

# MEET-CINCH

(Project Number: 754 972)

## DELIVERABLE D1.5

### School Workshops: Analysis of Student and Teacher Feedback

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## EXECUTIVE SUMMARY

NNL is responsible for the delivery of a “teaching package for high school use” which aims to raise young people’s awareness of the available careers in nuclear chemistry and attract them to the field. Following the Robolab workshops in June 2018, NNL has further developed the teaching material around the Ionlab experiment (extraction chromatography of  $^{90}\text{Sr}/^{90}\text{Y}$ ). In order to test the latest developments of the teaching material NNL has carried out five workshops with schools based in Cumbria and the North West of the United Kingdom. In total, 47 students and 6 chemistry teachers took part in the Ionlab workshops.

On completion of the workshops, teachers and students were asked to complete a short survey. Overall, the feedback from both students and teachers has been very positive. In terms of raising awareness of radiochemistry and nuclear chemistry, the workshops have been successful with 100% students stating that they had good understanding of the subject after the workshop. 96% students found the workshop interesting and engaging, 98% students felt that they had gained new knowledge or skills and 96% stated that they would like to do another activity like this. However, further consideration needs to be given to inspiring the students into these careers, as only 47% students would consider a career related to chemistry or nuclear. The teachers’ feedback largely echoes the students’ feedback; Robolabs are an interesting way of teaching, the content is good, pitched at the correct level and applicable to the curriculum.

The feedback from these workshops suggest that the high school teaching package will soon be ready for use, following some small modifications. The content of the e-learning and the in-class material needs to be reviewed to reduce the amount of repetition, whilst re-enforcing learning. The in-class material needs to incorporate more interactive or hands-on activities; this could be through more quizzes, “fill-in-the-gaps” sheets, etc. The University of Hannover is currently developing a “simulated” version of the Ionlab experiment and it is hoped that this will make the workshop more interactive, as students will be able to control the experiment individually or in small groups using laptops or tablets. Both the students and teachers would like more information on further education and careers in nuclear chemistry and radiochemistry. Some further consideration also needs to be given to making the material easy for high school teachers to use.

## CONTENT

<b>1</b>	<b>INTRODUCTION</b>	<b>5</b>
<b>2</b>	<b>FEEDBACK</b>	<b>7</b>
2.1	STUDENT FEEDBACK	7
2.2	TEACHER FEEDBACK	11
<b>3</b>	<b>CONCLUSIONS</b>	<b>14</b>
<b>4</b>	<b>REFERENCES</b>	<b>15</b>
<b>5</b>	<b>APPENDIX</b>	<b>16</b>

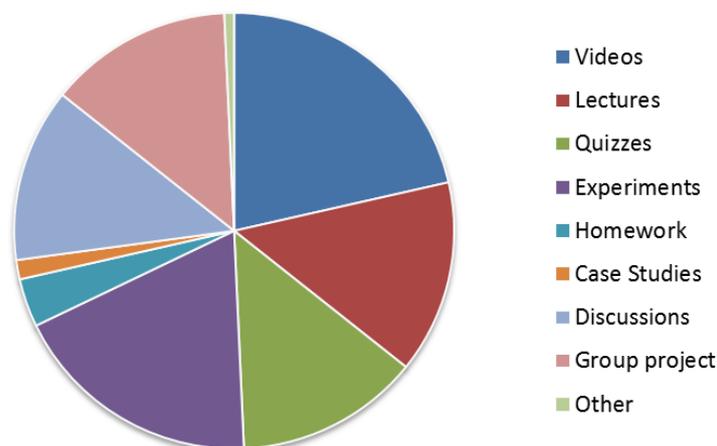
# 1 INTRODUCTION

MEET-CINCH aims to mitigate the skills gap in nuclear chemistry and radiochemistry, attract new talent to the field and develop a long-term sustainable strategy for education in nuclear and radiochemistry. NNL is responsible for the delivery of a “teaching package for high school use” which is a subtask (T1.3) of Work Package 1 (Nuclear Awareness). This task aims to raise young people’s awareness of the available careers in nuclear chemistry and attract them to the field.

NNL is building on existing teaching material from previous phases of the project (CINCH-I and CINCH-II) and adapting it for use in high schools. Earlier CINCH projects developed remotely operated “Robolab” experiments at the Universities of Oslo (UiO) and Hannover (LUH) for teaching undergraduate students. Working in collaboration with LUH and UiO, NNL has extensively tested the suitability of the Robolabs for high school students, considering the target group’s level of chemistry knowledge and potential IT challenges in schools. During June 2018, NNL carried out five Robolab workshops with 40 AS level chemistry students from schools in Cumbria and the North West of the United Kingdom. The purpose of the workshops was to identify a suitable Robolab experiment to take forward into the next phase of development. Based on the feedback from the workshops, the higher potential uptake by chemistry teachers and the ability for LUH to develop simulated versions of the Robolab experiments, NNL selected the Ionlab experiment for the high school teaching package.

Ionlab allows students to remotely control an extraction chromatography experiment, separating strontium-90 from yttrium-90 [1]. Over the last 12 months, NNL has been developing interactive teaching material on this subject. The material has been divided into two parts; online e-learning for students to complete before lesson and in-class material for the teacher to use. The teacher and student materials were made accessible on the CINCH Moodle, screenshots of each webpage can be found in the Appendix. The student page is open access to the public, but the teacher page requires a Moodle account and authorisation to access the webpage.

During the e-learning, students are introduced to the concept of radioactive isotopes, medical radioisotopes, chromatography techniques and the experimental procedure for the Ionlab experiment. In-class, teachers can check the students’ understanding with quizzes and discussion before starting the Ionlab experiment. Students can also learn about different careers for chemists in the nuclear industry through “a day in the life...” videos. The content has been developed in a “modular” way, giving an indication of time required for each activity. This is to allow teachers the flexibility to build-up a lesson plan based on their students’ preferred method of learning and how long the lesson is (lesson duration varies from one school to another). NNL has attempted to include a range of teaching techniques based on student feedback from June 2018 (Figure 1) [2].



**Figure 1: Students' preferred learning methods.**

To test the latest developments of the teaching material, NNL carried out five workshops with schools based in Cumbria and the North West. In total, 47 students and 6 chemistry teachers took part in the Ionlab workshops.

**Table 1: Robolab workshop dates at participating schools.**

<b>School</b>	<b>Location</b>	<b>Workshop Date</b>
West Lakes Academy	Cumbria	13th June 2019
St Benedict's	Cumbria	17th June 2019
Priestley College	Warrington	18th June 2019
Energy Coast UTC	Cumbria	19th June 2019
St John Rigby	Wigan	20th June 2019

In order to see how easily the material can be used by someone else (i.e. a teacher or STEM ambassador), seven NNL chemists were trained to carry out the workshops, delivering the teaching material in pairs. For this reason, the style of delivery varied from workshop to another as it would in real life. At the end of the workshop, students and teachers were asked to complete a short feedback form. The main findings from these surveys are reported below. It is worth noting that at some workshops, NNL staff experienced technical difficulties in accessing the Ionlab remotely and using the school's IT equipment and this is likely to have influenced the feedback received.

## 2 FEEDBACK

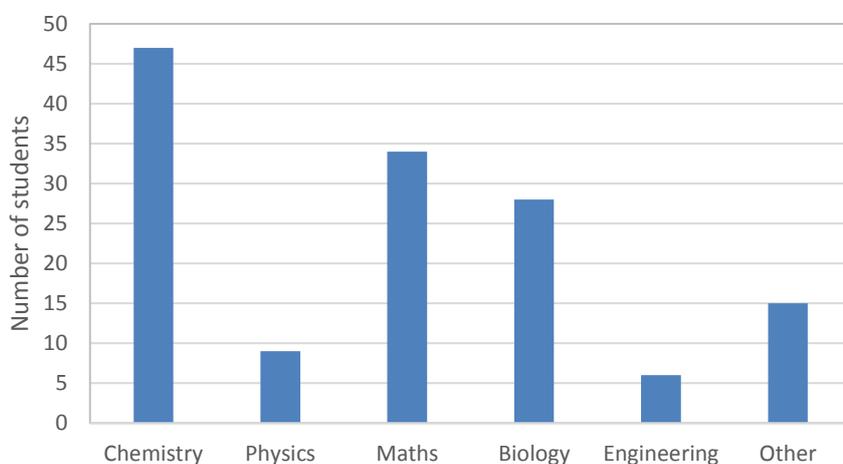
### 2.1 Student Feedback

In total, 47 students took part in the Ionlab workshops and were in the 16-18 age range (Table 2).

**Table 2: Age of students participating in Ionlab Workshops.**

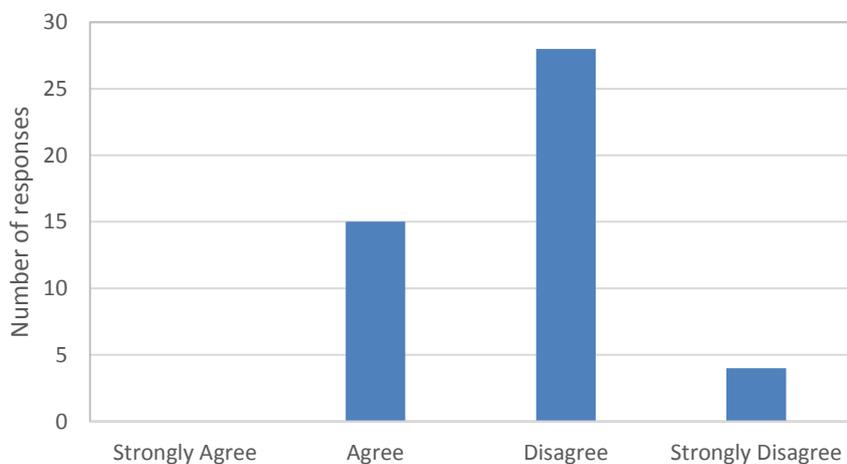
Age (years)	Number of Students
16	11
17	34
18	1
Unknown	1

All students were studying AS Level chemistry as well as other STEM subjects (Science, Technology, Engineering, Maths). Other popular subjects included maths (72 %) and biology (60 %). A breakdown of the students' subjects is shown below.

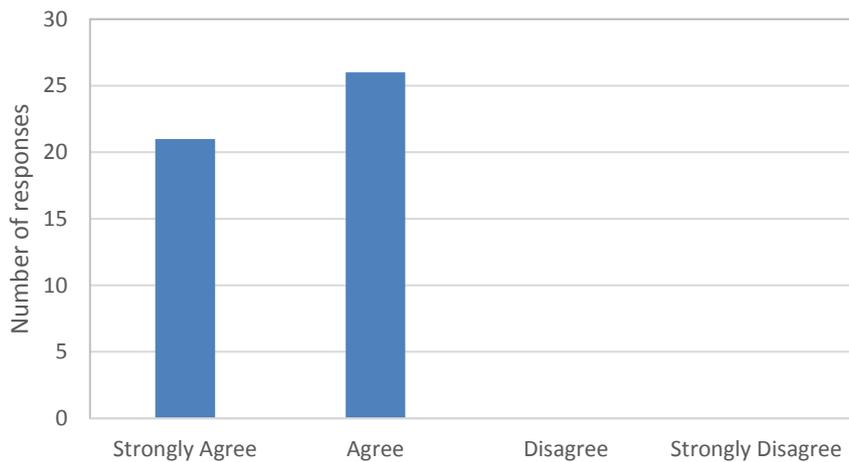


The students were given statements to which they had to respond “Strongly Agree”, “Agree”, “Disagree” or “Strongly Disagree”. Students were also asked to list their “favourite activities” and “least favourite activities”. The questions asked and the replies received are presented below.

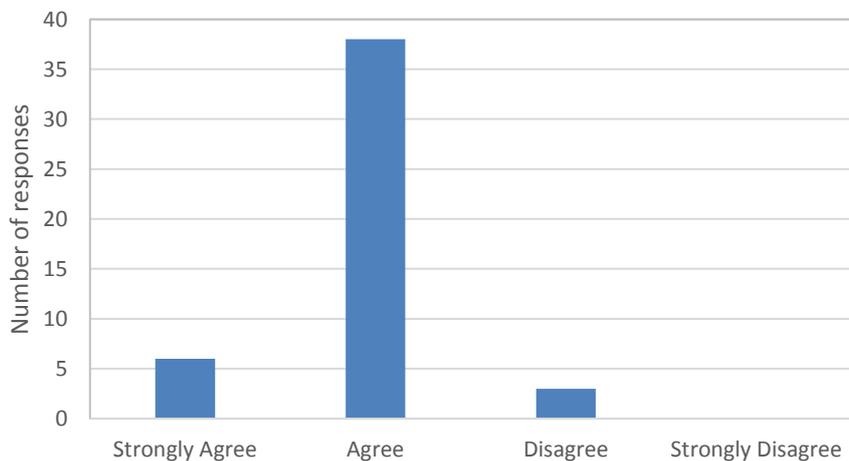
Q1 - Before the workshop - I had a good understanding of radiochemistry and nuclear chemistry.



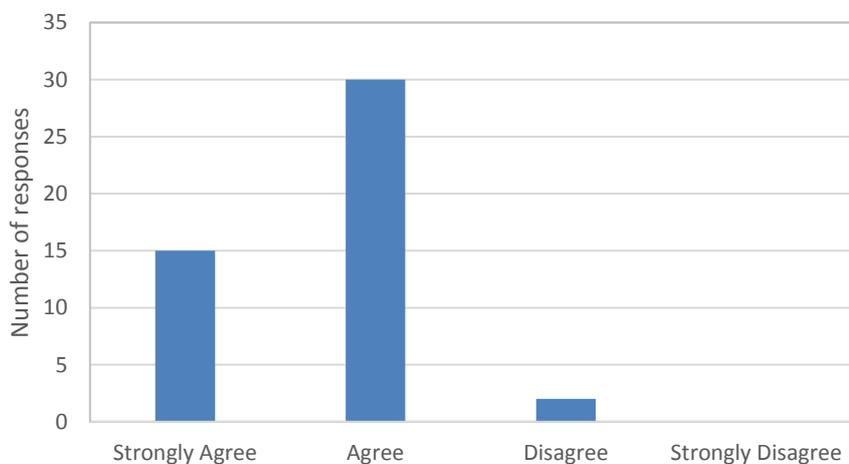
Q2 - After the workshop - I had a good understanding of radiochemistry and nuclear chemistry.



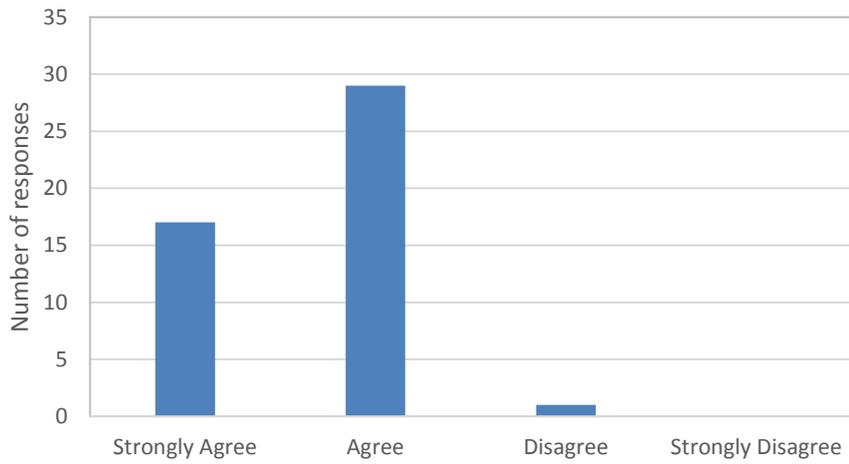
Q3 - The e-learning helped me prepare for the workshop.



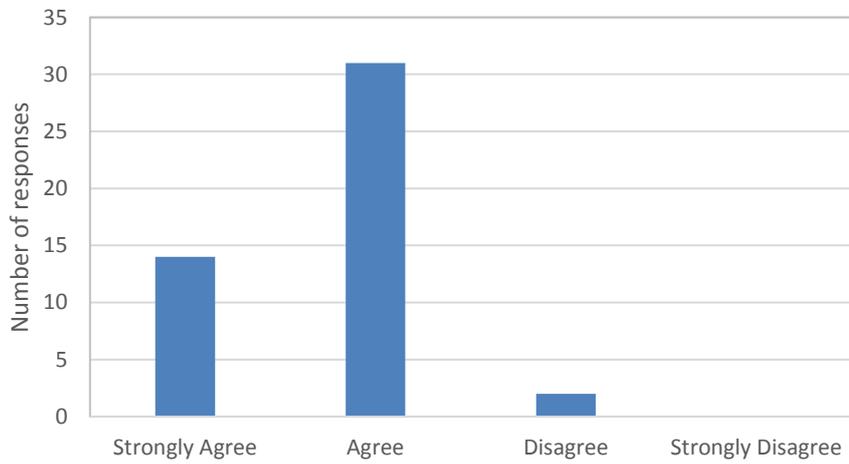
Q4 - I found the workshop interesting and engaging.



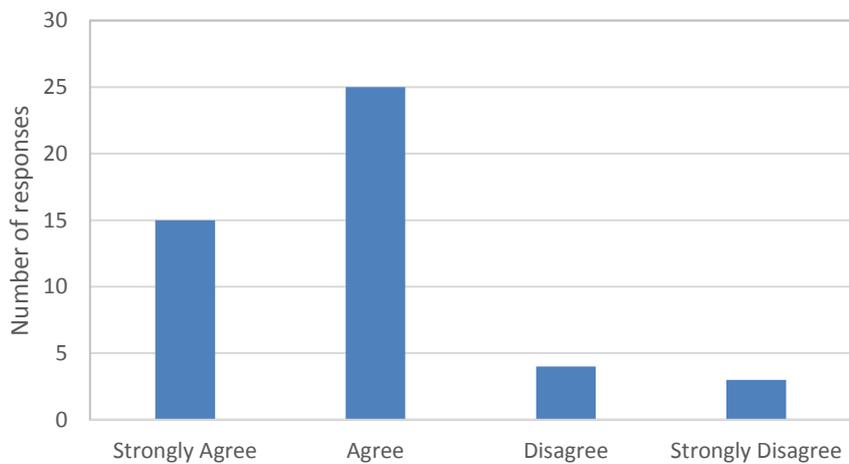
Q5 - I have gained new knowledge/skills from this workshop.



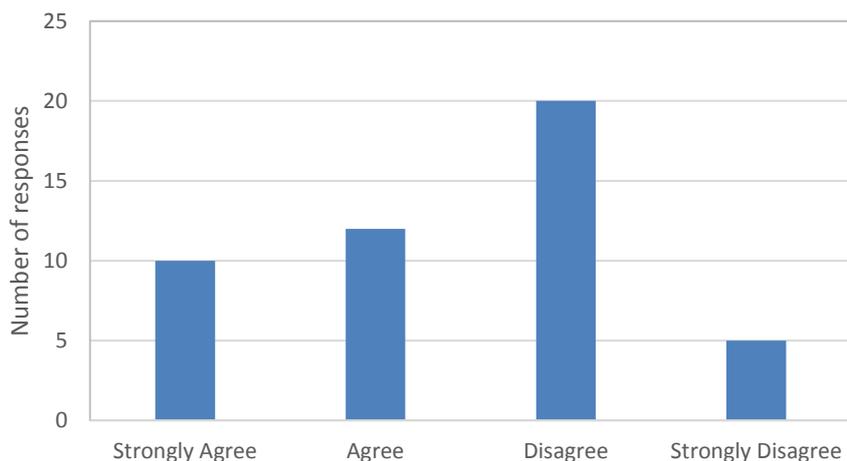
Q6 - I would like to do another activity like this.



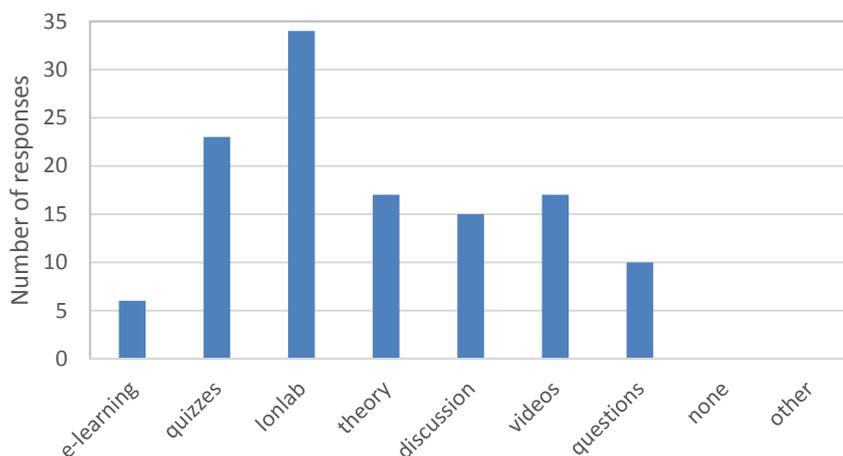
Q7 - I am interested in learning more about the subject covered in this activity.



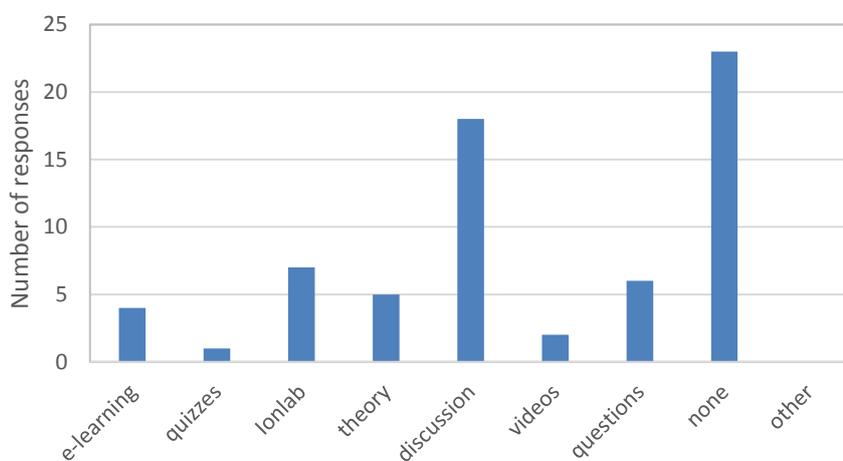
Q8 - This subject has made me consider a career related to chemistry or nuclear.



Q9 - My favourite part(s) of the activity is/are.



Q10 - My least favourite part(s) of the activity is/are.



Some students gave further written feedback, this has been summarised and is listed below. Written feedback was only received from three out of five schools. It is worth noting that some

workshops experienced technical difficulties in accessing the Ionlab experiment and using the school IT equipment.

- More information on further education and careers (e.g. leaflets, links to websites).
- Students generally liked the “day in the life” video. Students found it useful seeing what a normal day looked like for a chemist in the nuclear industry. Some students would prefer the video to go into more technical depth and some would prefer it to be more relaxed/personal.
- Student handouts could be more in sync with the presentation.
- Links to further information and reading on the subject.
- Some students would prefer a more interactive/hands-on workshop/experiment.
- Students found that there was a lot of repetition between the e-learning material and the in-class material.
- More detailed information on alpha, beta and gamma radiation.
- More information on how medical radioisotopes work in the body.
- Students would like a larger screen to see the experiment more clearly.

Overall, the student feedback is very positive. Before the workshop, 68% students did not have a good understanding of radiochemistry and nuclear chemistry; however, after the workshop all the students felt like they had a good understanding of the subject (55% agree, 45% strongly agree). Grouping “agree” and “strongly agree” responses together, 94% students found the e-learning helpful in preparing for the workshop, 96% found the workshop interesting and engaging, 98% students felt that they had gained new knowledge or skills, and 96% stated that they would like to do another activity like this. 85% students expressed an interest in learning more about the subject but only 47% of students would consider a career related to chemistry or nuclear.

Feedback from the June 2018 workshops showed that students like a range of learning styles (Figure 1). Using this feedback, NNL has tried to incorporate different teaching techniques into the e-learning and workshops (e.g. videos, quizzes) and this seems to have been well received with a relatively even distribution of “favourite activities”. Interestingly, 72% students placed Ionlab amongst their favourite activities which shows that there is a demand for Robolabs in the classroom. The least favourite activity was “discussion” with 38% voting for this, followed by “questions” (13%), Ionlab (15%) and theory (11%). However, 49% students responded “none” which suggests that the material was generally well received.

Based on the feedback, students find the teaching material interesting and informative. The workshop was successful in making more students aware of careers in nuclear chemistry and radiochemistry, whilst covering the school curriculum. There is currently too much repetition between the e-learning and workshop and there are some topics that the students would like to explore in more depth. Although the students enjoy the Ionlab, some students would like the workshop to be more interactive. Students would also like more information on careers and further education.

## 2.2 Teacher Feedback

Six chemistry teachers were present during the Ionlab workshops. Before the workshop, teachers were asked to review the e-learning material, however a small number of teachers experienced difficulties accessing the content. After the workshop, teachers were asked to respond to the following statements:

Q1 – The e-learning was pitched at the correct level.

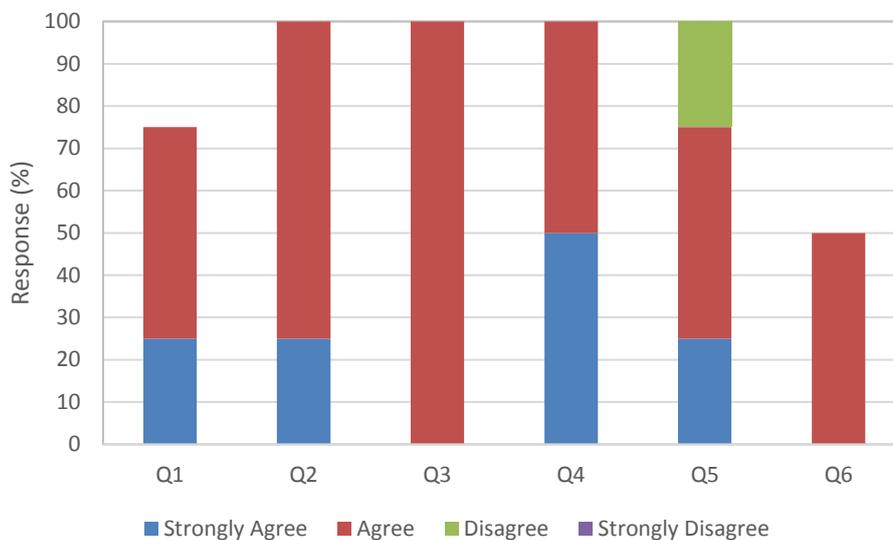
Q2 – The content of the workshop was pitched at the correct level.

Q3 – I can see how the content could support the school curriculum.

Q4 – I think robotic experiments are an interesting way to incorporate theories and practicals.

Q5 – I found the moodle (online teaching platform) easy to use.

Q6 – I would be comfortable using the online teaching material to run my own class.



**Figure 2: Teachers’ responses to e-learning and workshop survey.**

The teachers’ responses to these questions are shown in Figure 2, please note that not all teachers completed the survey and some questions were not answered. The feedback indicates that all teachers think that the content of the e-learning and workshop was pitched at the correct level and could support the school curriculum. The teachers also found the robotic experiments an interesting way to teach. Most of the teachers found the online teaching platform (Moodle) easy to use; however, one teacher could not access the webpage. The feedback indicates that teachers would feel comfortable using the material themselves although this is only based on two responses.

All of the teachers provided verbal feedback and this is summarised below:

- More activities to break up the talk.
- The students really enjoyed Kahoot (online quiz).
- Use a “fill in the gaps” activity sheet for the students to complete whilst the content is introduced.
- Liked the careers videos and how the ambassadors talked about their own backgrounds.
- One teacher was familiar with Moodle and thinks it’s a great platform but suggested that most teachers use Google Classroom.
- Discussion on video first.
- In case of technical problems affecting the interactive section of the session, it would be good to have a false program of pre-made videos with buttons to control (i.e. a simulated version).
- Really enjoyed the experiment and the Moodle platform.
- Would like to see more links to paper/TLC which students have already studied at GCSE.
- Ambassadors need to liaise directly with the school’s network team as they can assist better with any IT needs.

The written feedback indicates that the teachers are particularly interested in the further education and career information, which can be difficult to cover in class. Some teachers suggested that the

workshop needs more activities to break up the presentation. The IT difficulties encountered during some workshops may have been off-putting for some teachers and this risk needs to be removed to ensure uptake by teachers. Some consideration also needs to be given to making the material easy for high school teachers to use.

### 3 CONCLUSIONS

NNL has carried out five workshops with schools based in Cumbria and the North West of the United Kingdom in order to test the latest developments of the teaching material. In total, 47 students and 6 chemistry teachers took part in the Ionlab workshops.

Overall, the feedback from both students and teachers has been very positive. In terms of raising awareness of radiochemistry and nuclear chemistry, the workshops have been successful with 100% students stating that they had good understanding of the subjects after the workshop. 96% students found the workshop interesting and engaging, 98% students felt that they had gained new knowledge or skills and 96% stated that they would like to do another activity like this. However, further consideration needs to be given to inspiring the students into these careers, as only 47% students would consider a career related to chemistry or nuclear.

The teachers' feedback largely echoes the students' feedback; Robolabs are an interesting way of teaching, the content is good, pitched at the correct level and applicable to the curriculum. The teachers are particularly interested in the industrial applications and career aspects, which can be difficult to cover in class. Although the online Moodle platform was generally easy to use, it was suggested that teachers usually use another platform for e-learning.

The feedback from these workshops suggest that the high school teaching package will soon be ready for use, following some small modifications. The content of the e-learning and the in-class material needs to be reviewed to reduce the amount of repetition, whilst re-enforcing learning. The in-class material needs to incorporate more interactive or hands-on activities; this could be through more quizzes, "fill-in-the-gaps" sheets, etc. The University of Hannover is currently developing a "simulated" version of the Ionlab experiment and it is hoped that this will make the workshop more interactive, as students will be able to control the experiment individually or in small groups using laptops or tablets. Both the students and teachers would like more information on further education and careers in nuclear chemistry and radiochemistry. Some further consideration also needs to be given to making the material easy for high school teachers to use.

## 4 REFERENCES

1. W. Schulz, C. Fournier, J. Vahlbruch, C. Walther, „IonLab – a remote-controlled experiment for academic and vocational education and training”, *Radiochimica Acta*, Volume 104, Issue 10, Pages 743–748.
2. D1.4 Robolab School Workshops: Analysis of Student Feedback (03/08/2018)

## 5 APPENDIX

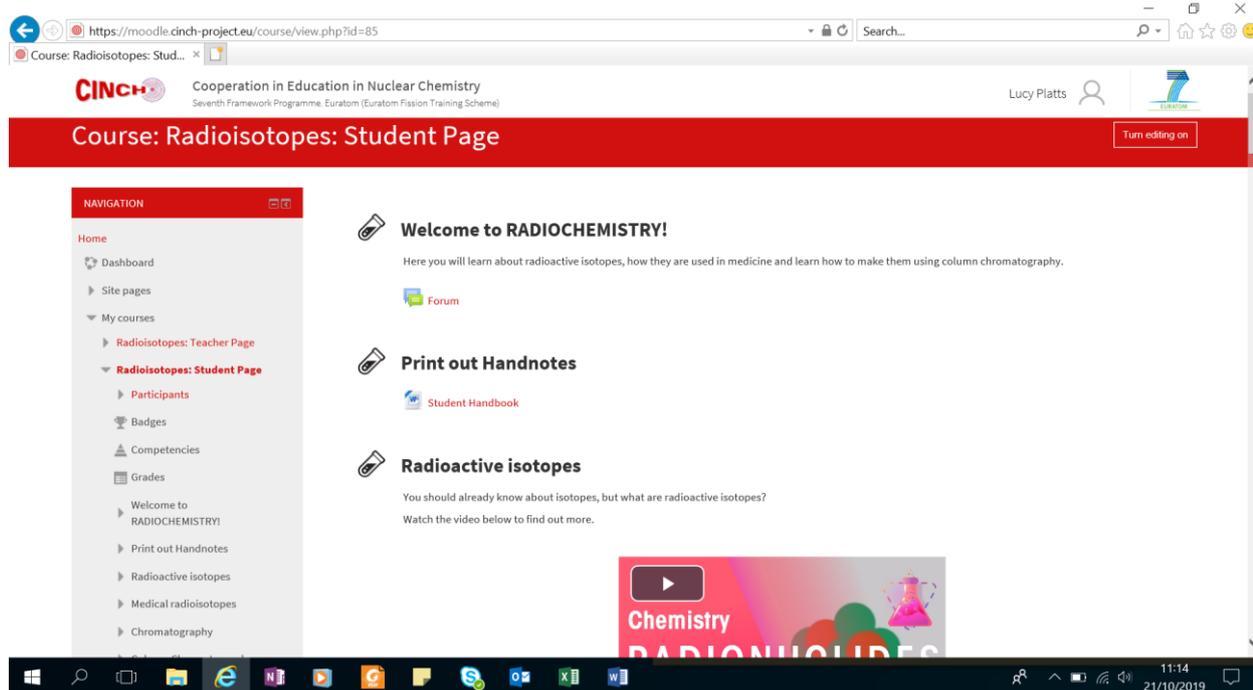


Figure A.1. Screenshot of Student Page on CINCH Moodle.

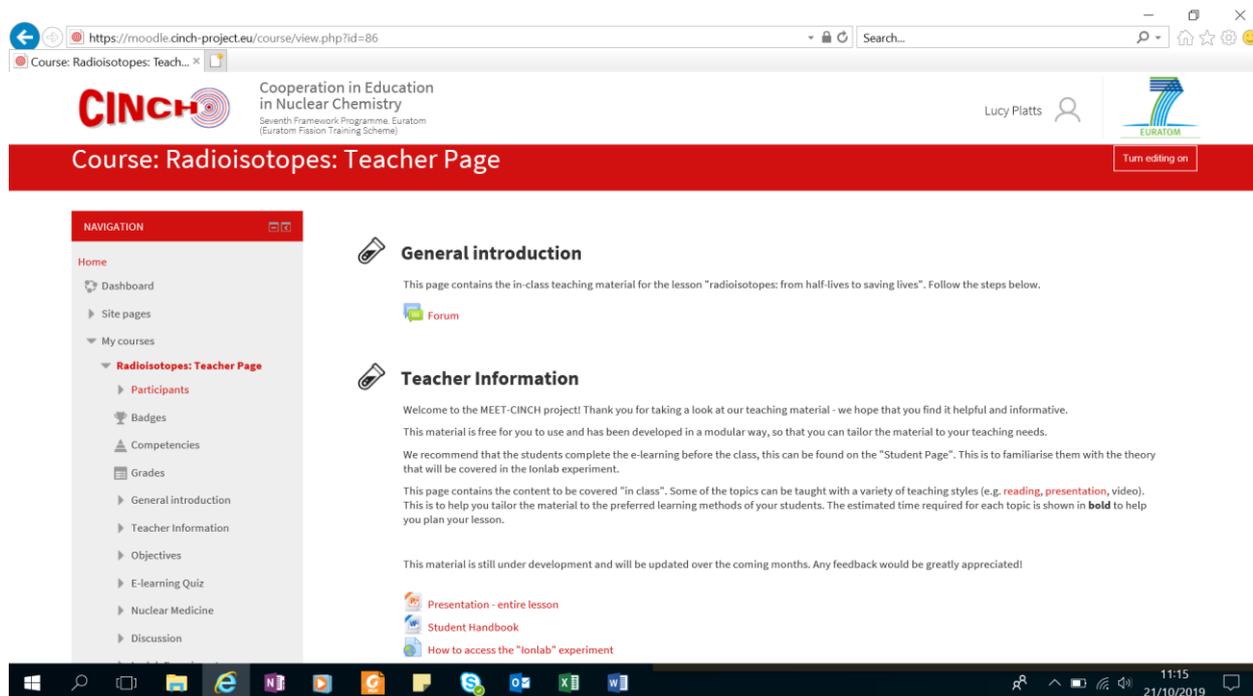


Figure A.2. Screenshot of Teacher Page on CINCH Moodle.