly relevant to the training situation that the learner finds themselves in. Location based education and training refers to material which is directly relevant to the location in which the students find themselves. Seeing as mobile devices can be used almost anywhere, they are perfect platforms for situated learning activities where real life is used to provide stimuli and activity for learning.

As the convergence of networks, media and end-users continues at great speed it will encourage the development of learning based around existing and emerging technologies. This should lead to huge advances and greater opportunities for a lifelong learner to choose how, when and where they learn, based on their personal preference. Already there are 31 network operators committed to the next step in the mobile technology roadmap, namely Long Term Evolution in Radio Access Networks (LTE), which will be introduced commercially in 2010 and allow users to avail of much higher mobile broadband speeds; matching fixed line broadband networks. The introduction of LTE and the move towards all IP mobile networks will further strengthen the ongoing convergence and lead to the development of a lifelong learning environment based on mobile technologies. Also as the number of broadband-capable mobile subscribers begins to grow rapidly (Figure 2 below), the demand for such learning environments is bound to increase.

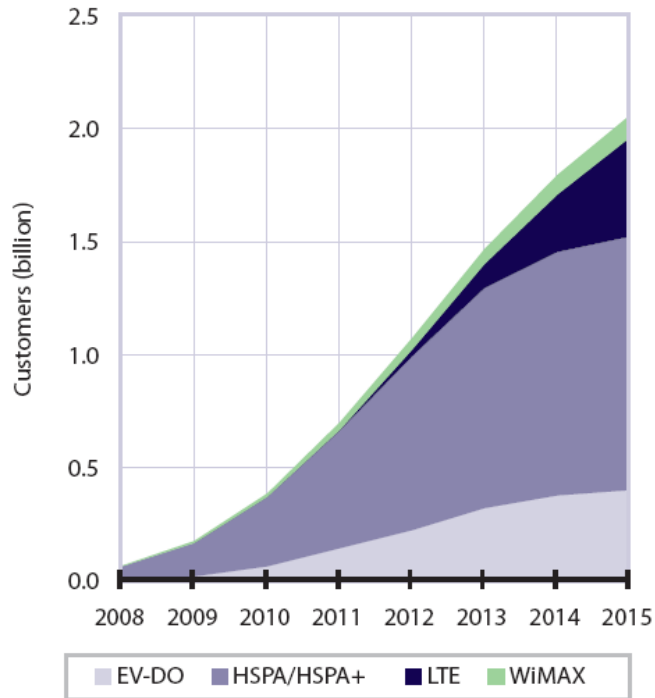


Figure 2: Wireless broadband customer forecasts worldwide, by technology.

## Training Requirements of Telecoms Field Engineers

The training required by Telecoms engineers is quite varied and would require quite a lot of time to complete all training deemed necessary by any single functional role. One of the major problems facing telecom engineers is the access to relevant training for their functional role. There are many reasons as to why they feel they are not getting the right training, for example:

- They are unable to attend training due to their workload
- Other people may have been given priority on courses ahead of them
- They have received some training that may not have been entirely relevant to their day-to-day role
- They require a broad range of training courses but may have only had the opportunity to attend one or two courses

This is a problem that is not easily resolved but something that is compounded further when the operator upgrades their network, for example. The combination of lack of training and network upgrades can sometimes leave customer's staff in a situation where they are trying to understand the operation of their network as well as having to get to grips with the range of new functionality and hardware introduced to the network.

The training package developed is a task-based mobile instruction guide of day-to-day tasks that a field engineer will encounter as part of their functional role. The package utilizes location firstly to identify what type of node the engineer has attended on-site, in terms of its hardware and software release, and context sensitive technologies to supply the engineer with a list of common tasks to perform based on that particular node type. The advantage of using such technologies is that the engineer does not have to be familiar with all tasks before entering field work, provides a form of on-the-job training and reduces the amount of time/money spent on traditional classroom based training programmes.

## **Development of Training Material**

The training package has been developed with two locations in mind, namely the two Ericsson offices in Dublin: Ericsson, Clonskeagh and Ericsson Global Services Delivery Centre (GSDC), Dun Laoghaire which are separated by a distance of approximately 10km. Both offices have test plants with different types of Radio Base Stations (RBS) and, for testing purposes, these can be used to simulate a field engineer visiting a node on-site. The tasks required to be carried out on each site differ completely so as to simulate the context based situation, in this case, the engineer visiting two different locations for two separate network faults.

The development software used for this project, *eXact Mobile* developed by Giunti Labs, enables access to a Learning Management System (LMS) with mobile 3G, Wi-Fi and GPRS devices. This allows the engineer to access Learning Objects (LOs) and learning paths specifically customized for the available peripherals and for the location of access. *eXact Mobile* is the first commercial mobile Learning Content Management Solution (LCMS). It is a module of learn eXact, that enables context-aware learning content delivery when the learner needs to access it.

*eXact Mobile* can be integrated with the learn eXact LCMS suite or interfaced with any 3rd party eLearning (LMS/VLE) solution. eXact Mobile provides access to the LMS through mobile 3G, Wi-Fi and GPRS devices providing a high level of flexibility in learning programmes planning. eXact Mobile also feeds tracking information back to the LMS allowing the learner or mobile worker to follow learning programmes using the most convenient device available.

The following outlines the steps to be taken to install eXact GEO on a mobile device

- Connect the mobile device to the computer.
- On the computer access a folder on the mobile device and copy over the two required application files (.jad and .jar).
- On the mobile device access the folder where the two files have been copied
- Select the .jad file and start the installation
- Select eXact GEO to start the application.

Once you have started the application, the following steps are required to retrieve the information from the database:

1. **Set GPS** – by using either a built in GPS device or one connected to the device, the users position can be calculated and used by the phone to inform the database of its location
2. **Set Server** – the student can set the web address of the server where Learn eXact is installed. This will allow the student to pull the relevant course from the database
3. **Set Distance** - The student can set the distance (in meters) used to retrieve eXact GEO LO list located around this distance from the GPS point. Default value is 10000 meters.
4. **Get GEO LOs** - The student can start eXact GEO to retrieve the relevant Learning Objects and he/she has to login to Learn eXact with a username/password. Once the student has logged in, eXact GEO sends the geo coordinates using the default GPS device. If there are Learning Objects between the student position and the distance, eXact GEO will display the titles of the Learning Objects, otherwise an empty list will appear. When the student is logged in, eXact GEO permits them to set up a new distance every time by command selection on the bottom of the display. If a title of the Learning Object is selected, the Learning Object is downloaded. At the end of the download, a player is going to display the Learning Object. eXact GEO downloads the Learning Object selected, only if the Learning Object has never been downloaded.

All the above was installed, run and tested on a Sony Ericsson Xperia X1 which has a 800 x 480 pixels, 3.0 inch screen and runs on Microsoft Windows Mobile 6.1 Professional Operating System.

### *Course 1 – Ericsson Dun Laoghaire*

In this scenario it is assumed that the engineer is working on an Ericsson RBS type 3206 and the relevant course is pushed to the phone based on the GPS coordinates (Figure 3).

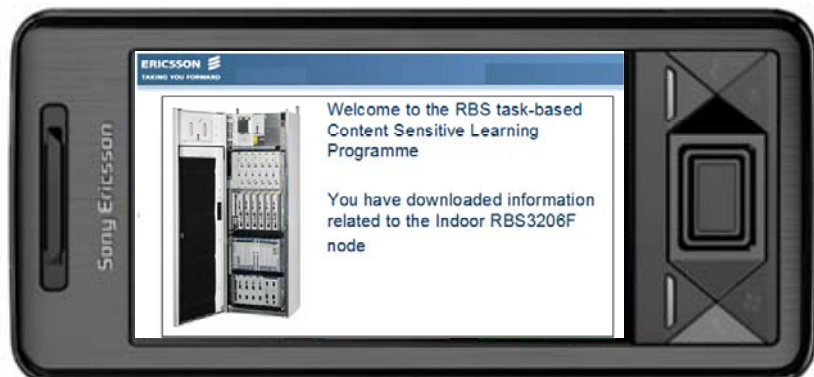


Figure 3: Start page of Dun Laoghaire RBS3206 course

After this, the engineer is asked to choose which task-based routine to perform from the following list (Figure 4):

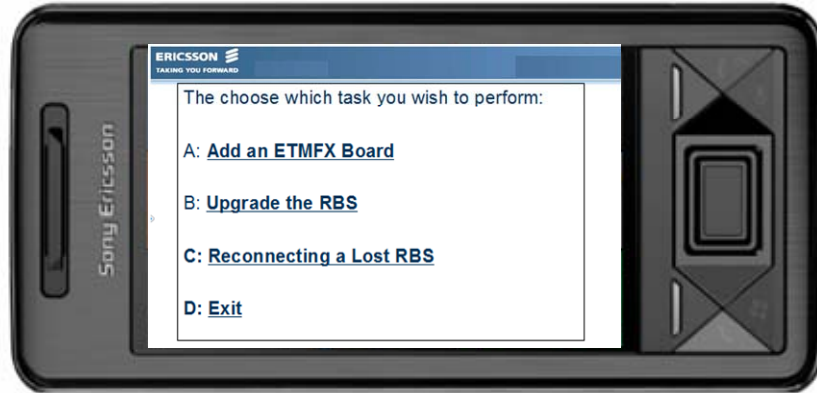


Figure 4: Task-based procedures for RBS3206

**A: Add an ETMFX Board**

Once the engineer has chosen to add new hardware in the form of an ETMFX board to the RBS 3206 node, the subsequent pages describe the exact procedure to follow in order to successfully add the board to the node and concluding routines to be performed before leaving the site

**B: Upgrade the RBS**

Once the engineer has chosen to upgrade the RBS 3206 node, the subsequent pages describe the exact procedure to follow in order to successfully create, install, run and confirm the upgrade to the correct software level.

**C: Reconnecting a Lost RBS**

Once the engineer has chosen the option to reconnect the RBS 3206 to an RNC, the subsequent pages describe the exact procedure to follow in order to attempt to restore contact with RNC

## Course 2 – Ericsson Clonskeagh

In this scenario it is assumed that the engineer is working on an Ericsson RBS type 3418 and the relevant course is pushed to the phone based on the GPS coordinates (Figure 5).



Figure 5: Start page of Clonskeagh RBS3418 course

After this, the engineer is asked to choose which task-based routine to perform from the following list (Figure 6):

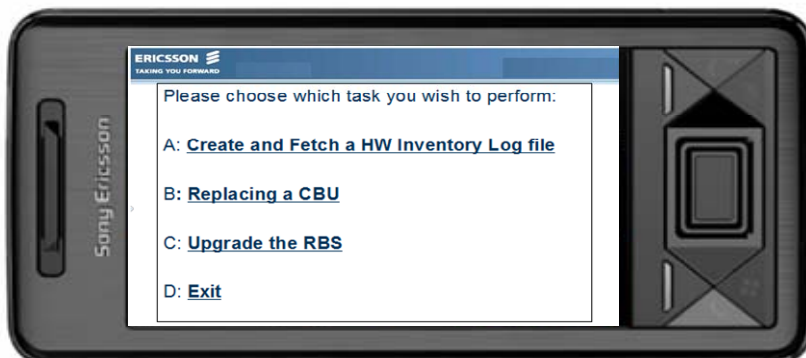


Figure 6: Task-based procedures for RBS3418

### A: Create and Fetch a HW Inventory Log file

Once the engineer has chosen this option, the subsequent pages describe how to create and fetch a hardware (HW) inventory log file in the node.

### B: Replacing a CBU

Once the engineer has chosen to replace faulty hardware in the form of a CBU board in the RBS 3418 node, the subsequent pages describe the exact procedure to follow in order to successfully replace the faulty board in the node and carry out all concluding routines required before leaving the site

### C: Upgrade the RBS

Once the engineer has chosen to upgrade the RBS 3418 node, the subsequent pages describe the exact procedure to follow in order to successfully create, install, run and confirm the upgrade to the correct software level.

## **Testing of Location and Context Sensitive Package**

The testing phase took place in Dublin during July 2009. The participants were a mix of telecommunication engineers working for Ericsson – 50% work within the Ericsson Education environment teaching and developing technical courseware which is delivered to Ericsson and network operator employees, 20% work supporting the Ericsson network test plants which are used for R&D, training and consultancy work and 30% work as telecommunication consultants advising operators on how best to optimize their networks. All are involved in Life Long Learning as the technical environment within the telecommunications environment is continually changing. It is also the philosophy of Ericsson to support Life Long Learning, as a well educated staff is vital to the success of the company worldwide. Ericsson Education in Ireland has 100 experienced learning consultants and instructors. There are 800 courses in the standard portfolio which is taught to the employees of Ericsson and customer organisation from over 160 countries which amounts to over 300,000 student days per year.

Ericsson Education in Ireland has always been to the forefront in researching innovative ways of deploying training material to Ericsson staff and customers. It has the global competence within Ericsson for eLearning, Synchronous eLearning and mLearning. It is also one of the leading centers globally for Learning Solutions, which focuses on Business Analysis and Training Analysis to optimize customers learning experience and competence development. Ericsson Education Ireland's aim is to help Ericsson and its customers to succeed in today's technology-driven telecom world through employee performance improvement.

As mentioned above, training is not always available at the right time for the reasons outlined. Using the functionality, computing power and mobility of mobile devices a task based course was developed to test context sensitive, location based training to enable telecommunication engineers to receive training at a time and in a place of their choosing.

The test phase took place on two different sites, 10 kilometers apart in Dublin. The participants downloaded the appropriate material for the task at hand to their mobile phone.

# Evaluation and Analysis

## *Evaluation Methodology*

In total, a group of 38 participants in total took the context sensitive courses and were split into 2 groups depending on their location. Each individual was given a short introduction regarding the purposes of the project and the reasoning for developing such a mobile based application for individual learning. A single GPS-enabled mobile phone was used for testing purposes, namely the Sony Ericsson XPERIA X1.

Each student completed the tasks in approximately 10-20 minutes. The aim of the testing was to evaluate the “look and feel” of the application rather than the technical content, hence the participants were not required to physically carry out the tasks on a piece on network equipment. Also, not all of the participant would not have had experience in the technical area for which the course was designed, so the time required to carry out the task is greatly reduced in this situation.

The following data has been gathered from the testing phase:

- Questionnaires completed by each student

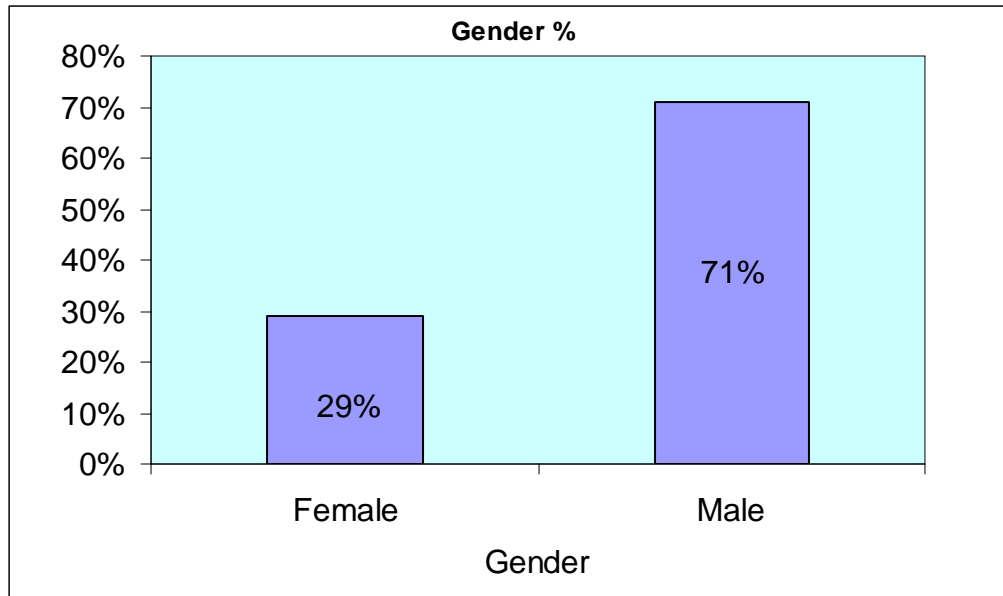
## *Evaluation results*

### **Student questionnaire results**

38 questionnaires were completed using the questionnaire in Appendix 1. The questionnaire aims to gauge the user experience of a variety of users of different age, gender and technical experience.

#### **Gender**

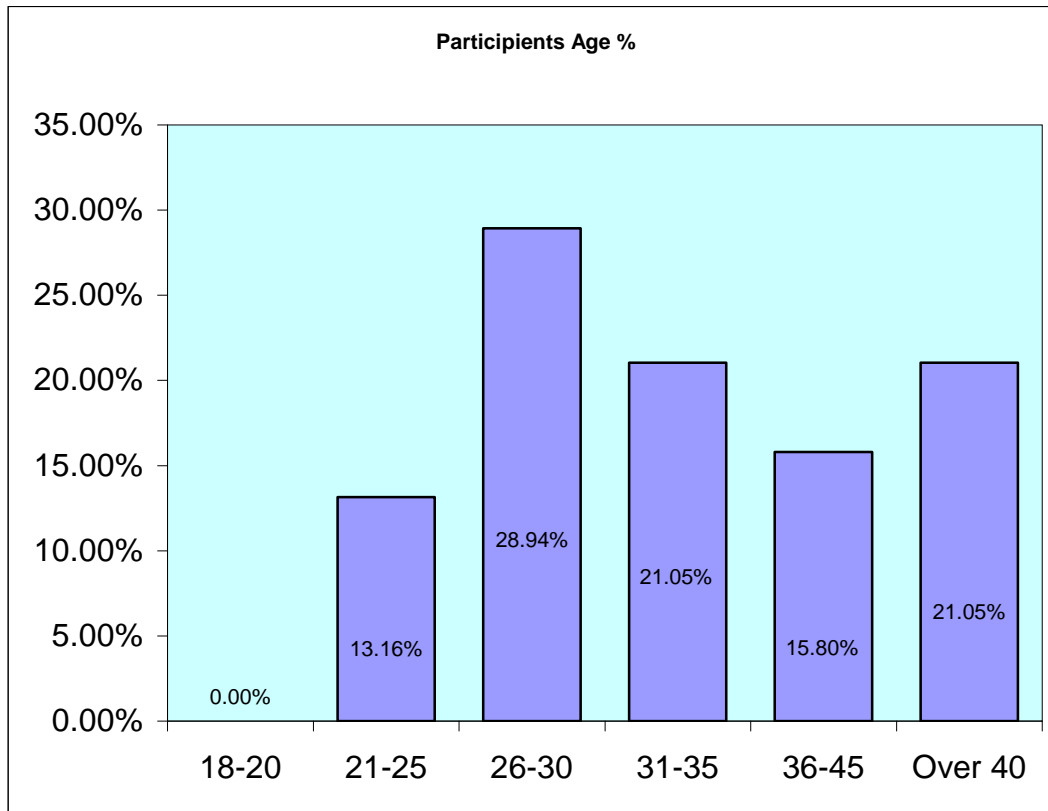
	<b>Frequency</b>	<b>Percent (%)</b>
F	11	29%
M	27	71%
Total	38	100%



The sample comprised 29% females and 71% males.

#### Age

Age	Frequency	Percent (%)
18-20	0	0
21-25	5	13.16
26-30	11	28.94
31-35	8	21.05
36-45	6	15.8
Over 40	8	21.05
Total	38	100



The age range of the students spans from 21 to over 40. 42% (16) are aged 21-30 and 58% (22) are over 30.

**1 Which mobile phone do you own?**

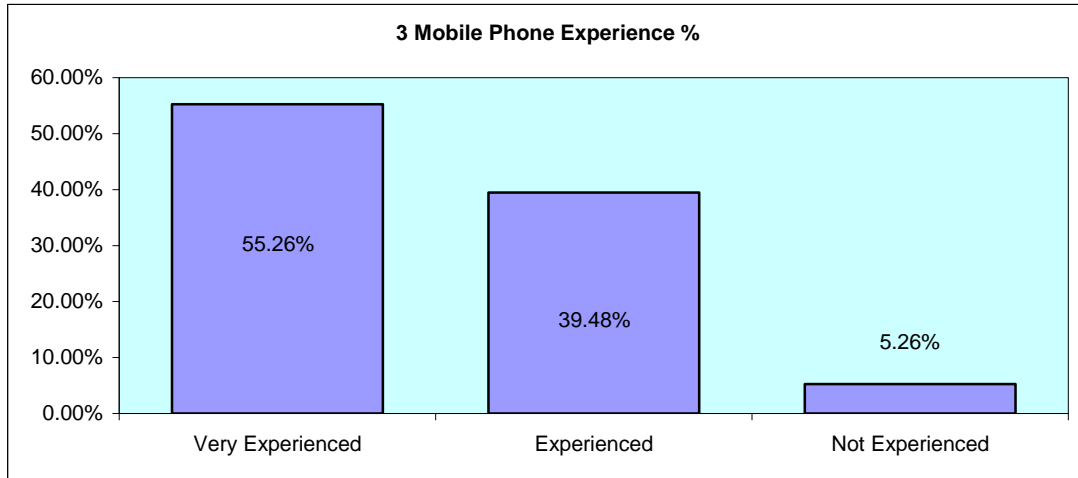
All the students used the Sony Ericsson Xperia X1

**2 Does your phone have GPS?**

The Sony Ericsson Xperia X1 has built-in GPS capability.

**3 How would you rate your experience in using mobile phones?**

		Frequency	Percent (%)
Valid	Very experienced	21	55.26
	Experienced	15	39.48
	Not experienced	2	5.26
	Total	38	100



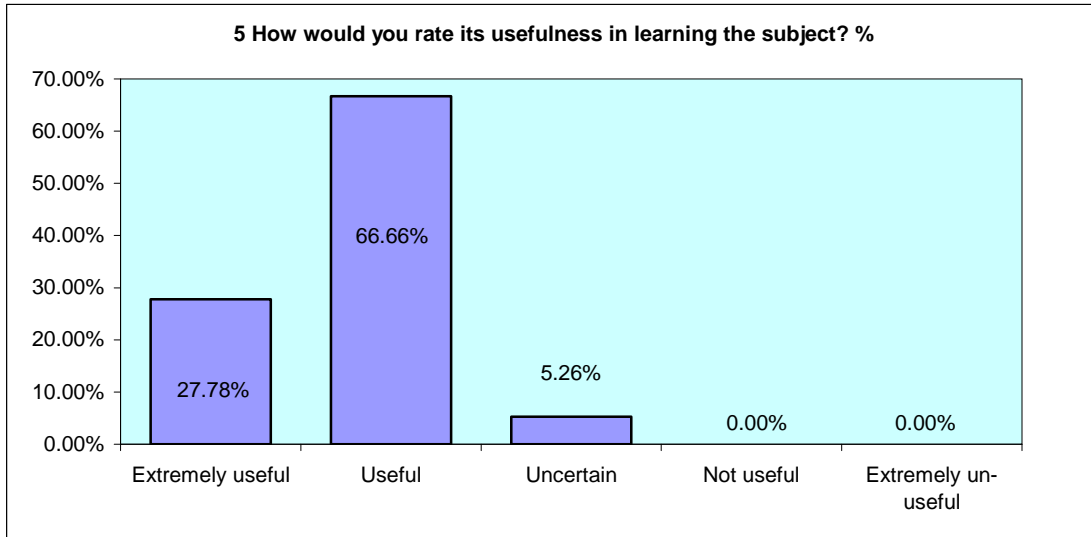
**4 What did you think of the mobile learning course you have just experienced?**

1. Very useful
2. Excellent. I believe this is the new way forward to telecommunications. However I do not think that this concept could work for very technical courses.
3. Interesting experience. The content was displayed clearly though diagrams for technical information are difficult to read and understand in small screen layout.
4. I thought the text was very clear and well laid out. Maybe more screen shots required. Even at the largest zoom the screen shots and images are difficult to view clearly. If they required more detail it might be very hard for someone to read the text within them.
5. I was quite impressed as the graphics were very clear and there was no delay. The course itself is well structured simple, clear and concise.
6. Very simple to use. Info is concise
7. Very clear and precise / specific instructions
8. Very good
9. Excellent, clear, easy to use.
10. Nothing particularly innovative about the experience, but has potential for field engineers
11. It's good but very limited. Its just one task of maybe thousands on an RBS.
12. Very relevant to a number of job roles (field, technician, procedure-based roles). Less relevant to more theory-based job roles.
13. Good beginning
14. Brilliant. Feel, content, pictures all added to the course being a success. Could have 1000s of applications
15. Good layout. Very clear course of action. Nice level of detail
16. Very impressed but needs good quality phone with large screen, like a smart phone.
17. Very good. Good refresher if just about to perform a task not so familiar with. Be careful thought it shouldn't replace CPI. Eyes tired by the end though even though only after 5-7 minutes. Maybe that's my age!
18. Very good, easy to read, laid out well. Pictures were very clear. You could use more colour in the text (i.e. red for warning, green for successful etc)

19. Easy to follow, easy to use. However, without the stylus is may have been difficult to navigate as here were no instructions on how to use keys.
20. It was ok. It lacked some functions in my opinion e.g. I think each page should have the page number on top and an introduction on navigation would be useful (maybe this is not possible as it would be phone specific
21. The content was delivered clear so very handy. I would prefer to see some completion message or status
22. This is not a course This is a structured knowledge transfer for on the job activities – excellent.
23. Clear navigation, good diagrams. Well presented
24. Excellent. Q: Once I've "bought" the course can I continue to refer to it on demand?
25. I thought it was excellent and would take more courses. I like the idea of being able to take the training when and where you want.
26. Practical, short overview of what to do. Like the concise nature of the course.
27. The course supplied relevant information when and where I need it.
28. Easy to understand. GUI easy to follow
29. Useful for snapshots. Text and picture quality excellent, very readable
30. Graphic unnecessary on all screens. Zoom in on screen shots to show which option to select
31. Very good for in-field reference. Not so good for pure training product
32. Very clear and well laid out. Slight problem with navigating to main menu and split graphics and know about scrolling.
33. Handy for field
34. Very good
35. Excellent concept, and very usable

**5 How would you rate its usefulness in learning the subject?**

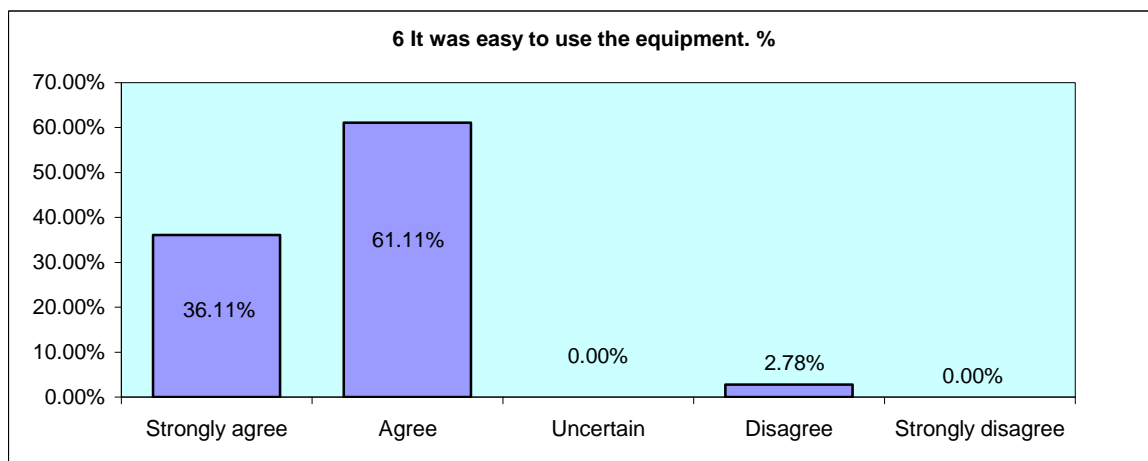
		<b>Frequency</b>	<b>Percent (%)</b>
Valid	Extremely useful	10	27.78
	Useful	24	66.66
	Uncertain	2	5.26
	Not useful	0	0
	Extremely un-useful	0	0
	Total	36	100



No negative ratings were given concerning the usefulness of the course in learning the subject. 28% thought it was 'extremely useful' and 67% 'useful'.

**6 It was easy to use the equipment.**

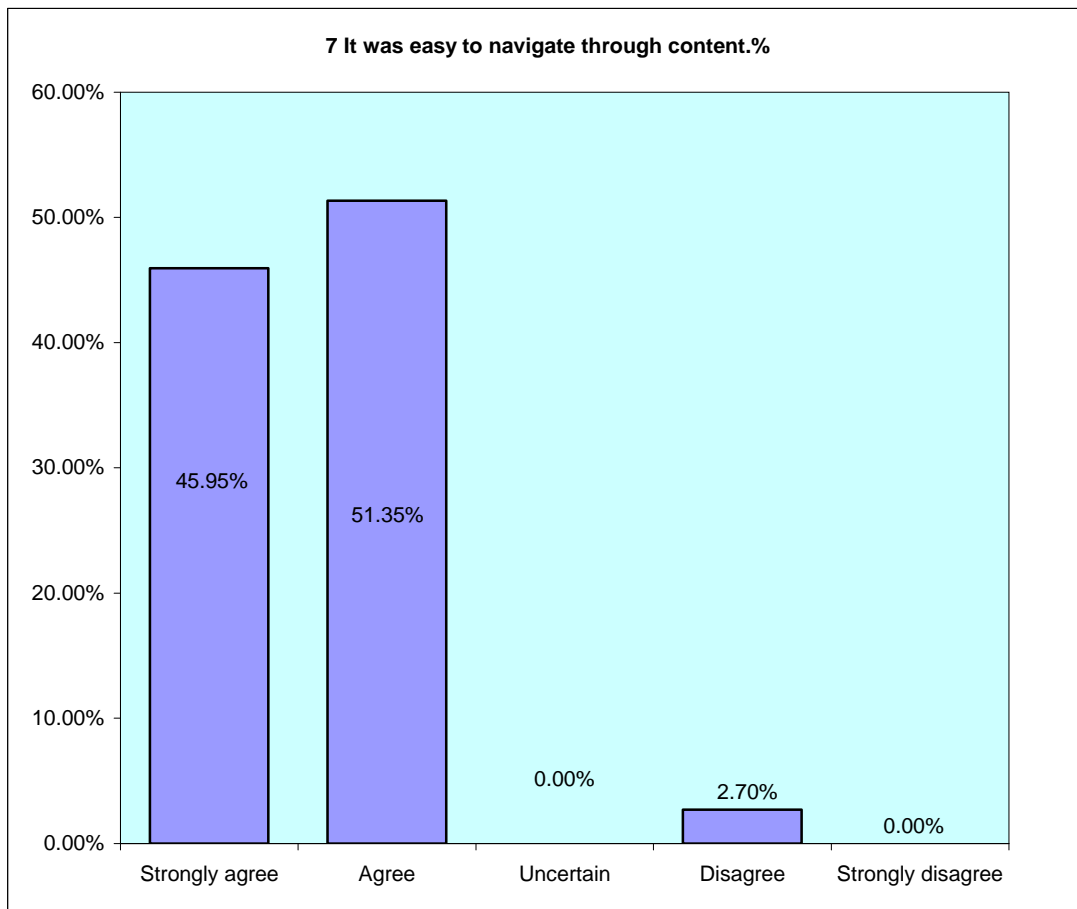
		Frequency	Percent (%)
Valid	Strongly agree	13	36.11
	Agree	22	61.11
	Uncertain	0	0
	Disagree	1	2.78
	Strongly disagree	0	0
	Total	36	



The majority said it was easy to use the equipment, 61% answered 'agree' and 36% 'strongly agree'. One person disagreed as he found the stylus difficult to use.

**7 It was easy to navigate through content.**

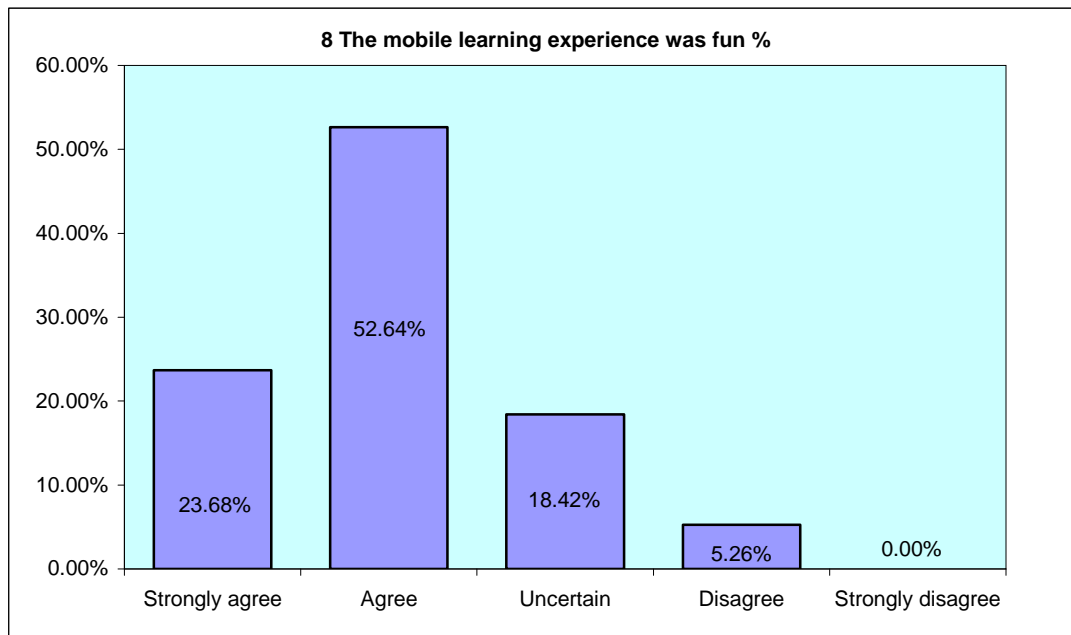
		<b>Frequency</b>	<b>Percent (%)</b>
Valid	Strongly agree	17	45.95
	Agree	19	51.35
	Uncertain	0	0
	Disagree	1	2.7
	Strongly disagree	0	0
	Total	37	



The majority also found it easy to navigate through the content, with only 2 (9%) rating 'uncertain'. 51% rated 'agree' and 46% rated 'strongly agree'. One person disagreed as she felt the menus should show completed and the screens should have a title on them.

### 8 The mobile learning experience was fun

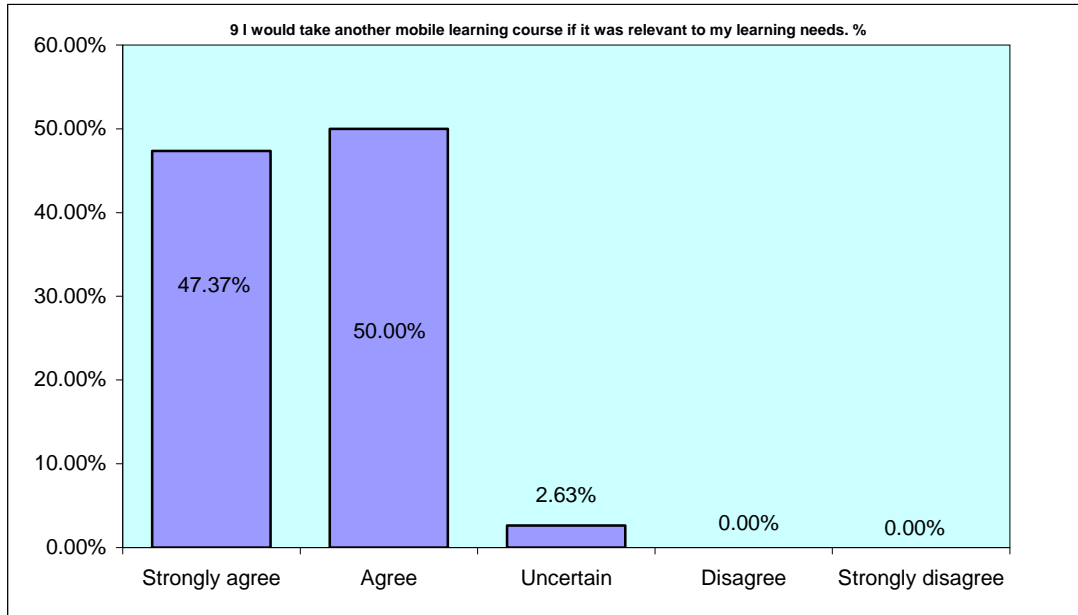
		Frequency	Percent (%)
Valid	Strongly agree	9	23.68
	Agree	20	52.64
	Uncertain	7	18.42
	Disagree	2	5.26
	Strongly disagree	0	0
	Total	38	



76% of the students agreed that the mobile learning experience was fun, with 24% answering 'strongly agree'. The fact that 24% would not agree that it was fun could be expected from the nature of the courses. Updating telecommunications equipment would be considered a serious task by many.

### 9 I would take another mobile learning course if it was relevant to my learning needs.

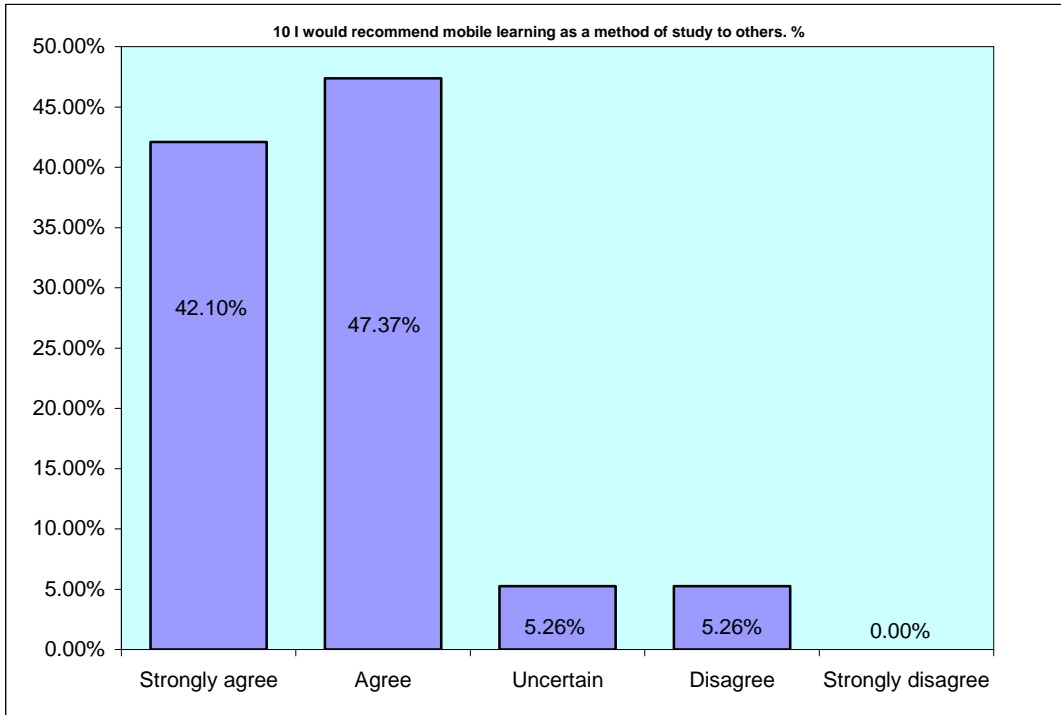
		Frequency	Percent (%)
Valid	Strongly agree	18	47.37%
	Agree	19	50.00%
	Uncertain	1	2.63%
	Disagree	0	0%
	Strongly disagree	0	0%
	Total	38	



A good indication that the students had a positive experience is that none disagreed with taking another mobile course. 47% answered 'strongly agree' and 50% answering 'agree'. Only one person was uncertain.

**10 I would recommend mobile learning as a method of study to others.**

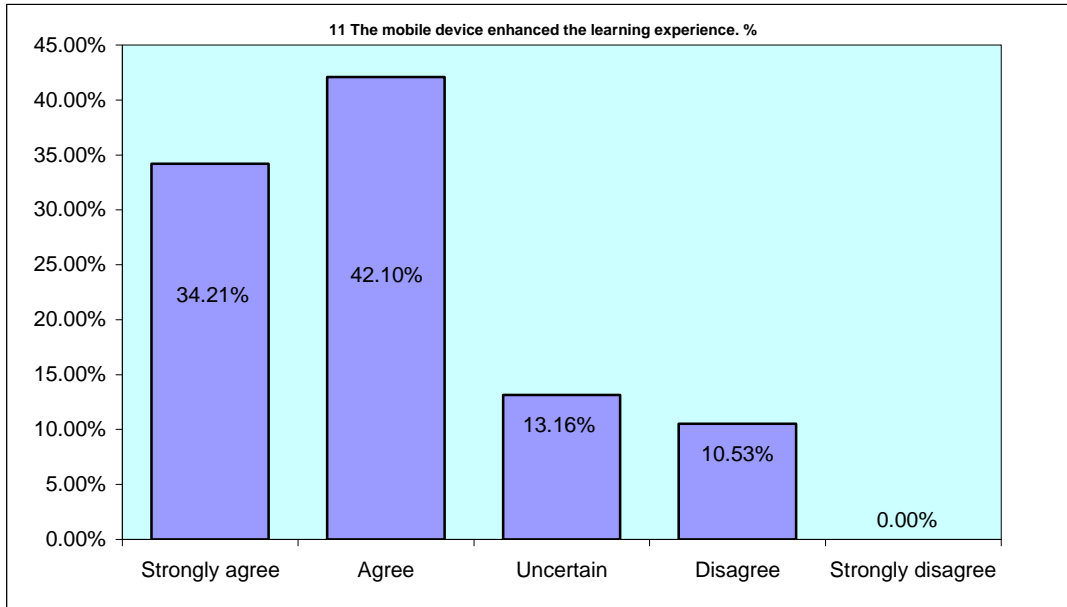
	Frequency	Percent
Valid Strongly agree	16	42.10%
Agree	18	47.37%
Uncertain	2	5.26%
Disagree	2	5.26%
Strongly disagree	0	0%
Total	38	



All of the participants 89% would recommend mobile learning as a method of study to others, while 4 participants were unsure or disagreed; of those 2 were 'uncertain' and 2 disagreed. Of those that agreed, 42% 'strongly agreed' and 47% 'agreed'.

**11 The mobile device enhanced the learning experience.**

		Frequency	Percent (%)
Valid	Strongly agree	13	34.21
	Agree	16	42.10
	Uncertain	5	13.16
	Disagree	4	10.53
	Strongly disagree	0	0
	Total	38	



76% thought that the mobile device enhanced the learning experience: 34% 'strongly agree', 42% 'agree' 23% were uncertain or disagreed.

## 12 In what ways did it (or did not) enhance the learning experience?

1. To me it is easier to read on a screen than on paper, since more used to the TV, PC input than reading on actual paper
2. Convenience to use it anytime and any place
3. Again the shots were not very clear and if the course required detailed slides with screenshots it may be an issue. I also am not very keen on the fact all the info on a page cannot be seen at once – you have to scroll up and down. May be a problem with slides showing a lot of data.
4. If this was a training course which you had to take it is very convenient that you do not have to be sitting at your desk. You could reference this in a server room which would save you time or carrying extra manuals etc.
5. I have never seen anything like a course on your phone so I found this exceptional.
6. Screen is small. Can only see ¼ lines at a time. Not as convenient as laptop screen
7. It's quick and very accessible.
8. I'm not sure.
9. Mobility
10. Nothing hugely different or better than existing experiences.
11. It didn't really. I could have just read a book or looked at Alex. It's very basic but the idea definitely has potential.
12. It provides quick, relevant information when needed during field maintenance work, of wherever you are.
13. Good – allows setting my own pace and having information as required when working.  
Bad – display is small and more tiring.

14. Allowed me to go back and forth at my own pace. Overall an excellent way to learn in your own time at your own pace.
15. For mobility reasons it is a very useful resource – portability. Got tough on your eyes after a short period. Text bigger perhaps.
16. Easy to follow steps. Fast response when next button selected.
17. It enhanced the learning experience in terms of learning at anywhere at anytime.
18. Plus – easy to ready, easy to skip through material. Minus Navigation – no page number, when finished keeps repeating last slide.
19. Can be used as a refresh just before task, if learning event taken earlier. Maybe more diagrams would be good.
20. I could use this while I'm on the go or would be useful if I was trying to refresh my memory on the subject
21. As it is on a mobile phone, access can be anywhere and at anytime.
22. I was never sure where I was in the course e.g. I should know that I'm on page 5 of 10 or at least the name of the course.
23. Can be more useful if manuals are in audible format.
24. Could in a specific context i.e. task-based training. Probably not applicable for a longer course.
25. Having this on a mobile device means it can be done anywhere
26. It gives clear and concise definition of tasks to complete. Excellent graphics
27. Ease of access
28. Easily portable – could use it anywhere
29. Immediacy - that I could look at the course material when I had the time to do so.
30. Was able to walk around – very impressed that I was able to do this when downloading the material to the phone
31. By being extremely mobile: authoritative content had graphics, just in time. What you need when you need it.
32. Short and easy access
33. Navigation from main menu is fine. In sub menu it is no obvious that top of screen that you are on Step 1.7 etc
34. Useful as reference after attending training. Useful as checklist on site
35. Small screen (but very clear)
36. There are problems initially getting used to features (scrolling e.g.) but once these are go over, it should enhance experience.
37. This course was a series of instructions on how to perform tasks: the instructions were clear and confidence boosting.

### 13 Which functions of the device did you use most?

1. Forward and back for the course.
2. Arrow keys for navigation and zoom function
3. Zoom, scrolling
4. Sidebar, arrows
5. Screen scrolling
6. Mainly the arrow keys
7. Touch screen
8. Easy to navigate
9. ?
10. Browsing
11. Browsing the instructions and content of the course
12. Pen and mostly screen
13. User friendly layout
14. Course navigation buttons only
15. Scrolling up and down on each page
16. Main menu navigate
17. Arrow keys
18. Simple and very straight forward
19. The stylus – to change pages and to scroll
20. Next arrow, scrollbar and stylus
21. GPS
22. Browser
23. Navigation, forward, back, scrolling
24. Step by step instruction
25. Navigation bar
26. Very little – scrolling
27. Switching from landscape to portrait. The course looks like it may have been designed for viewing in portrait but I preferred to view it in landscape. Forward / backward menu buttons
28. Reading text, navigation of the course
29. Explored various sections in windows mobile explorer
30. The menu
31. Pointer
32. As checklist to perform a task
33. Pen
34. Up down buttons
35. The screen text and graphics

#### 14 What did you think about the look and visual design of the course?

1. Simple, graphics too small, clear
2. Good & clear
3. Very clear
4. Needed larger font, graphics need to be limited
5. Bullets look clickable, excellent readability
6. Very good
7. Simple, elegant, well laid out
8. Clear text – a little small under notes. Clear images
9. I think the Ericsson Taking you Forward banner at the top of screen should be made smaller or removed and try to get all content on one page instead of having to scroll down. I think the graphic on right or left would be better than at the bottom on each screen, would make each screen initially more interesting. Text seems to be wrapped on bullets. After a while I found the text quite small (that could be my eyesight). Testing on sentences leading to bullets seems to be a smaller font than the bullets. Text very close to end of screen sometimes. When you hit the back up arrows on the main menu screen it goes into a part of training.
10. Impressive, seeing the “boxes” as photos gives a very hand-on feel
11. Maybe too many pictures of the RBS on second course – no need for picture on every screen
12. Good mix of text and images
13. Excellent (this is more of SKT)
14. It was clear – some more work could be done on branding Ericsson
15. It was fine but a more intuitive interface is needed
16. Have not been to course
17. Text was clear. Images were good quality. I didn't like the scrolling on each page
18. Simple and easy to read
19. Good, could use more colour for text etc
20. More diagrams might be good showing where to connect thin client etc
21. Good definition (relying on good quality phone)
22. Fairly good
23. Very good. Simple design which is better for this type of app. Easy to navigate through the steps
24. Very nice, simple and clear
25. Excellent, especially the pictures
26. Looks, good although sometimes the spacing of the text was wrong i.e. sentences divided in two lines unnecessary
27. Very neat and easy to browse. Simple
28. The look is excellent and the pictures are clear
29. Looks like standard documentation format so for me usual design follows what I know
30. Good, diagrams clear and concise
31. Very modern
32. Easy on the eye for someone with bad eyesight!

33. Looks good
34. Basic but at the same time remarkable. The visual design is not completely necessary as it does not take away from the experience.
35. It is well laid out, again diagrams and all the info on a page not visible at once may put me off using this method – very modern neat feel though
36. Good design and layout
37. Very clear. However, zoom functionality doesn't work in each screen

**15 The course used location-based technologies to provide relevant learning materials to your phone. How did you find this?**

1. Already configured prior to my test
2. Yes. I found the material relevant and working exceptionally
3. Worked fine
4. I'm not a "techy" but the material appeared very comprehensible
5. Yes, material was relevant
6. Very good
7. The content could be more personalised – based on the know users background. RBS content delivered to Radio Engineer. MSC content delivered to Core Engineer.
8. Yes, it worked well
9. Nice to have
10. The idea is great, although not suitable for all kinds of training
11. Essential and would prove very useful
12. Fine
13. Not used (inside building) only works outdoors, which can limit usefulness
14. Very good
15. Yes
16. Helpful if the correct information / date it sent to my phone when required
17. This was a nice idea
18. Need more info
19. No problems
20. Yes, this works well
21. V. good
22. Not sure, both Beech Hill & Dun Laoghaire material was already downloaded onto the phone
23. Good
24. I found it very good and can see where this could be very useful for training deliveries
25. Yes
26. Seems like a good idea: The course was relevant to my local RBS
27. Always relevant
28. Yes, but to some extent this was transparent to me

29. Yes, but GPS didn't work indoors. Hence the need to download outdoors. This would seem to indicate that the geographical context accuracy is limited to 100m & dimensions of the building

**16 Did you encounter any technical problems? If so, what problems did you have?**

1. The application hung on the phone which had to be switched off. The zoom font functionality did not work on all screens
2. Getting back to main menu, switching to 2<sup>nd</sup> course, scrolling, split graphics (not intuitive)
3. No
4. Font changes wouldn't work initially
5. GPS didn't work indoors
6. No
7. Finding the main menu was not clear
8. When I switched from portrait to landscape the phone jammed and had to be switched ff/on. Apart from that no technical issues.
9. No
10. No
11. None
12. No
13. Ok. But when finished, I clicked the up arrow which brought me back into the course for some reason
14. No
15. No
16. There were no instructions on how to get back to the start if needed
17. No problems
18. Nope
19. Device screen no always responsive. No possibility to "calibrate" the stylus – a shortcut to do so would help those wearing glasses
20. No
21. No
22. No
23. No
24. No
25. No
26. No
27. No
28. No
29. No
30. No
31. No

32. No
33. None
34. Zoom functionality didn't work on each screen

**17 What did you like most about the mobile learning course?**

1. The clarity on the content and just relevant information
2. Ease of access to content on mobile device
3. I like the way it can be used when on the move. It is a convenient way of viewing data
4. The fact that a course could be taken on a mobile phone was remarkable. The phone could fit in your pocket and was really easy to use. The picture of the processes.
5. Convenience of having content on phone
6. The fact that it was short, specific and to the point.
7. It was easy to navigate through it.
8. Easy to use, concise
9. Quick access to relevant information.
10. The clear step by step approach. Could be very useful to an inexperienced engineer on site.
11. Capability to check one bit of information whenever needed. Portability
12. Step by step concise information. Handy to have while working
13. I controlled the pace and could go back and forth as I wished.
14. The clarity of the visual design
15. Good step by step guide (structure). Illustrations useful
16. Convenience in terms of being able to access anywhere at anytime.
17. Short, basic information.
18. Relevance to task
19. I was surprised at how easy it was to use and the layout of the content
20. Easy to use. Simple and understandable layout.
21. That it can be received to phone when required/relevant
22. Have not been to course
23. Ease of use, portability
24. Very clear graphics and very fast loading of pages
25. Concise and good graphics
26. Clear structure
27. Ability to navigate to relevant reference material
28. The freedom to take the course when and where you want. Very easy to use and could move easily around the menus.
29. Concise, being able to move around
30. Well laid out relevant information when and where I need it.
31. Easy to use and short learning

32. Accessibility. Do it to my own schedule
33. Useful as reference
34. Layout of slides
35. Very clear and particularly suited to an ordered list of instructions
36. Just in time and place

### 18 What did you like least about the mobile learning course?

1. Fiddly pointer, screen going to power save.
2. Some difficulties such as split graphics, scrolling, getting back to main menu and switching to 2nd course.
3. Size of screen
4. Size of screen
5. Sound less
6. Font should be set at least to 10pt – 11pt font size
7. I had to wait until I downloaded the course: surely it should come straight from the web
8. Notes section was difficult to read. It needs better linkages, proper end message. NO facility to add notes
9. I think shorter courses would work better on this device as I found my eyes straining after a while from looking at the screen. I would like to be able to bookmark.
10. Q? I have a stylus with my own phone. Would it be possible to take the course without this? If not, it would be very cumbersome.
11. I think you should use hyperlinks e.g. "connect the thin client and start em" – How?
12. Design could be better and there was no audio or tests/quiz
13. Lack of help
14. Scrolling. Inability to tell where in course I was
15. No relevant animation / pictures to help with the installation. Keyboard instructions
16. You could try and make it a bit more instructive
17. Risk: might replace actual procedural documentation e.g. CPI. Eyes sore after a while
18. A lot of text – should have expandable bullet points that can be expanded individually or all together, as part of navigation bar.
19. Small monitor – too much of scrolling up and down on the page.
20. Small navigation, buttons hard to press. Should be possible to enlarge images to view in more detail
21. Text size too small
22. Nothing to be honest
23. It's not possible to extend the information available i.e. what if I don't know what type of screwdriver size to?
24. Not enough details in some instances, if we take into account the target group for such a course
25. Nothing
26. Nothing

27. The fact that it may not be suitable for a more technical course.
28. Image size, size of screen too small
29. Small screen and difficult to read technical diagrams.
30. Can't make some content bigger.

**19 Do you have any suggestions for how we could improve the mobile learning course?**

1. Increased zoom function for clearer usability of technical information. Option to add student notes for learning
2. Course seems fine. Phones with larger display would be better. More images for exact steps. Perhaps some video for tricky steps.
3. No
4. Easier to read on screens when presented horizontally
5. I would imagine the more content available per GPS location the more irrelevant the information would become would again suggest some kind of personalised mobile experience
6. No
7. Needs to be able to browse through the ALEX/OPI for more details on some steps. Can it be customised to customers (based on their environment)
8. Remove irrelevant images i.e. rack cabinet in 2. Upgrading an RBS. Add titles to the instructions in each step, not only in the menu. Allow to 'check 'or mark the steps. Including links in the steps, like hyperlinks, describing tools, etc. Take care of the text format, avoiding lines with only one word with no need
9. Making the Sony Ericsson Xperia the standard Ericsson phone as the size of screen for this type of delivery is perfect. Other phones may reduce the quality of the course.
10. Bigger text and possibly wherever an acronym or abbreviation is used that one could click on this and learn more.
11. Make the acronyms clickable – to give the full term to student. Progress bar at top of page to tell you the % complete you are at. Slight difficulty in navigation for left handed user.
12. Photo – same photo on each page is useless and waste of space for the content. When describing each step, there should be a photo of what it's going to look like. When it comes to the end of the course, it should bring you to another page to clearly state that the course is finished with menu to go back to the main page.
13. Use animations
14. More pics!
15. Possibly sound and animation. Also "back to the start" button to quickly navigate back in case a step was skipped over.
16. I think the user should always know where they are in content. Add page titles or menu bars.
17. Provide course on device as well
18. Improve the interface – audio
19. Improve the design, clean up exit, include user status, add audio where applicable, add interaction or testing etc, add certificate
20. I would see this as an excellent extra for SKT.
21. Change orientation to use wider screen aspect
22. Concept would be better if you could choose a specific document from a list to download

23. Maybe a test? It's great to have the reference material but also good to know that you understand it.
24. I think sound would be a good option. Someone reading though the text so you can scroll to the graphic. As above, bookmark functionality
25. Would like an audio section along with some animation
26. Context sensitive help would be nice. Zoom feature on graphics. Bookmarks
27. Add more colour to the interface, add bookmark function
28. Add audio
29. Not so much a course as a useful tool for reference and checklist
30. Need zoom function
31. Small tutorial at start
32. Bookmarks, indicator of where you are in the course. Title on screen

## **Synthesis of the evaluation results**

38 students completed the training course. Each student completed a paper-based questionnaire after complete the course

The responses to questions in the student questionnaire are synthesized below.

### **Learners**

29% of the participants were female and 71% were male, reflecting the employee gender ratio in Ericsson Ireland. The age range of the students spanned from 21 to over 40; of this 42% (16) are aged 21-30 and 58% (22) are over 30, reflecting the maturity of the organisation and its commitment to Life Long Learning. All participants owned a mobile phone and the vast majority (94.7%) considered themselves to be experienced users.

### **Student feedback**

#### **Q4 What did you think of the mobile learning course you have just experienced?**

Of the 35 learners who responded to this question 8 (23%) stated the experience was excellent, 7 (20%) said it was very good, 18 (51%) agreed that it was good and 2 (6%) were not particularly positive.

Of those who felt it was excellent, one could see 1,000 applications for the concept, one did have a reservation but using the solution for very technical courses and another pointed out *"This is not a course. This is a structured knowledge transfer for on the job*

*activities”*

Two of learners in the very good category remarked that the material would be useful for in-field reference while screen size, navigation and layout were mentioned as needing improvement. This would reflect the experience of the course developers among the participants.

The group who found the experience good highlighted the structure of the material, the graphics and the level of detail available as “*very clear and precise/specific instructions*”.

The comments of those who were not particularly positive about the experience have a modicum of positive in them “*Nothing particularly innovative about the experience, but has potential for field engineers*” and “*It was ok. It lacked some functions in my opinion e.g. I think each page should have the page number on top and an introduction on navigation would be useful (maybe this is not possible as it would be phone specific*”

As an overall majority of the group viewed the experience as good or better, it can be stated that the concept is acceptable to the learners albeit with some reservations which will be discussed in more detail below.

**Q5 How would you rate its usefulness in learning the subject?**

Only 5.26% were uncertain of the usefulness in learning whereas 28% thought it was ‘extremely useful’ and 67% ‘useful’.

**Q6 It was easy to use the equipment.**

The majority said it was easy to use the equipment: 61% answered ‘agree’ and 36% ‘strongly agree’. 3% answered ‘disagree’. One person found the stylus difficult to use.

**Q7 It was easy to navigate through content.**

The majority also found it easy to navigate through the content, with only 1 (3%) rating ‘disagree’. 51% rated ‘agree’ and 46% rated ‘strongly agree’. The person who disagreed felt the menus should indicate when a section was completed and the screens should all have titles.

**Q8 The mobile learning experience was fun**

76% of learners agreed that the mobile learning experience was fun, with 24% answering ‘strongly agree’. 24% were either uncertain or disagreed which would reflect that the content of the course namely updating telecommunication equipment would be considered a serious task by many.

**Q9 I would take another mobile learning course if it was relevant to my learning needs.**

A good indication that the students had a positive experience and felt that they learned from the experience is that only one person (3%) was uncertain about taking another mobile learning course: 47% answered 'strongly agree' and 50% 'agree'.

**Q10 I would recommend mobile learning as a method of study to others.**

89% would recommend mobile learning as a method of study to others (those 2 were 'uncertain' and 2 "disagreed"). Of the rest, 42% 'strongly agreed' and 47% 'agreed'.

**Q11 The mobile device enhanced the learning experience.**

76% thought that the mobile device enhanced the learning experience: 34% 'strongly agree', 42% 'agree' and 13% are 'uncertain' and 11% "disagree". 24% of the group being uncertain or disagreed with the mobile device enhancing the learning experience is not reflected in the preceding questions but will be answered through the responses to question 12.

**Q12 In what ways did it (or did not) enhance the learning experience?**

37 (96%) participants answered this question. On the positive side convenience, mobility, accessibility, working at own pace, learning anywhere at anytime and immediacy were cited as enhancements of the learning experience by 22 (59%) learners. On the negative side screen size, lack of audio, no page numbers, problems with navigation, text size, more diagrams, display is small and more tiring were mentioned as aspects which did not enhance the experience for 11(30%) of the participants. This explains the reaction to question 11 above. The majority of the negatives could be addressed through course design.

**Q13 Which functions of the device did you use most?**

This question elicited a wide ranging and mixture of responses – 6 liked the arrow keys, 2 the zoom function, 3 scrolled, 1 the touch screen, 4 the stylus, 4 the browser, 2 up down buttons, 3 liked the course menu, and 1 welcomed the ability to use the course as a checklist to perform a task. One person said "*Switching from landscape to portrait. The course looks like it may have been designed for viewing in portrait but I preferred to view it in landscape*". Other aspects which were appreciated were:

- *user friendly layout*
- *simple and very straight forward*
- *step by step instruction.*

**Q14 What did you think about the look and visual design of the course?**

As might be expected from an audience which contains course developers, the reaction to the look and visual design was constructively critical. 6 comments were very positive pointing to aspects such as:

- *“excellent readability”*
- *“the look is excellent and the pictures are clear”*.

27 comments stressed positive features such as clear text, clear images, easy to read, well laid out, good design and layout. 16 pointed to areas that could be improved such as larger font, more colour in text, no scrolling, improving the design and zoom functionality which not working on every screen.

**Q15 The course used location-based technologies to provide relevant learning materials to your phone. How did you find this?**

Of the 29 people who answered this question, 23 (79%) were positive towards the material being relevant to their location *“Seems like a good idea: the course was relevant to my local RBS”* 6 learners (21%) were less than positive; the following comment captures the issues:

- *“Yes, but GPS didn’t work indoors, hence the need to download outdoors. This would seem to indicate that the geographical context accuracy is limited to 100m & dimensions of the building”*.

As expected, having to download the appropriate material outdoors is an issue with GPS.

**Q16 Did you encounter any technical problems? If so, what problems did you have?**

Of the 34 participants who answered, 24 (71%) had no problems. The issues mentioned by the remaining 10 (29%) fell into two categories: course design and technical issues with the phone. On the course design side, getting back to the main menu, no instructions on how to get back to the start of the course and the course starting over again at the end of the course were cited as problems. Technical issues on the phone such as the zoom function not always working, switching from portrait to landscape causing the phone to jam and the device screen not always being responsive were highlighted. Whereas the course design aspects can be addressed in future courses, the technical issues on the phone are not so easy to resolve.

**Q17 What did you like most about the mobile learning course?**

Among the 36 response, 3 words appeared frequently in the feedback; easy, convenient and clear. The comments which best sum up all the feedback were:

- *“Easy to use. Simple and understandable layout.”*
- *“Quick access to relevant information”*
- *“Step by step concise information. Handy to have while working”*.

- One respondent said *“The fact that a course could be taken on a mobile phone was remarkable. The phone could fit in your pocket and was really easy to use. The picture of the processes.”*

#### **Q18 What did you like least about the mobile learning course?**

As already mentioned, there were a number of course development involved in the testing and evaluation stage. This background is reflected in the comments received to this question.

Screen and text were mentioned regularly as being too small *“Size of screen” Text size too small*”. Connected to the size of the screen is the issue of scrolling which some learners did not like. Suggestions such as:

- *“No relevant animation / picture to help with the installation*
- *“Keyboard instructions”*
- *“Should be possible to enlarge images to view in more detail”*
- *“Design could be better and there was no audio or tests.*
- ***Another suggestion received*** *“A lot of text – should have expandable bullet points that can be expanded individually or all together, as part of navigation bar.”*
- One risk was highlighted: *“might replace actual procedural documentation”*

By and large the elements least liked by the participants could be addressed by designing the courseware differently.

#### **Q19 Do you have any suggestions for how we could improve the mobile learning course?**

The majority of suggestions received concentrated on the design of the course and how it could be enhanced. The comment which encapsulates the feedback best is *“Improve the design, clean up exit, include user status, add audio where application, add interaction or testing etc, add certificate”*

#### **The benefits of context aware content:**

As the courses were aimed at very specific tasks for very specific versions of telecommunications equipment, the participants welcomed the benefit of the context aware content.

Employees who had just started in the organisation were more impressed which is reflected in *“I feel I could have performed the tasks even if I knew nothing about the RBS in question”*. More experienced people regarded it as a *“good refresher”*. Very experienced people were less impressed and as they were looking for something more in line with their experience, for example, *“Why not have the whole CPI (A large Ericsson database library on all Ericsson equipment) available”*

#### **The use of location aware technology:**

Although the course had to be downloaded outdoors due to the constraints imposed by GPS, people seemed to appreciate the advantages of the location aware aspect of the course. Unfortunately location determination via IMS was not yet available and as expected people foresaw limitations with using GPS. The ability to move between different equipment within a building and accessing the relevant course material would not be possible.

## **Conclusions**

Location based, context sensitive training material was successfully developed for tasks on two different versions of a Radio Base Station (RBS) in two different locations in Dublin. These locations were approximately 10 kilometers apart and proved the concept of the location based aspect of the application. The location based aspect was obvious to the learner and all those that participated saw how location based was addressed.

The survey dealt with a mix of genders and age groups which would have been ideally suited to trial this course. In addition, the skill and knowledge of the group dealing with handsets was high. This meant that training was not required and the course developed was intuitive to the needs of the learner.

The ability to download the appropriate material in the right location was achieved. This was achieved with no issues relating to the download procedure. The context sensitive aspect of the trial was not emphasized during the evaluation process. As the subject in the course was directly related to telecoms, it was felt that the emphasis was more implicit than explicit. More direct questions on this should be included in future evaluations to make the subject more explicit.

The learner's reaction to the courses was very positive. Percentages of over 94% were achieved with the learners finding the experience useful and indicating they would take other courses in this format. However, issues such as course design and technical aspects of the mobile device were highlighted and will be addressed in future course development. These issues relate to areas such as screen size and phone functionality. These issues are common across most research in this area. Issues such as screen size have been addressed somewhat by handset manufacturers and will continue to be addressed as handset development increasing to suit the changing needs of the end users. Through future research, we will see this become less of an issue.

Overall, the concept of context and location sensitive learning was seen as extremely useful and one that would be very beneficial to learning in a personal manner. The majority of participants alluded to the fact that the clarity and simplicity of such applications which could greatly enhance learning, with comment relating to:

- *Usefulness of the application*
- *Excellent concept and the way forward for telecoms*
- *Clarity of the material*
- *Relevancy to functional role*
- *Simplicity of use*

One of the main advantages of such positive feedback is that one can see there is a huge interest in technologies like this as it allows end-users to choose when/where/how they learn and takes away the link, which is sometimes negative, to education being perceived classroom based.

Another positive is that the majority of people found the experience to be fun with 97% of participants expressing they would do a similar course again. The fun aspect of learning will encourage people to engage in lifelong learning as they will be more engaged and active in the learning experience, and will feel they have a greater control in their own development. Also, the majority of participants highlighted the fact they found that the experience enhanced their learning.

In general, the context and location sensitive course was well received by all participants and the vast majority can see the benefits that such technologies will have for end users. The main negative aspects were largely related to limitations with the mobile device but these did not detract from the learning experience and the overall satisfaction of those who participated.

# Appendix 1: The Questionnaire

## CONTSENS Mobile Learning Evaluation Questionnaire

Please complete this questionnaire. Your views are very important to us, so please do give your honest opinion. All your answers are confidential, and you will not be identified in any resulting work.

Name:  Male:  Female:

Course or module:

Age: 18-20  21-25  26-30  31-35  36-45  Over 40

1. Which mobile phone do you own?

2. Does your mobile have GPS (Global Positioning System)? Yes  No  Don't know

3. How would you rate your experience in using mobile phones?

Very experienced  Experienced  Not experienced

4. What did you think of the mobile learning course you have just experienced?

5. How would you rate its usefulness in learning the subject?

Extremely useful  Useful  Uncertain  Not useful  Extremely un-useful

6. It was easy to use the equipment.

Strongly agree  Agree  Uncertain  Disagree  Strongly disagree

7. It was easy to navigate through the content.

Strongly agree  Agree  Uncertain  Disagree  Strongly disagree

8. The mobile learning experience was fun.

Strongly agree  Agree  Uncertain  Disagree  Strongly disagree

9. I would take another mobile learning course if it was relevant to my learning needs.

Strongly agree  Agree  Uncertain  Disagree  Strongly disagree

10. I would recommend mobile learning as a method of study to others.

Strongly agree      Agree      Uncertain      Disagree      Strongly disagree  
                                                                               

11. Using the mobile device enhanced the learning experience.

Strongly agree      Agree      Uncertain      Disagree      Strongly disagree  
                                                                               

12. In what ways did it (or did not) enhance the learning experience?

13. Which functions of the device did you use most?

14. What did you think about the look and visual design of the course?

15. The course used location-based technologies to provide relevant learning material to your phone. How did you find this (e.g. was the course material always relevant, did this work well, etc.)?

16. Did you encounter any technical problems, e.g. in using the device and/or location-based technologies? If so, what problems did you have?

17. What did you like most about the mobile learning course?

18. What did you like least about the mobile learning course?

19. Do you have any suggestions for how we could improve the mobile learning course?

If you would be interested in being involved in further research with us into using mobile phones for learning, please give your details below:

Name:

Email address:

Thank you for your help