Pilot trial of a smart phone App for ascertaining water quality

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Introduction

An important aspect of studying a technological module such as T868 Environmental monitoring and protection, is the acquisition of practical skills. Normally such skills are taught through practical sessions in a laboratory. Sometimes they are taught in the field. In distance teaching, they can be taught through the use of home experiment kits. Now an opportunity has arisen with the ubiquity of smart phones and mobile Apps, for students to get hands-on experience of field measurements. A pilot trial of one such App, used in conjunction with test-strips, was undertaken in late 2018. The App selected for use was one that was freely available and is utilised for monitoring and managing water quality in swimming pools and spas. The success of the trial offers the possibility of using Apps in developing students' practical skills and techniques of data analysis whilst studying environmental protection.

Methodology

One of the subjects covered in T868 is Water Pollution Control. Various water quality parameters can now be easily measured in the field using test-strips, and the data obtained can be sent by e-mail in real-time, using a smart phone and an appropriate App. The practicality of using such an App on T868 was tested, after an eSTEeM Proposal had been submitted and approved by the OU Student Research Project Panel.

Volunteers for a pilot-trial of a smart phone App for measuring water quality, were invited from a cohort of T868 students who were studying water pollution control on the module. Ten students (seven from the UK and three from Kenya) and one Tutor signed-up to participate. All of them were sent test-strips and Instructions for undertaking the trial, by measuring the water quality at two different locations. Some did more than this, since four test-strips were sent to each participant. There was a mistake in the original set of Instructions for downloading the App. This was rectified by e-mail correspondence, and a Note on the appropriate Forum in the Module website. The final set of Instructions is shown in Appendix 1.

Posting the test-strips and Instructions by normal mail to Kenya proved difficult, and so these were couriered.

Results

Results (Appendix 2) were received from nine of the participants. Eight of them were able to send their data in using the App chosen for the trial. The Results were accompanied by excellent photographs (Appendix 3) of the sampling locations.

Participants had to answer six Questions (listed in the Instructions) pertaining to the activity. The Answers are shown in Appendix 4. The findings for each Question are summarised below.

(i) Were the Instructions for the above Activity clear, and easy to follow?

Most participants found the Instructions easy to follow. There was a problem initially but this was rectified by e-mail correspondence and a Note on the appropriate Forum. One of the students missed seeing the Note but used their initiative to solve the issue.

(ii) Please list any difficulties that you experienced, in downloading the App and using the Test Strips.

Downloading the App was not found to be difficult, and once the preliminaries were undertaken, its use was straightforward, in general. One participant was unable to e-mail their Results from an iPad. One person had difficulty with the orientation of the test strip, and another found it a challenge differentiating between some of the colours.

(iii) Please list issues that other users might experience in using the App and Test Strips.

The issues identified were related to the incomplete Instructions initially given. As mentioned earlier, this was rectified through e-mail and a Note on the appropriate Forum.

Regarding the test strips, guidance on the orientation of the test strip when using the App, was required. (This has now been incorporated in the Instructions, in Appendix 1).

One student commented on the fact that the App was designed for use with pools and spas. A reply was sent to the student, saying that for the trial an off-the-shelf App had been chosen but if the idea of using Apps were to be taken up by The Open University, bespoke Apps would be created.

A student raised the issue of colour-blindness being an obstacle to using the App, and also said that people don't all see colours in the same way.

(iv) Please suggest how the Activity can be made more engaging.

Several students stated that having information on the four parameters being measured (e.g. as to how they affected water quality), would have made the Activity more engaging. Another stated that GPS co-ordinates incorporated within the photographs of the sampling locations, would do the same.

One student suggested having test strips specifically for water pollutants such as phosphates, nitrates, nitrites, and ammonia. Another student said having more test parameters, with explanation of sources and effects of each parameter, would make the Activity more engaging.

A student suggested having an option for omitting the water body dimensions. (This will be possible with an App created specifically for use in T868).

Another student said that it would be nice to have access to data and details of sampling locations of the other participants.

One student suggested having an App that read the colour, to assist students who were colour-blind, while another suggested a better, detailed, set of Instructions would make the Activity more engaging.

(v) Did you find the Activity beneficial in relation to the material studied in 'Water Pollution Control'?

All the participants answered 'Yes' to this Question but one commented that it would have been more relevant if the App had been tailored specifically by The Open University.

(vi) If you answered 'Yes' to Question (v), please give your reasons why.

Several students appreciated the hands-on experience offered by the tests, and its application to the local context. One student said it enhanced their understanding of water quality testing, and another said their apprehension regarding carrying out the tests was allayed. One student said that 'leaving theory behind and going practical' boosted their confidence in the subject.

Impact

a) Student experience

- In what ways has your project impacted on student learning?

  The use of the App has involved the students acquiring hands-on experience in measuring water quality parameters. This lends a whole new perspective to learning about environmental protection, taking them away from theory in a

study room to the practical world outside. They've had to organise how to get to sampling sites, acquire samples, and carry out practical work. All this will have been a new experience for many of the students, and something they are not likely to forget. This will help reinforce the learning that is intended.

The Open University doesn't conduct sessions in laboratories for its Modules, and Apps will potentially play a vital part in developing important practical skills.

When the App is used in earnest in the Module, the diversity of data from different parts of the world will give students an idea of the richness of the environment.

- How is your project contributing to increasing student success (i.e. retention, employability, etc.)?

  The use of Apps increases student interest, and thus will help increase student retention. The fact that students gain practical experience of measuring (in the present case) water quality parameters will add to their employability skills and make them attractive in the job market.

- Have there been or will there be any benefits to students not directly involved in your project?

  The data that is acquired by using Apps could be utilised in other Modules for teaching or assessment purposes.

b) Teaching

- How have you affected the practice of both yourself and others within the OU?

  We are now keen to include the use of Apps in the online activities in the rewrite of T868. Whilst in our Project we tested a Water Quality App that is freely available in the market, the intention would be for us to create our own App, for use with test-strips that we would selectively purchase, for different pollutants (such as nitrate and phosphate). Ideally, we would create Apps for use with measurements related to Water, Noise, and Air (these being the subject areas of T868 amenable to practical work with Apps). Questions would be set in the TMAs requiring data obtained using the Apps. The data would then be used in problem-solving exercises. Examples are given below.

Subject Area	Components of Interest	Example Questions Posed
Water	Nitrate and Phosphate in a watercourse	a) What are the levels in g m^{-3}? b) What treatment or other options are there available to reduce the nitrate and phosphate levels to i) Eliminate the possibility of algal blooms occurring OR ii) Enable the watercourse to be used as a raw water source for a potable water treatment plant
Noise	Sound Pressure Levels	a) What is the noise level inside and outside your house / Office at the busiest time of day? b) Suggest ways in which the noise level penetrating inside, can be reduced
Air	Particulates	a) What is the level of particulates, in µg m^{-3}, in the air just outside the main door of your home / Office? b) What are the sources of particulates in the locality? c) Suggest methods of elimination or entrapment of the particulates for the main source.

- What has been the impact of your project outside the OU?

  We haven't publicised our findings anywhere yet.

c) Strategic change and learning design

- What impact has your work had on your Unit's or the University's policies and practices?

  It is hoped that the use of Apps will be commonplace in the environmental technology and environmental science areas of the curriculum of the University, thus helping with student retention and adding to the employability skills of our students.

Discussion

From the above, it is apparent that Apps can be a very engaging means of teaching environmental technology. In the above case, we trialled a water quality App but there are others, concerned with air pollution and noise. The Apps can be used not only to acquire data but be a means of teaching environmental technology directly relevant to the student, by acquiring data which students can directly relate to.

An example of teaching related to water might be where a student uses test-strips to measure nitrate and phosphate levels in a river, and then suggests a treatment system to reduce the levels such that eutrophication and algal blooms do not arise. Or students can measure noise levels in different environments and suggest noise reduction measures. Assessments based on scenarios such as these will make the module very practical.

Data can be shared amongst a given student cohort widening the exposure of students to situations in different parts of the country, and indeed the world.

Photographs of sampling locations sent in with the data, will bring all the examples to life. Sharing of such information in distance-teaching modules will reduce the sense of isolation some students feel, and build a sense of community.

For the purposes of T868, bespoke Apps should be created, with the facility for including the co-ordinates of sampling locations. This should be possible since smart phones are able to generate this data when photographs are taken with them.

Conclusions

The use of smart phone Apps promises potential for skills development amongst students studying technological subjects. For T868, these Apps can be a means of acquiring environmental data from diverse regions, and this data can be used towards teaching environmental engineering. It is best if bespoke Apps are created specifically for use on the module.

References

This Project was an extension of an earlier eSTEeM Project [Nesaratnam, S.T. & Taherzadeh, S. (2014) 'The potential for the use of smart phones to enhance teaching in environmental engineering and environmental science modules', Report produced for eSTEeM, The Open University).

Statement of ethical review

A Student Research Project Panel Review was undertaken and approved (Ref. 2018/072).

Acknowledgement

The authors are very grateful to all the participants of the above Trial. Their enthusiasm through speedily sending their data, with lovely photographs, is much appreciated. Thanks are also due to eSTEeM, The OU Centre for STEM Pedagogy, for approving and funding the Trial.

APPENDIX 1

PILOT TRIAL OF A SMART PHONE APP FOR

ASCERTAINING WATER QUALITY

Introduction

The aim of this Activity is to measure four water quality parameters (Total Hardness, Total Bromine, Total Alkalinity, and pH) in two different water sources, using Test Strips and an App on a smart phone. The Procedure is outlined below. In case of any difficulty, please send your query to suresh.nesaratnam@open.ac.uk

Procedure

Download the AquaChek Smart App onto your smart phone, as follows:

Go to http://www.aquachek.com

Click on the 'AquaChek Smart App' and download it onto your phone.

Once you've downloaded it, there will be options for 'Chlorine', 'Bromine' and 'Others'. Click on 'Bromine'. (Selecting 'Bromine' allows us to see the colours for the four parameters of concern to us).

Because the App is designed for use with pools and spas, once 'Bromine is selected, the diameter and depth of the water body are required. Using the slider on the screen, choose some fictitious values. Once this is done, the option 'Water Testing' becomes available. Click on this.

You should then see four rows of coloured squares for Total Hardness, Total Bromine, Total Alkalinity, and pH.

These rows can be scrolled to view the complete range of colours.

Your App is now ready for use.

Taking and recording measurements

Consider your locality and choose two different, relatively clean, water sources for investigation. These could be rivers, streams, wells, lakes, etc. Please do not choose water sources that are visibly polluted, and/or have an odour, as they could be dangerous. Please also keep away from fast-flowing water sources.

In a bag, put the following :

- two clean glass containers that are at least 6 cm tall
- the four test strips that were sent to you
- some tissues
- rubber or plastic gloves.

<u>At each location</u>

Take a photograph of the location.

Open the Water Testing App on your phone.

Put on the gloves and collect a sample of water, having first rinsed out the container three times using water from the source.

Immerse a test strip into the sample and take it out immediately.

Wait 15 seconds for the colours on the test strip to develop.

Compare the four colours on the test strip with the colours on the App. The top square (at the very end of the test strip) is for Total Hardness, the next for Total Bromine, the third square for Total Alkalinity, and the bottom square for pH.

Select the colour on the App that is the closest match, for each of the four parameters.

Then click on the arrow (→) at the top.

You will get a message saying ‘You have successfully generated the Test Report’.

Click on ‘OK’

Click on ‘Email’ (at the bottom of the screen), and in the ‘To’ box, type ‘suresh.nesaratnam@open.ac.uk’, and in the ‘Cc/Bcc’ box, type in your own e-mail address.

In the ‘Subject’ box, write the name of the location.

In the body of the e-mail (where your results will be displayed), write the headings shown below and give the required information :

Details of water source : (name of water source; type of water source [river, well, etc.]; its geographic location)

Observations on the water source : (is it clear / cloudy, etc.; does it have any vegetation in it?; is there any smell?, etc.)

Attach the photograph of the location to the e-mail.

Click 'Send'.

Repeat the above procedure at the second sampling point that you selected (but see below first).

When you have finished sampling at both sites, please write your responses to the six Questions below, within the body of the second e-mail you send :

(i) Were the Instructions for the above Activity clear, and easy to follow?

(ii) Please list any difficulties that you experienced, in downloading the App and using the Test Strips.

(iii) Please list issues that other users might experience in using the App and Test Strips.

(iv) Please suggest how the Activity can be made more engaging.

(v) Did you find the Activity beneficial in relation to the material studied in 'Water Pollution Control'?

(vi) If you answered 'Yes' to Question (v), please give your reasons why.

Appendix 2

Data from Participants

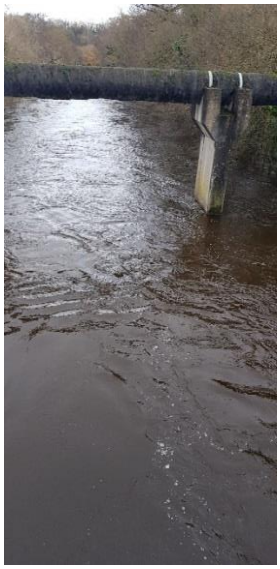
	1	2	3	4	5	6	7	8	9
Location	Stowe Pool (disused reservoir), Lichfield, England.	River Trent, Kings Bromley, England.	Brecon Beacons National Park, Wales.	Aberdare Park, South Wales.	Leixlip Reservoir (drinking water source), Ireland.	From River Liffey, after outlet of Leixlip Wastewater Treatment Plant, Ireland.	Protected Spring, Bomet, Kenya.	Itare River, Kenya.	Litein Stream, Kericho County, Kenya.
Date / Time	18 November 2018 / 3:28 p.m.	18 November 2018 / 4:15 p.m.	5 December 2018 / 11:49 a.m.	5 December 2018 / 3:59 p.m.	19 December 2018 / 2:01 p.m.	19 December 2018 /	20 December 2018 / 3:36 p.m.	23 December 2018 / 1:32 p.m.	23 December 2018 / 1:34 p.m.
Total Hardness (ppm)	250	250	250	500	250	100	100	500	0.00
Total Bromine (ppm)	1.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00
Total Alkalinity (ppm)	240	240	240	180	240	240	180	240	240
pH	7.2	7.8	6.2	7.2	7.2	7.2	6.8	8.4	8.4

	10	11	12	13	14	15	16	17	18	19
Location	Mbagathi River, Kenya.	Kiserian Dam, Kenya.	Back entrance of Shanklin Chine, Shanklin, Isle of Wight.	Sainsbury's Duck Pond, Newport, Isle of Wight.	Boating Lake, Queen's Park, Crewe, England.	Wistaston Brook, Crewe, England.	Siston Brook, Willsbridge, South Gloucestershire, England.	River Avon waterway lock, Keynsham, Bristol, England.	Borehole, Kenya.	Road-side river, Kenya.
Date / Time	24 December 2018 / 10:26 a.m.	24 December 2018 / 2:31 p.m.	25 December 2018 / 9:55 p.m.	25 December 2018 / 9:59 p.m.	28 December 2018 / 11:38 a.m.	28 December 2018 / 12:04 p.m.	29 December 2018 / 3:40 p.m.	29 December 2018 / 3:46 p.m.	12 January 2019 / 5:45 p.m.	12 January 2019 / 9:00 p.m.
Total Hardness (ppm)	250	250	1000	500	250	250	250	100	0.00	250
Total Bromine (ppm)	0.00	1.00	2.00	2.0	0.00	0.00	1.00	1.00	1.00	1.00
Total Alkalinity (ppm)	240	120	240	240	240	180	2.40	240	240	40
pH	8.4	8.4	8.4	8.4	6.8	7.8	7.8	7.2	7.2	8.4

Appendix 3

Photographs of sampling locations

1  **Stowe Pool, Litchfield, England.** **Observations :** Disused reservoir. Water is clear with no smell. No vegetation on the margins.	**2**  **River Trent, Kings Bromley, England.** **Observations :** Clear water, with no smell, or vegetation on the banks. Bottom is silty.
3  **Brecon Beacons National Park, Wales.** **Observations :** Clear water, with a tree, reeds and various other vegetation growing in it.	**4**  **Aberdare Park, South Wales.** **Observations :** Artificial lake fed by a natural stream, with ducks, Clear on the top, muddy on the bottom, and cloudy if disturbed. Sample of water was clear, and there was no vegetation growing in the lake.

5  **Leixlip Reservoir, Ireland.** **Observations :** This artificial lake is fed by the River Liffey, and is dammed to generate 5 MW of electricity. Water is abstracted from this lake and treated for potable use.	**6**  **River Liffey, Ireland.** **Observations :** River was fast-flowing due to the recent bad weather. A wastewater treatment plant was discharging its effluent. No obvious smells present.
7 	**8** 

Protected Spring, Bomet, Kenya. **Observations :** This drains into the Itare River, which leads to Lake Victoria. The water is clear. There is some algae, and also some floating green plants.	**Itare River, Kenya.** **Observations :** Shallow river shared between Bomet and Kericho Counties. Clear water, with reeds by the banks, and no smell.
9  **Litein Stream, Kericho County, Kenya.** **Observations :** Somewhat cloudy stream, with no vegetation, and no odour.	**10**  **Mbagathi River, Kenya.** **Observations :** The water was a bit cloudy, probably due to the heavy rain in the region. There was a lot of vegetation growing in the river. There is intensive farming on land along the river. Several institutions abstract water for purification for domestic use. Some sewage treatment plants discharge their treated effluent into the river.
11 	**12** 

Kiserian Dam, Kenya. **Observations :** The dam is located in Kajiado County, and receives water from three rivers – the Ilkeekonyokie, Naromoru and Kiserian. It is surrounded by informal settlements, and is prone to pollution from run-off and irresponsible discharge of liquid wastes. It lacks a buffer zone. Surrounding towns abstract water from the dam and purify it for domestic use.	**Shanklin, Isle of Wight.** **Observations :** Slightly-murky, fast-flowing stream which goes into the main Shanklin Chine attraction area. An outflow pipe runs directly into the stream.
13  **Sainsbury's Duck Pond, Newport, Isle of Wight.** **Observations :** The water is clear, with a population of ducks. A water current runs through the pond.	**14**  **Boating Lake, Queen's Park, Crewe, England.** **Observations :** The water is fairly clear, with low turbidity. The water source has an abundance of geese using it, and is aerated by artificial means. It has several outflows.
15	**16**

Wistaston Brook, Crewe, England.
Observations : This is a small suburban stream with various human-made subterranean tributaries. The water is very clear and fast-moving. There is evidence of recent flooding.

Siston Brook, Willsbridge, England.
Observations : This is a fast-flowing river in South Gloucestershire, that passes through a nature reserve on the edge of a housing estate situated between Bristol and Bath. It is clear, with some weed on the river bed.

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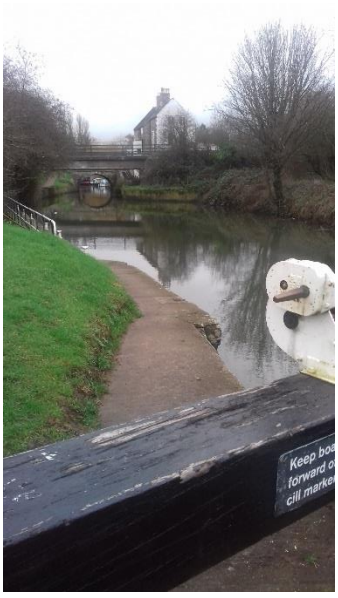

18

River Avon, Bristol, England **Observations :** This section of the River Avon makes up part of the Kennet and Avon Waterway. It passes through fields and a marina. It is slow-flowing, and is used for fishing and narrow-boating. The water was slightly turbid with organic matter.	**Borehole in Mung'ang'a Town, Kenya.** **Observations :** The water is clear and very clean, and is used for drinking and other household activities. The borehole is about 30 feet deep, and was dug manually.
19  **Huluche River, Huluche, Kenya.**	

Observations : The water is dark, cloudy, and soapy. There is some vegetation, with insects. There are also some rocks.	

Appendix 4

Answers to Questions

(i)	***Were the Instructions for the above Activity clear, and easy to follow?*** In general, yes. Instructions were easy to follow – yes. The instructions for the activity were very clear and easy to follow. I did not experience any major challenges. The instructions were clear and easy to use. The instructions were clear but the detail of the coloured squares was not clear due to lack of correlation with the Application. Instructions could have been clearer. I think someone with less familiarity with Apps may have struggled to follow the instructions Yes, the instructions were easy to follow. Instructions were clear and easy to follow. Although they were easy to follow, they were not sufficient. For instance, the third step instructs one to click onto "Water Testing" whereas it was not available after the downloading. Hence, I decided to manoeuvre and was forced to put some imaginary pool details for shape and volume, then chose all the test system types and selected a product to allow me to match with the parameters given, since the ones appearing earlier, for example, when I chose the yellow test system, the displayed parameters (**pH**, **free chlorine**, **total alkalinity** and **cyanuric acid),** were different to what was given in the instructions/introduction (**total hardness, total bromine, total alkalinity** and **pH)**. This forced me to select **test type as bromine** (after trying others which failed to produce the required parameters), then I selected the **product as AquaChekRed** and put some pool details in. Then all the parameters given earlier appeared.

(ii)	***Please list any difficulties that you experienced, in downloading the App and using the Test Strips.*** a) I wasn't expecting a swimming pool test and it took me a little while to find the correct test under "Bromine". (b) I was unable to email the results from my iPad despite trying two different email Apps. This may have been my fault. Downloading the App and using the test strips were straightforward. There were no challenges experienced in downloading the App and using the test strips. This was because the App was readily available on google play store. Difficulty in finding the correct section of the App to use as it seemed to be specifically for pool water, and I had to select pool parameters. There was no difficulty downloading the Application. The test strips changed colour in response to the water samples. I found the App not very user-friendly. It took a while to learn how to use it. Initially I had to guess which was the top of the test strip. No difficulty. No difficulties in downloading the App. Challenge came with test strips, when distinguishing between colours. It is a bit of a challenge to differentiate between some colours (was it beige or grey or dark grey?)
(iii)	***Please list issues that other users might experience in using the App and Test Strips.*** I would add the note, "select 'Bromine' before clicking on 'Water Testing'". Users might experience difficulties in using the App because the four rows of coloured squares do not initially appear. I had to contact Suresh on how to proceed. The instructions do not tell you to press 'Bromine' on the first screen of the App. Also, instructions could be improved by informing the student which colour on the strip corresponds with which of the tests i.e. total hardness, bromine, total alkalinity and pH. I assume most people had the same issues as I did. See (i) above. There is a lack of correlation between the exercise and Application. The Application is specifically designed for pools and spas, not outdoor water samples. I had no means of accurately measuring the volume of the water source, and had to enter a dummy value. The

	test strips are generic and there was no clear guidance in the instruction for which type of test strip as being used. I had to randomly select 'AquaChek Red'. Subsequently, the Orange Square was assessed as 'pH', the Green Square was assessed as 'Alkalinity', the Yellow Square was assessed as 'Bromine', and the Purple Square was assessed as 'Hardness'. As above. Others may experience some minor issues in using the App, such as challenges in computing the measurements of water bodies since some bodies such as rivers may be difficult to determine. In addition it was a bit confusing to navigate through the App considering that the instructions had not indicated one would have to provide the dimensions of the water body and click on the bromine tab first so as to generate the interface for the other parameters. Nonetheless, the above-mentioned challenges may be experienced by beginners only. As above. The issue of colour blindness especially in men; also, we don't all see colours the same way.
(iv)	***Please suggest how the Activity can be made more engaging.*** I suggest that the activity could be more engaging if tests more appropriate to water pollution, such as tests for parameters such as Phosphate, Nitrate, Nitrite and Ammonia, (see https://uk.hach.com/test-strips/test-strips/family?productCategoryId=24758400534) were used, instead of Total Hardness, Bromine and Alkalinity. I also constructed a crude colour/turbidity/suspended solids test by passing 2 ½ litres of river water through a Kleenex tissue. A number of particles could be seen with the naked eye; many more could be seen with a cheap 10x magnifying glass. A slightly improved version could easily be made using a filter paper and a large funnel. If a small ring were laid on the used filter paper, a reasonable estimate could be made of the number of particles per unit area. This could be compared with results from other sources; perhaps a set of "standard results" could be constructed? The activity would be more engaging if the meanings of each reading 1 – 4 on the Result page were published, so that the student understands what the test means regarding water quality. I had to google these. I think the App may be improved by providing the camera interface and that for GPS coordinates reader for location identification, especially if it is to be used for field surveillance. In addition, an option for skipping the step for providing water body measurements could be provided (assuming that this modification would not affect the measured parameter standard limits). It would be nice to have access to others' results and locations and also to have an idea of what the results might indicate, all on the App. Design application specifically for outdoor sampling with test strips suited for application.

	More test parameters. More explanation around sources and effects of each parameter. I enjoyed carrying out the test as it was very relevant to me. What if the App detects the colour (like a scanning/code reader) to help with colour-blind people ..? By giving all the details step-by-step. For instance, after the second step in downloading, tell individuals to take measurements of the pool, choose test system type, and test product required, for them to finally see the **water testing** option.
(v)	***Did you find the Activity beneficial in relation to the material studied in 'Water Pollution Control'?*** Yes I did, but would make the same comments as in (iv) above. The Activity was beneficial in relation to the material on water pollution control – yes. Yes. I found the Activity beneficial to my studies on the course. It also gave me some ideas for TMA02 Q1 (the path of the river and the pollution it receives). Yes, I found the Activity beneficial but it would have more relevance if the Application was tailored specifically by The Open University. Yes, interesting to apply to course material. Yes, the App was very beneficial. Yes. Yes.
(vi)	***If you answered 'Yes' to Question (v), please give your reasons why.*** I found information for both these locations online at http://environment.data.gov.uk/catchment-planning/WaterBody/GB30436433 and http://environment.data.gov.uk/catchment-planning/WaterBody/GB104028047290 . I found it useful to be able to compare that data with my own tests.

	It is good to have hands-on experience of doing the tests, which provides some understanding, having read water pollution control. Comparisons to local activities in relation to course concepts. The Activity provided a practical element to the course. Nice to develop a practical element alongside the online study materials to relate the course content to real-world sampling and monitoring. a) It enabled me to directly relate the ongoing Activities along the river riparian to the parameter levels exhibited in test samples. b) The App provides standard limits for the values of the test parameters thus provided an insight for interrogating and interpreting the results whose outcome may be utilized in developing control measures and corrective actions. c) It greatly enhanced my understanding of water quality testing and monitoring. d) Duplicate testing ensured reproducibility of results. Conclusively the App was very beneficial and very relevant to the T868 Block 1 on water quality. I came to understand the importance these four parameters in rivers. I was wondering how difficult it is do the testing; now I know I can handle it. More so, it is easy to explain rather than reading from a theoretical perspective. I enjoyed it. Integrate into the OU System. I felt like an experienced water quality monitoring officer. There is also the aspect of leaving theory behind and going practical, which boosts confidence in the subject.