

Course outline and lesson plans for SSIBL teacher professional development (TPD) sessions

UCL Institute of Education, London, UK

Pre-service biology, chemistry and physics teachers in lower secondary school (11-14 year olds)

Overview course outline

Duration	One 1 hour and 3 two hour face-to-face workshop sessions and three independent tasks in school, in the context of a regular 36-week pre-service teacher (PST) training programme (three semesters).
Short summary	<p>This teacher professional development (TPD) programme is designed to develop PSTs' understanding of, skills and competence in teaching and learning through socio-scientific inquiry based learning (SSIBL). There are three pillars of SSIBL: socio-scientific issues (SSI), citizenship education (CE) and inquiry-based science education (IBSE). These are underpinned by the concepts of responsible research and innovation (RRI). The programme consists of a series of face-to-face workshops, online tasks and in-school (work place) tasks and is underpinned by cycles of reflection-on-action. The programme uses both formal (in-class) and non-formal (out-of-class) contexts and learning settings. There are two distinct phases of the programme: the introductory / orientation phase (autumn term), followed by the two-part practical teaching phase (spring and summer terms). As part of both phases, participants embed lower secondary national and school curriculum requirements (both content and Working Scientifically, from the English science National Curriculum, 2014) into SSIBL activities. Participants work on tasks individually and in school in collaboration with experienced science teacher-mentors. The TPD is structured through a model of teachers as researchers, as learners, as developers, as teachers and as reflective practitioners.</p>



Intended learning objectives of the TPD	<p>The pre-service teachers will be able to:</p> <p>O1. recognise and reflect upon experienced science teachers’ perceptions of the nature of, opportunities for and challenges of learning through practical inquiry, SSI and SSIBL in the lower secondary school curriculum;</p> <p>O2. foster open, questioning learning environments in school science, in order to promote students’ curiosity and imaginative thinking;</p> <p>O3. foster collaborative learning;</p> <p>O4. identify the main educational ideas underpinning SSIBL, in comparison with learning through SSI or IBSE, including citizenship and responsible research;</p> <p>O5. design SSIBL activities, including assessment for learning strategies, drawing both on existing and novel SSI and inquiry scenarios/contexts;</p> <p>O6. recognise and implement opportunities for teaching school students aspects of citizenship in SSIBL;</p> <p>O7. foster responsible and valid research approaches in the science classroom;</p> <p>O8. implement SSIBL activities in science classrooms in school placements;</p> <p>O9. evaluate and reflect upon the learning outcomes for students in SSIBL activities, and PSTs’ own progress with using SSIBL to promote student’s progress;</p> <p>O10. share and reflectively evaluate resources with peers on an online platform;</p> <p>O11. critically reflect on and plan for own future TPD needs in teaching inquiry and SSIBL within the Working Scientifically element of the National Curriculum (England)</p>
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Session no. / suggested timing	Duration	Main Activity /objective	Mode	TPD approach
Workshop 1 (early autumn semester)	1 h	<ul style="list-style-type: none"> • explore the nature of inquiry in science (O2,3,4) • undertake subject-specific (biology, chemistry, physics) inquiry activities, including learning in outdoor contexts (e.g. pollution monitoring in Central London) 	Face-to-face (F2F) Practical investigation Online research methods (available in main Lesson plans_UCLIOE):	<i>Teachers as learners</i>
Task 1 (early autumn semester)	Over 1 week in school	<ul style="list-style-type: none"> • research experienced science teachers’ perceptions about and teaching of inquiry, SSI and SSIBL (O1,4,6,7) • carry out research in placement schools: interview experienced science teachers and analyse curriculum requirements • write reflections on findings 	Work place School-based task: Task 1 - ‘Ideas about inquiry science’ (available in Handouts_UCLIOE)	<i>Teachers as developers</i>
Workshop 2 (early autumn semester)	2 h	<ul style="list-style-type: none"> • learning through SSI and collaborative learning (O3,4,6) • scaffolding discussion and argumentation using science and society contexts 	F2F Interactive activities (available in Lesson Plans_UCLIOE):	<i>Teachers as learners Teachers as developers</i>

Workshop 3 (mid autumn semester)	2 h	<ul style="list-style-type: none"> • learning through practical inquiry (O2,3,4) • designing subject-specific practical inquiries, promoting asking investigable questions linked to national curriculum requirements 	F2F Interactive activities (available in Lesson Plans_UCLIOE and Presentations_UCLIOE):	<i>Teachers as learners</i>
Workshop 3 (late autumn semester)	2 h	<ul style="list-style-type: none"> • developing open, questioning classroom skills (O2) • understanding SSIBL including citizenship (O4) • developing SSIBL planning and design skills (O5) • exploring citizenship aspects of SSIBL (O6) • eliciting authentic inquiry questions and SSIBL • promoting students asking authentic questions which could then be investigated • planning for responsible research or practical approaches as appropriate • mapping the controversies associated with consumerism and use of materials • exploring the science and issues associated with consumerism 	F2F Interactive activities (available in Lesson Plans_UCLIOE and Presentations_UCLIOE):	<i>Teachers as learners Teachers as researchers</i>
Tasks 2&3 (spring and summer semester)	<i>Over 1 month in schools in 2nd and 3rd semesters</i>	<ul style="list-style-type: none"> • designing, implementing and reflectively evaluating SSIBL activities in school placements (O1,5,6,7,8,9,10,11) • working collaboratively with experienced teacher-mentor(s) to create a SSIBL activity • where possible, teaching the SSIBL activity • writing a written reflective account of student's progress/PSTs' own learning/teaching experiences of SSIBL 	Work place School-based task: Tasks 2&3 - 'Designing and teaching SSIBL activities' (available in Handouts_UCLIOE)	<i>Teachers as learners Teachers as developers Teachers as teachers Teachers as reflective practitioners</i>



Lesson plans

Introductory Phase (autumn semester) Practical Phases (spring and summer semesters)

Timings	Workshop / Session Title	Description of suggested activities	Learning outcomes and how met
60 mins	Introductory workshop 1 -inquiry learning	<p>During the introductory session, the teacher educators introduce PSTs to various in various science inquiry activities in formal and informal settings.</p> <p>For example, the PSTs carry out pollution monitoring in Central London by conducting a survey of particulate pollution on trees lining a street near / not-near a busy road (available at http://fua.field-studies-council.org/teaching-resources.aspx)</p> <p>Ask questions such as:</p> <ul style="list-style-type: none"> -where would you cite your collections and explain your rationale? -what do you predict for the results? -what might explain your results? -what actions might you expect children to suggest for improving air quality in the street? <p>After the session, the PSTs complete two follow up activities:</p> <ul style="list-style-type: none"> -reading about a local Air Sensa citizen science project (available at http://www.airsensa.org/) which they are invited to explore with their school placement -supporting the university #UCLChemAirPoll (available online)project in London primary schools which is led by our chemistry department 	<p>Ask meaningful questions</p> <p>Follow an inquiry learning strategy (plan an approach, collect valid data, analyse and present data, draw valid conclusions)</p> <p>Raise awareness of citizen science projects and how to promote with school children</p> <p>Give feedback on planning to groups of undergraduate chemists going into schools to monitor levels of NO₂</p>



<p>60mins (15mins)</p> <p>(15mins)</p> <p>(30mins)</p>	<p>Workshop 2 -learning through SSI and collaborative learning</p>	<p>The teacher educator shows PSTs how to use concept cartoons to support students interrogating evidence and taking part in argumentation.</p> <p>The activity runs as follows:</p> <ul style="list-style-type: none"> -ask PSTs to work in groups of 4 -they all have a concept cartoon (various possible scenarios including scientific ideas which hold misconceptions as well as socio-scientific dilemmas) -they read the statements and decide which ones they agree or disagree with, and which children may agree or disagree with - the teacher educator outlines the process of argumentation and development of the necessary skills to reach consensus <p>Then the PSTs work in small groups, trialling and critiquing learning resources (eg Engaging science EU project (available at https://www.engagingscience.eu/en), identifying rules and routines for effective collaborative learning; PSTs complete a follow up activity by watching an online TPD on argumentation strategies (available at https://pstt.org.uk/resources). They plan and use a concept cartoon in a lesson.</p> <p><u>Follow-up activity</u></p> <p>PSTs write a reflection on the learning outcomes of the concept cartoon activity in school.</p>	<p>Gain confidence in unpicking evidence, taking a position, building an argument, considering the validity of evidence and data</p> <p>Record and recognise the importance of different perspectives on issues over time</p> <p>Plan and teach a decision-making activity in school</p>
<p>60mins (10mins)</p> <p>(20mins)</p> <p>(30mins)</p>	<p>Workshop 3 -practical inquiry</p>	<p>The teacher educator gives a presentation on strategies for practical inquiry (available at https://www.ase.org.uk/professional-development/getting-practical/)</p> <p>PSTs work in small group activities in specialist science subjects to design practical inquiries.</p> <p>The teacher educator supports students asking questions, then re-focussing to generate investigable questions linked to national curriculum (NC) statements (content and process in the English National Curriculum for science Working Scientifically (available at</p>	<p>Ask authentic questions and re-focus to investigable questions</p> <p>Unpick steps in practical inquiry</p>



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		<p>https://www.gov.uk/government/publications/national-curriculum-in-england-science-programmes-of-study/national-curriculum-in-england-science-programmes-of-study</p> <p>Encourage PSTs to plan how to:</p> <ul style="list-style-type: none"> -initially open up and then guide inquiry -plan 'typical' practical inquiries into eg osmosis in potatoes, rates of reaction, current flow in simple circuits which support students gaining confidence in asking their own authentic questions, planning strategies and thinking about the outcomes of inquiries 	Plan an inquiry strategy to answer chosen question(s)
Over 1 week	Task 1	<p>Work Place Task in the PST's placement school which uses semi-structured-interview guidelines (available in Resources as Handouts_UCLIOE)</p> <p>PSTs interview experienced science teachers about their beliefs and actual practices in inquiry science and whether they use SSI as teaching and learning approaches. This is so the PSTs can situate the TPD within current practices.</p> <p>The PSTs also analyse National Curriculum (NC) requirements to understand how inquiry is contextualised in school science.</p> <p>They analyse and write reflections on findings to bring into TPD Workshop 3</p>	<p>Adopt interview approach</p> <p>Carry out interviews in school</p> <p>Link research findings to curriculum statements</p> <p>Write personal reflections on findings to share in Workshop 3</p>
120mins (15mins) (15mins) (30mins)	Workshop 3 -science for and with society: The big challenges of the 21 st century	<p>The teacher educator gives a presentation on eliciting inquiry questions and teaching and learning strategies for socio-scientific inquiry based learning. The slide presentation for Workshop 3 is available in Resources as Presentations_UCLIOE.</p> <p>PSTs share research findings from school (Task 1) and review the requirements of the NC.</p> <p>Then the teacher educator introduces the 'ask the picture or object a question' activity (individual and small group work) using the image of a SMART phone. The question is:</p> <ul style="list-style-type: none"> -how many elements are in a mobile phone? 	<p>Recognise the importance of learning through inquiry as well as science with and for society</p> <p>Ask meaningful questions</p>



(30mins)	<p>-who loses and who gains from the manufacture of SMART phones is the overarching question from which inquiry questions can emerge. Encourage the PSTs to focus on embedding this activity in the ‘typical’ curriculum so that SSIBL thinking starts to become part of how we learn science.</p>	<p>Recognise the implications and impacts of scientific and technological developments on society and the environment</p>
(30mins)	<p>Introduce the 3 phase of a SSIBL activity: asking authentic questions, enaction and action, and the 3 pillars of SSIBL: socio-scientific issues, citizenship education and inquiry learning.</p> <p>The teacher educator initiates the ‘mystery box’ activity which is designed to promote students asking their own questions about the objects in the box and making links between them.</p> <p>The PSTs then map the controversies associated with consumerism by exploring environmental social, economic, political, ethical issues associated with producing and consuming Kinder Eggs (adapted from Centre for Alternative Technology activity (also available at http://learning.cat.org.uk/en/resources), using A3 paper. They present their ideas to each other.</p> <p>Encourage PSTs to think about how to promote students asking authentic questions which can then be investigated using SSIBL approaches.</p> <p>The teacher educator runs through examples of how to foster a classroom environment which welcomes students’ own questions. Then follows a presentation on the aluminium story, highlighting aspects of science with and for society, which the PSTs can work through as a follow-on activity.</p> <p>In the final phase of the workshop, the teacher educator supports PSTs understanding of the SSIBL approach by sharing examples of SSIBL activities designed and taught by previous PSTs (eg why do teenagers smoke?).</p> <p>The PSTs explore the authentic outcomes, personal actions and behaviours resulting from SSIBL</p>	<p>Explain the SSIBL approach and recognise the 3 pillars as component of SSIBL</p> <p>Identify a range of issues associated with impacts of mining, production and use of materials from the Earth Link science knowledge to the issues</p> <p>Extend skills and gain confidence in promoting inquiry learning into SSIBL strategies</p> <p>To be watched post-session</p> <p>Analyse example SSIBL activities</p> <p>Begin to generate ideas for a designing a SSIBL activity</p>

		The teacher educator establishes the strategy for planning and teaching a SSIBL activity in school with the PSTs	
Over 1 month in two placement schools in spring and summer semesters	Tasks 2 and 3	In these Work Place tasks , the PSTs design and teach SSIBL activities and lessons in their teaching placement schools with 11-14 year old students. They work collaboratively with experienced teacher-mentors to create an appropriate SSIBL activity, including assessment for learning. Tasks 2&3 are available in Resources as Handouts_UCLIOE Where possible, the PSTs teach the SSIBL activity and write a written reflective account of their student’s progress/PSTs’ own learning/teaching experiences of SSIBL	Plan at least two high quality SSIBL activities and where possible teach the activities in two school contexts PSTs build confidence in teaching through SSIBL within science lessons and in longer sequences of lessons, embedding aspects of SSIBL within the curriculum

References

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