The Teacher’s Role in Educational Innovation

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The Teacher’s Role in Educational Innovation

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The Teacher’s Role in Educational Innovation

This issue of eLearning Papers deals with the teacher’s role in educational innovation. By focusing on the teacher’s role, we wish to acknowledge and further explore in what ways and with which means teachers can apply their expertise in the design of new teaching practices; ICT-based teaching, learning and materials; networked learning; etc.

The proliferation of technology enhanced learning solutions has not obscured a simple truth: few things are more important to students’ learning achievements than the quality of their teaching and learning experiences, and no-one knows better than teachers how learning takes place in practice. Other innovations may contribute fractionally to improved student learning, but according to John Hattie’s Visible Learning (Hattie, 2009), which synthesizes over 800 meta-analyses of interventions in student learning to rank them by effect size, those related to teacher-student or student-student interactions are most likely to be transformational. Yet often when edupreneurs, policymakers and researchers imagine the future of school, they focus on digital textbooks, self-directed environments, and learning games. Teachers, schools and the collaboration with peer-students are too often bypassed.

We know that this type of innovation tends to be collective - teachers working with peers, principals and as part of the school community. From research we know that teachers’ innovations arise in informal settings, together with colleagues and other supporting people, and, in addition, the role of an encouraging principal is essential (e.g., OECD, 2014).

For this issue, we invited papers which would inspire more teacher-led innovations in Europe. We present three in-depth articles, four reports from work in the field (short format), and finally two design papers. The papers deal with the topic in various ways, and we present papers that look into the work of teachers in collaborative innovation, papers that deal with the topic of innovation in education, and papers which present the results of an innovation. Both technological, psychological and educational aspects of teacher led innovation are presented and discussed, and in this way the papers in this issue represent a wide range of perspectives of the topic.

In the first paper, Boschman et al. present an analysis of the knowledge and beliefs of a group of teachers and the impact of this on their collaboration. Hunter et al. deal with the impact of teacher inquiry on the process of carrying out teacher led innovations in the teachers’ own classrooms, and the paper provides a detailed insight into the role teacher inquiry may play in a broader approach to professional development. In the third paper, Chelioti et al. present yet another perspective on the issue of developing teachers’ and schools’ capacity for teacher led innovation, namely by looking at how teacher networks may serve as an alternative forum for learning. The paper presents the concept of Open Discovery Space and discusses the both obstacles to change, change management strategies, and successful examples of organisational change.

In the first of the four reports from the field, Lappalainen presents a case study of a pedagogic endeavour aiming to integrate degree studies into working life skilling. In the second report, Garreta Domingo et al. present the HANDSON MOOC as an approach to continued professional development. The article by Nkuyubwatsi et al. introduces the Open Scholars Network, located in Rwanda, and the role of the network in increasing accessibility to higher education for underprivileged learners in Rwanda. Finally, Burden and Jones present examples of innovative use of mobile technologies in teacher education across Europe in a quest for transformation.
This issue also presents two design papers. In the first one, Okada et al. present the first findings from European project ENGAGE, where teachers integrate dilemma lessons into science teaching. Analysis shows that among 3500 teachers, 70 different strategies are shared on how to engage students with dilemma materials. The second design paper deals with game-based learning and its potential for renewing education. Nousiainen et al. present ways in which games-based pedagogy can be used in teaching and include guidelines for teachers on how to facilitate this process.

As the recent frenzy about the OECD report on students, computers, and learning reminds us - no matter how good the technology, the curriculum or the policy, the defining factor in any educational experience is the interaction between teacher and student. This issue celebrates those teachers who are leading the way to better education.

Marianne Georgsen, VIA Media and Learning; VIA University College, Aarhus (Denmark)
Liisa Iломäki, Technology in Education Research Group (TEdu), Institute of Behavioural Sciences, University of Helsinki (Finland)
Alex Beard, Teach for All (United Kingdom)
Yishay Mor, eLearning Papers, Editor in Chief
Tapio Koskinen, eLearning Papers, Director of the Editorial Board
Teacher design knowledge and beliefs for technology enhanced learning materials in early literacy: Four portraits

Teacher engagement in the design of technology-rich learning material is beneficial to teacher learning and may create a sense of ownership, both of which are conducive to bringing about innovation with technology. During collaborative design, teachers draw on various types of knowledge and beliefs: know-what (facts, information); know-why (principles, beliefs) and know-how (ways to shape learning materials and activities). The goal of the present study was to understand the nature of individual teacher contributions during the collaborative design of learning materials and activities for early literacy. Through interviews, teacher knowledge and beliefs related to use of technology for early literacy were investigated. Thereafter, teachers collaboratively designed learning materials and activities for use with PictoPal (a technology-rich environment for early literacy). Analysis of design talk that occurred during the design of PictoPal resources showed that teachers differ in the kinds of design knowledge they explicate during design. Of the four teachers, two teachers were inclined mostly to express know-how, one teacher proportionally expressed more know-what, and one teacher more know-why. Given the variety in knowledge and beliefs among teachers, practical implications for supporting such diversity during collaborative design are discussed.

1. Introduction

Successful and sustained implementation of innovation in education succeeds or fails with the commitment of teachers (Clandinin & Connelly, 1992). While some teachers may choose to innovate of their own accord, many feel compelled to do so while tackling the complex challenge of translating abstract curricular goals into concrete learning materials and activities. For most, recognizing how affordances of technology could be used as part of such resources is an even greater challenge. The active involvement of teachers in determining the nature and content of innovation contributes to its ultimate success (Penuel, Fishman, Yamaguchi, & Gallagher, 2007).

Few teachers innovate with technology in complete isolation. Though the frequency and intensity varies greatly, most teachers seek inspiration, guidance or support through collaboration with immediate or distant colleagues. Increasingly, and especially for technological innovation, teachers work together in teacher design teams (TDTs). Implementation of technology in education has a better chance of success when teachers are engaged in TDTs (Huizinga, Handelzalts, Nieveen, & Voogt, 2014). In part, this is because participation in design teams contributes to a sense of ownership, which supports the
Successful TDT work depends largely on teachers reaching a shared vision (Huizinga, 2014) and communicating well with each other (Handelzalts, 2009) as well as procedural support (Albashiry, Voogt, & Pieters, 2015). Previous studies have examined closely how TDTs function as groups (Boschman, McKenney, Pieters, & Voogt, in press; Boschman, McKenney, & Voogt, 2014, 2015). This study seeks to understand how individual teacher contributions shape the shared vision and the technology enhanced learning materials that are designed. It portrays how teachers use their knowledge and offers potential anchor-points for supporting them.

2. Conceptual underpinnings

For decades, it has been accepted that teacher knowledge and beliefs underlie teaching practices (Verloop, Van Driel, & Meijer, 2001). Teachers’ knowledge and beliefs are intertwined (Pajares, 1992), and they are used not only in the classroom, but also when teachers design materials, lessons and activities. Research has shown that teachers draw on their own private understandings as they design technology-enhanced learning, and that this can influence technology integration practices (Churchill, 2006).

Shulman (1987, p. 14), has long argued that reform and innovation in teaching must take into account how teachers use the knowledge base of the profession. He discusses the process of pedagogical reasoning, which “... involve[s] a cycle through the activities of comprehension, transformation, instruction, evaluation, and reflection.” Tempering views that focus on specific behaviours or processes, the concept of pedagogical reasoning emphasizes the intellectual basis for teaching performance. Accordingly, to understand and support the professional development of those participating in TDTs, investigation is warranted into the knowledge shared and used by teachers in design.

Looking specifically at the design of technology enhanced learning, McKenney, Kali, Markauskaite and Voogt (2015), describe different kinds of knowledge and beliefs that underpin teacher abilities to ‘engage skilfully in design’ (p. 3). Three types are particularly relevant to this study, which seeks to understand how individual knowledge and beliefs contribute to collaboratively designed technology resources for early literacy: know-what, know-why, and know-how. Know-what refers to a teachers’ fundamental knowledge base, which consists of conceptual knowledge and facts such as subject-matter content and pedagogical theories. Know-why pertains to a teacher’s knowledge and beliefs about principles of learning and teaching. Know-how is a teacher’s skill to produce what is needed and can include learning materials, instruction or classroom management. This last category can include design thinking1.

The knowledge that teachers have and use becomes visible during discourse with colleagues. When teachers replay previous experiences and rehearse future ones, they involve one another in sense-making through emotional and cognitive engagement (Horn, 2010). By investigating TDT talk, we can gain insight into the kinds of knowledge teachers draw on while generating ideas, weighing alternatives, mapping the innovation, discussing potential (desired and undesired) consequences and planning for enactment. TDT conversations during the creation of technology-enhanced learning opportunities provide windows into how teachers share and use their own knowledge when innovating with technology. Thus, this study was undertaken to investigate: What kinds of design knowledge and beliefs (know-what, know-why, know-how) do individual teachers have and use during collaborative design of instructional material to be used in a technology enhanced learning environment for early literacy?

Method

A multiple case-study approach was employed with four kindergarten teachers in the Netherlands. Teachers were the unit of analysis. Data representing teacher knowledge and beliefs were collected through interviews and analysis of their contributions to design team conversations.

3. Participants

Four teachers from one school voluntarily participated. They responded to an open call for kindergarten teachers interested in developing their own classroom innovation for early literacy, using an existing learning environment called PictoPal. The teachers explained that they volunteered because they wanted to learn about and develop new ways of integrating technology in kindergarten. Within the framework of the PictoPal learning

1 Design thinking includes cognition about the design process itself, including efforts to understand, observe, take points of view, ideate, prototype and test. The design thinking mindset includes: human-centeredness, empathy, mindfulness of process, culture of prototyping, a “show don’t tell” approach, bias toward action, and radical collaboration.
environment, the teachers were encouraged to design learning activities as they saw fit. As such, the innovation was teacher-led and researcher-supported. One teacher (Henriette) was formally the lead kindergarten teacher. She acted as liaison and coordinated with the researcher to arrange introductions and workshops that could also be attended by three other teachers (Esther, Gees and Sylvia). The teachers knew each other well and had worked together for several years. The team of teachers is considered representative of other teams of kindergarten teachers in the Netherlands.

4. Procedures

Teachers’ individual design knowledge was first explored using a semi-structured interview. Following these interviews, the four teachers worked together in a TDT to create a set of learning materials for use in their own classrooms. Because examples were available and the basic structure of the learning environment was already determined, their work could be described as adoption and adaptation. Over the course of three design workshops, they created instructional materials for PictoPal. PictoPal is a learning environment featuring on- and off-computer activities to develop understanding of the functions of print (Cviko, McKenney, & Voogt, 2014). With PictoPal, teachers design activities around a specific theme (in this case, they chose ‘farm’). Using the on-computer activities designed by the teachers, children construct written products with the aid of the computer. Their prints are then used in off-computer classroom applications (also designed by the teachers). The workshops were facilitated by a researcher (Facilitator, F), monitoring the design process, and an early literacy expert (EL), offering content expertise. The EL was an accomplished teacher trainer in the area of early literacy and currently held a teaching position at a school for special educational needs.

5. Instruments & Analysis

The interviews and design conversations were transcribed. Thereafter, qualitative analysis began deductively (Miles & Huberman, 1994), by looking for evidence of different kinds of knowledge described previously (know-what, know-why, know-how). In the interviews, this was done for each response, and summaries were generated. This resulted in portraits of the knowledge and beliefs each person had articulated.

For the design conversations, each speaking turn was coded as relating to know-what, know-why, know-how (or none). Then, the contributions per knowledge type were counted. To ensure quality in the analysis, the interview summaries as well as the coded conversations were discussed in the research team until consensus was reached.

Results

6. Henriette

Interview data

At the start of the interview, Henriette defined early literacy: “It means that children become aware that letters are not abstract but are meaningful.” For Henriette, early literacy means learning to understand the link between sounds and letters. She considers this development as: “... an exploration: ‘hey, but if you remove the first sound and you replace it with another sound, then it becomes...’ and that ‘expedition’, is just so wonderful to witness in kindergartners” (know-what). The appropriate way to teach early literacy in kindergarten is play-related and exploratory in order for children to make discoveries about literacy (know-why). The zone of proximal development, as is implicitly mentioned here, is also specified further: “You keep searching for the next step, and if they get it, then reading will develop in and out of itself.” Furthermore, Henriette mentions invented spelling (children writing words using the rudimentary knowledge of spelling conventions) as appropriate (know-why); developing skills for listening and whenever necessary call in the aid of a speech therapist (know-how).

Henriette’s repertoire for action (know-how) is extant and aligns with knowing what, especially in specifying what kind of activities can be conducted to stimulate awareness of the meaningfulness of letters: “[reacting on how learning to write should look like] it’s okay with junior kindergartners to... it may just be scribbles, drawings... as long as they think ‘it’s my grocery list.” Next to writing she also mentions book reading activities, activities that involve telling stories to each other and listening. Book reading was also used as a learning situation that could directly be linked to writing activities: “reading occurs in an interactive way.” All children’s activities are accompanied with writing: “what are you building? A garage, well let’s write that down.” Henriette expressed curiosity in learning how to use ICT effectively and showed a positive attitude towards ICT in kindergarten education.
Design talk

The results of the count of Henriette’s utterances showed that 24 (15%) individual utterances were coded as know-what; 34 (21%) as know-why and 101 (64%) as know-how. Compared to her team members, Henriette provided the most contributions (159 utterances) to the conversation. She often initiated new conversations and also provided the most reactions to the language expert. Furthermore, Henriette was the team leader of the kindergarten team.

Know-what. Understanding what early literacy means as well as explaining reading-related concepts is explicated as know-what. For instance, in response to F’s opening question (“What do you think is important in early literacy education?”), Henriette stated: “Early literacy means, functional writing, scribbles can be letters...”. During the remaining part of the first workshop, Henriette often was the first to respond to either the facilitator or the language expert. For instance, Henriette tells the early literacy expert that all kindergarten teachers at her school “strongly address phonological awareness”. In another part of workshop three, she recognizes invented spelling (children write words according to the way they understand spelling rules) as appropriate, especially when done by the children who are more developed in early literacy. She envisions them using PictoPal by stating: “You would really have to listen carefully to the sounds” (know-what). This last statement differs from the other two statements made earlier. Functional writing and phonological awareness are not followed by an explanation of what these concepts mean, in contrast invented spelling is explained and underlies one of the decisions in PictoPal: children may use their own way of writing a word to explore the link between sounds and words.

Know-why. During the first workshop she states: “You make use of the zone of proximal development.” This remark was in response to Gees who tells that teachers monitor the development of children. Henriette’s remark is part of a larger episode in which all teachers share their beliefs about early literacy education. “You try to enact the real world as much as possible...we go to a ‘store’... making it really meaningful for children.” Also in the first workshop she repeatedly states that writing activities should be meaningful. Henriette responds to a video-vignette: “...what’s the use of that? You might as well put hieroglyphs there.” To her, when children write a word, they should be able to understand what they write. Furthermore as she also adds, children may recognize words. “Good sentences, for me that’s really important” Also, in response to the early literacy expert mentioning the appropriateness of using articles with verbs she repeats by stating: “It’s really good to train this immediately, I guess?” (see Figure 1). Also, know-why is expressed when Henriette clearly sees that the affordance of PictoPal not on training the sound-letter link, she states: “This is not going to replace our phonological awareness. PictoPal addresses a different goal, and should be set up as such.”

Know-how. Most of Henriette’s contributions pertain to Know-How: various words and categories of words regarding the theme ‘Farm’ (the central theme of the design activities). She mentions all kinds of written material such as a mind-map of words, a small list, and a letter as being the appropriate written products children will work on. Third, when discussing particularities of the letter, Henriette proposes various kinds of sentences (“I am a horse, or a...” “I give, milk or eggs”). Finally, she is also very active in proposing activities to be done with the written product, like making a drawing with a sentence or actually visiting the farm and reading the lower-case containing an informative question: “Can I pet the sheep?”.

7. Gees

Interview data

Similar to Henriette, Gees defined early literacy as becoming aware of the meaning of letters. She also explains: “...children
grow up in a literacy rich environment, starting at very young age, everything in their environment is with letters, so it’s very meaningful for children” (know-what). In contrast to Henriette, Gees does not provide a rich description of early literacy, rather she states: “… that these can be letters and that these can be used to make words (know-what). And early on, you may say: “just draw it, a message, letter or something like that” (know-how). Gees explains what she does to stimulate early literacy but also explains how she thinks early literacy develops: “Just see how they engage with it. Do they write, at some point they start writing their own words, or they’ll ask things, and by breaking words down to individual sounds and putting them back together” (know-why). Finally, Gees provides detailed accounts of various activities regarding writing letters, making written objects, writing ones’ own name (know-how). For example she states: “this morning we did a game with the letter ‘r’ from ‘rug’ and children had to search all sorts of other objects with the letter ‘r’.” Also, she explains how she writes down words that children are interested in learning about. Gees expresses curiosity in effective ICT use and furthermore expresses a positive attitude towards ICT in kindergarten.

Design talk

The results of Gees showed that 15 (19%) individual utterances were coded as know-what; 9 (11%) as know-why; and 56 (70%) as know-how. Gees provided less input to the conversation (81 utterances) than Henriette and Esther, but more than Sylvia.

Know-What. Know-what reflects two topics: first, Gees reminds the other three teachers that during the time-period in which PictoPal is implemented, ‘The farm’ is the theme that is central to all learning activities in both kindergarten groups. This theme was established earlier that year by a committee of which Gees was one of the members. At the end of workshop 1, Gees is the one to mention this to all other teachers. During the actual design, Gees and Henriette both brainstorm on categories of words that could be meaningful in the theme ‘Farm’. For instance: “Machines of the...how do you call that.” And “…crops that grow on the pastures.”

Know-Why. Gees states: “We have to monitor the development”, also she mentions on writing activities: “sometimes they [children] want the correct word. You have to write that down.” During design, she first poses the question whether to use capitals or not. She prefers not to, as she mentions this being the standard at their school (see Figure 2). Second, in response to Henriette, she confirms that pictograms support vocabulary development. Third, she proposes that a screen for making a list should be divided into two: one depicting words the other, depicting a corresponding Pictogram. The reason being, that this would be much more effective in lay-out. However, this is not being taken up by the other teachers (see Figure 2).

Know-How. During workshop 1, after an initial look at PictoPal, Gees asks: “And do we need parents to help children with these activities?” F suggests to do so. The team decides to try and find parents for computer support. Also Know-How is expressed by Gees by proposing various activities like making a letter for the farmer, but also by discussing how the letter is actually being used on a farm, how children learn how to pose a question (before actually writing the letter)(Figure 2). Second, she also expresses how various written products can be used in subsequent off-computer activities.

8. Esther

Interview data

Similar to Henriette and Gees, Esther also defines early literacy as becoming aware of the meaning of letters (know-what). Esther furthermore explains differences between junior and senior kindergartners in the goals that each of them has to attain. “At the end of junior kindergarten, the goal is to write one’s own name, at the end of senior kindergarten, they have to write their own name, that of a friend, mummy, daddy” (know-what).
On what is appropriate practice in early literacy, Esther explains: “especially by creating a safe environment in which children will talk” Also, in such an environment, the zone of proximal development is addressed: “Do not present children with something they are not ready for, you should always keep that in mind I think” (know-why).

Like Henriette and Gees, Esther also provides example reading activities, writing activities and listening activities (know-how). Some examples to illustrate this: “in the ‘spring-book’ they write words that are written on wildcards. And we have a ‘letter-table’, which is there when they start writing.” “Often, children will come to you “miss, can you write this down for me?” then I write it down and then they may copy this. Finally, she also explains that she uses ICT for early literacy. “I really don’t have a goal. We have all kinds of activities, children may just pick one at random, for instance ‘Vocabulary’ or ‘Treasure Chest’ (both are common Dutch early literacy related software applications).

Similar to the other teachers, Esther also shows a positive attitude towards ICT.

Know-What. Know-what is expressed by explaining that early literacy means engaging children in all sorts of writing activities. Also she mentions that children make discoveries about written material. Furthermore, know-what is also expressed when discussing the theme of PictoPal with Gees.

Know-Why. Esther stresses the zone of proximal development: “I find it important that early literacy development should occur by itself. If we sit a child down and tell him, you have to write this letter, that does not stem from their own fantasy.” Second, Esther acknowledges the support from the early literacy expert and adds: “Yeah, it’s also how you would do this [using an article] in spoken language.” Third, in response to Gees, Esther also provides reasons to use lower-case letters. Fourth, when discussing the goal of PictoPal, she also concludes: “But this is also for vocabulary development!” Which is agreed upon by the other teachers and the early literacy expert as well. Finally, Esther also explicates know-why when she stresses the need for children to write proper sentences when using PictoPal (see Figure 3).

Know-How. Similar to Henriette and Gees, Know-How is expressed when discussing various activities on the computer, words and lay-out of the computer screen. However, Esther provides most of the contributions to the actual design of PictoPal. Also, she frequently makes most of the initial proposals for certain parts of PictoPal. For instance, she is the first one to propose making a letter (which later on is planned to be used during an actual visit to a farm). Also, Esther expresses know-how as: what letter to be written by children, what kind of sentences and words, and the letter is used in play. Finally, Esther repeatedly finds words and sentences that pertain to the theme, like kind of animals and properties of animals (a cow provides milk). When discussing letters, she often comes up with various sentences and parts of sentences (see Figure 3).

9. Sylvia

Interview data

Like the other three teachers, Sylvia defines early literacy as becoming aware of the meaning of letters as is expressed by her statement: “Children start with scribbles, they see examples and start imitating, grocery lists and it starts with small drawings and ultimately they become aware, like ‘hey, these are actually letters and then they start writing.” Ultimately they make a discovery: “hey, there’s actually something written up there” (know-what).
Also, similar to the other three teachers, Sylvia states the importance of building a learning environment that engages children in writing. She states: “it’s important that it’s really alive.” Similar to Esther, Sylvia also stresses the importance of a safe environment: “safety is the first basis.” “Soothing, providing compliments, that a child thinks ‘I can do it!’” (know-why). As with all three other teachers, Sylvia expresses a positive attitude towards ICT and even explains why she does not use ICT in her teaching of early literacy and how much she resents this. First, she mentions the lack of an interactive whiteboard: “Right now, you use one computer in front of an entire group, half of them can’t see it, and if you have an interactive whiteboard, you can do more… I think we are getting them though” (know-how). She also thinks ICT is valuable: “…it’s valuable for them. Also when they play games, they will learn some basic skills.”

Sylvia mentions learning-activities (know-how) similar to all three other teachers, for instance: “We use word-cards, writing corner”.

**Design talk**

The results of Sylvia showed that 7 (11%) individual utterances were coded as know-what; 18 (33%) as know-why and 32 (56%) as know-how. Compared to the other teachers relatively many utterances were coded as know-why. Sylvia provided the least input to the conversations (57 utterances).

**Know-What.** Utterances by Sylvia coded as know-what only were made in response to Gees about the theme.

**Know-Why.** Sylvia is very detailed in providing reasons for how she teaches early literacy. On the zone of proximal development she explains: “Keep going up a step” and “especially by letting it come out of themselves.” Also, in response to Gees (sometimes children want to write a word properly) Sylvia states: “but then they would ask for it.” Also, she often provides reasons on other teachers’ comments. For instance Esther states: “…some children were writing a flag, and then you go like ‘Netherlands’, what’s the first letter, and that one, we write down.” Sylvia comments: “Then it’s more meaningful to them.” During design, similar to the other teachers, Sylvia stresses the importance of proper sentence building, as she provides a reason: “You are an example” “they have to be good [sentence]”. Finally, she makes an interjection, on a proposal to include an exercise that will involve linking male and female versions of animals (a mare and a stallion). She states: “For some children that’s too difficult.”

**Know How.** Similar to the other teachers, Sylvia expresses know-how when brainstorming on the actual design of PictoPal, words and sentences to be used and activities that can be done with the written material made with PictoPal. However, she makes less contributions that refer to know-how than the other three teachers. Although her comments are short, other teachers agree with what she says. For instance, she mentions, during the end of workshop 3, that lesson 7 and 8 might be put on hold. Sylvia also mentions that during the sixth week, childrens’ on-screen activity should show less support. This would allow for the activity in which children make their own story using only single words within a specific theme. Figure 4 shows how this proposal is designed: five options for words are given within the category ‘where’. Children listen to the words and then decide which word fits best in their own self-made story.

**Discussion**

**Synthesis**

This study investigated the knowledge and beliefs individual teachers have and use during collaborative design of technology enhanced learning materials for early literacy. The findings of the interviews as well as findings from design conversations reveal key themes in the knowledge and beliefs shared by
teachers as they innovate for their own classrooms. Specifically, the participating teacher discussions related to:

- Zone of proximal development.
- Play and authentic activity are important.
- Children develop early literacy in and by themselves, through discovering the link between sound and words.
- Children should write down words, only when they know the meaning of those words (in response to the video-vignette, showing a teacher who doesn’t).

During the design of PictoPal, all four teachers agreed on these design decisions:

- Goal of PictoPal is vocabulary development and learning to make proper sentences.
- This goal should be reached as children make a list, a lower-case letter and categorize words on the computer.
- These written materials are then used in play as well as authentic activities such as visiting a farmer.
- Ample proposals for on-computer and off-computer activities in which children make a variety of written materials (lists and kinds of letters) are made by all teachers.

This agreement formed the foundation for further design work. Findings however also highlight individual differences in design knowledge expressed in interviews and design talk; these are summarized in Table 1. Know-what was hardly expressed by all four teachers, as was know-why. For instance, teachers agreed that the material designed should target vocabulary development, which was translated into concrete activities and material such as making a list of words.

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### Table 1. Percentages of codes (what, how and why) found in design talk for all four teachers.

<table>
<thead>
<tr>
<th>Teacher</th>
<th>What</th>
<th>How</th>
<th>Why</th>
</tr>
</thead>
<tbody>
<tr>
<td>Henriette</td>
<td>24 (15%)</td>
<td>101 (64%)</td>
<td>34 (21%)</td>
</tr>
<tr>
<td>Gees</td>
<td>15 (19%)</td>
<td>56 (70%)</td>
<td>9 (11%)</td>
</tr>
<tr>
<td>Esther</td>
<td>7 (5%)</td>
<td>115 (76%)</td>
<td>29 (19%)</td>
</tr>
<tr>
<td>Sylvia</td>
<td>7 (11%)</td>
<td>32 (56%)</td>
<td>18 (33%)</td>
</tr>
<tr>
<td>Total</td>
<td>53 (13%)</td>
<td>304 (65%)</td>
<td>90 (22%)</td>
</tr>
</tbody>
</table>

In solving design problems, individuals may differ in their problem-solving approach. Dijkstra and Van Merrienboer (1997) distinguish three kinds of problem solving activities: (a) categorization or description problems, (b) interpretation problems, and (c) design problems. Accordingly, these kinds of problems require (a) conceptual knowledge (similar to know-what); (b) hypotheses, theories and principles (know-why); and (c) design rules to actually build artefacts (know-how). Table 1 shows percentages of codes on the different kinds of knowledge and beliefs identified.

When compared to the overall percentages, design problem solving (with know-how) is at the heart of the teachers design talk. However, when comparing individual distributions in percentages to the average, differences emerge. Henriette’s and Esther’s distributions were in line with the average. The large absolute amount of contributions that both teachers made weighs in on this distribution. However, Gees and Sylvia not only have less input (in terms of absolute amount of contributions), but they also differ in the kind of input they bring to the conversation. Gees brought in more know-what topics; Sylvia brought in more know-why information. Gees provided information on the specific theme; Sylvia explicated principles and beliefs on how to teach early literacy in education.

Although not explicitly investigated in this study, the teachers’ sense of community and unspoken power dynamics may have influenced their design conversation engagement. The team worked quite naturally together and, although some members were more quiet than others, none appeared to feel uncomfortable. Still, it is notable that the lead teacher (Henriette) talked more than the others during the conversations.

Also notable is the fact that the teachers felt substantially challenged by this work. We bear in mind that the tasks were heavily scaffolded by the presence of existing materials (not requiring the creation of something completely new) as well as researcher-support. Our personal observations suggest that the task of adopting and adapting existing materials appeared to be within their own zone of proximal development. However, the degree to which it was challenging gives us cause to question the extent to which it would be productive to – as is quite often the case - challenge teachers to innovate from scratch.

### 10. Recommendations

Design is mostly intuitive (Boschman, McKenney & Voogt, 2014), which was also shown in this study by the large amount of know-how expressed. Facilitators should be aware of the various characteristic design approaches. To engage all TDT participants, and to maximize use of their diverse knowledge to the enrichment of the final designed product, TDT facilitators should not necessarily work toward consensus immediately (a natural inclination for most designing teachers), but explicitly attempt to draw out the varied perspectives and knowledge within the group. Support can then be provided to the design
process by giving information, facilitating discussions, or challenging teachers to explicate their underlying principles (know-why) and conceptual knowledge (know-what). Furthermore, teachers should also be invited to reflect on their know-how. Steering the conversation towards explication of reasoning underlying certain decisions can contribute to professional development.

This was a small-scale study involving four teachers and one innovation, only. Further research with more teachers focusing on various domains and levels of schooling is needed to explore additional patterns and variety in the design contributions of individual teachers. Future investigations could replicate the conversation analysis approach described here, possibly in combination with the phases of pedagogical reasoning described earlier (Shulman, 1987), or specific phases of design. This could give more insight into not only the kinds of contributions teachers make, but also portray relationships between contribution types and stages of innovation work.

11. Conclusion

Overall, the findings of this study suggest that mostly, know-how was expressed during design talk. However, as the interviews also revealed, know-why played an important role because it showed to be underlying the know-how. Know-what was hardly expressed by teachers. This study also found differences between teachers. Of the four teachers, two teachers were inclined mostly to express know-how. These two teachers also made more contributions to the design than the other two teachers did. Of the other teachers, one teacher relatively expressed more know-what and one teacher more know-why.

This study highlights the variety in kinds of contributions made by individuals in TDTs and their implications. First, teacher differences yield varied types of design contributions. These can range from considerations of developmentally appropriate practice (“You make use of the zone of proximal development”) to concerns about facilitating enactment well (“And do we need parents to help children with these activities?”). Second, the varied design contributions enrich the pedagogical reasoning in the discussions as well as the products themselves (e.g. “We have to monitor the development ... sometimes they [children] want the correct word. You have to write that down”).

With the ultimate goal of understanding and supporting the professional development of those participating in TDTs for technology innovation in kindergarten, this study investigated how individual teacher contributions shape the design conversations and resulting products. Acknowledging that design work requires pedagogical reasoning, the present study portrays how teachers share and use their knowledge in this collaborative process. This study emphasizes kinds of differences that can be anticipated among teachers, and offers recommendations for supporting them. Thus, this research makes modest but important steps toward understanding and facilitating teacher-led innovation.
References


Handelzalts, A. (2009). Collaborative curriculum development in teacher design teams. (Doctoral thesis), University of Twente, Enschede.


‘Talking in Class’: School-based approaches to enhance the impact of teacher inquiry across an organisation.

Teacher inquiry bridges the roles of teacher and researcher. It provides opportunities for educators to engage in research as significant CPD, using theory to ‘stimulate inquiry into practice, and the assimilation of the research findings into pedagogy’ (Colucci-Gray et al., 2008:129). Though valuable to the personal development of teachers with direct engagement in inquiry, achieving broader school impact can be challenging.

This paper discusses inquiry as part of contemporary educational and professional development contexts. It presents a case study of a teacher-led workshop of inquiry findings, providing insight into methods used to implement broader school impact. The workshop design encourages deeper understanding of pedagogical issues for cross-curricular colleagues, supporting other teachers to implement findings in forthcoming lessons. This paper challenges notions that teacher inquiry can lead to only a superficial understanding of research findings for those teachers without direct engagement in the inquiry process.

1. Literature

‘Teacher inquiry is a vehicle that can be used by teachers to untangle some of the complexity that occurs in the profession, raise teachers’ voices in discussions of educational reform, and ultimately transform assumptions about the teaching profession itself.’

(Fichtman Dana & Yendol-Hoppey, 2008:1)

Clark et al. (2011) outline a range of definitions of teacher inquiry. These include a bridge connecting research, practice and education policy; a way in which to engage teachers as consumers of research; a method to support teachers in research to shape practice and professional development; and a way to provide teachers with channels of communication to inform critical issues in the field of education (Rust, 2009, Clark et al. 2011). Put succinctly, teacher inquiry ‘involves systematic, intentional, self-critical inquiry about one’s own work’ and produces evidence-based findings, which can be shared among colleagues (Cochran-Smith and Lytle, 1999, Clark et al., 2011). As such, it exemplifies the principles of school-based teacher learning.
Classroom-based inquiry provides teachers with the opportunity to innovate in their classrooms, exploring tools and techniques which work with their own classes, in their own specific teaching contexts. It can engage teachers at all stages of their career in a dialogue with their leadership teams by feeding into evidence-based practice, which can in turn inform school strategic plans. Rather than relying on professional learning opportunities delivered by outside experts, embedding teacher inquiry into everyday practice allows for sustained, school-based professional development as teachers formalise and develop their research skills, while applying pedagogical changes within their lessons. Classroom-based research findings play an important role in demonstrating evidence-based practice, and can provide teachers with robust data that can shape future teaching and learning. They can also inform researchers about teaching practices as they actually occur in classrooms. Bannan-Ritland (2008) describes the ‘power of the context’ of classrooms as fundamental to design and research activities (Bannan-Ritland, 2008:249).

As the Department for Education in the UK seek a ‘self-improving’ school system, practitioner research has become an increasingly familiar part of school professional development programmes. The DfE report, ‘Building Evidence into Education’, recommends schools developing robust evidence to inform policy and practice which delivers effective education and children’s services, with stakeholders fulfilling a clear role in raising the prominence of evidence-informed practice in schools (Goldacre, 2013).

Clark et al (2011) outline teacher inquiry as a form of innovative practice ‘conceived as a form of teacher-led professional development’ that provides an opportunity for ‘team-oriented teacher learning about students’ learning’ (Clark et al, 2011:9). This can be seen to align with the development of models of school-based training in the UK. An evaluative study on the early phases of teaching schools in the UK has found that some schools promote classroom-based teacher inquiry to encourage increasingly reflective teaching, and to challenge a ‘one size fits all method’ of CPD delivery (Gu et al., 2014). Zeichner (2003) outlines that the research experience can pose a number of valuable intellectual challenges in comparison to the perceived ‘superficial nature’ of other professional development experiences (Zeichner, 2003:309).

However, the impact of teacher inquiry can be limited. Inquiry-based work provides opportunities for teachers to explore nuances of teaching and learning by asking questions which outsiders may not deem relevant (Dana & Yendol-Hoppey, 2008). There is also scepticism surrounding the impact of dissemination of research findings for colleagues not directly engaged in the inquiry. Teachers who directly engage in inquiries are able to develop and maintain an inquiry stance deemed essential to ‘teachers’ continuing education’ (Rust, 2009:1890). For colleagues not engaged in the research process, assuming an inquiry stance can prove challenging. It is important that teachers undertaking inquiries consider how best to engage their colleagues with their findings in a meaningful way, to ensure that the dynamism of inquiry is not diluted through the delivery of findings (Borko, 2004). Achieving this level of understanding encourages broader enactment of research findings, shared across colleagues so that it the process is no longer solely valuable for the lead teachers of the inquiry.

In a study evaluating the effectiveness of CPD in schools, time (spent participating in the activity, and needed to implement CPD in practice) and cost (including cover, transport and course fees) were the main barriers to achieving successful impact on practice (Goodall et al., 2005). The use of internal staff to engage colleagues in CPD activities can overcome these issues when using external speakers or courses. The study highlighted headteachers’ concerns about CPD opportunities which removed staff from their teaching duties, and the need to explore CPD options which were less disruptive (Goodall et al., 2005:9). Provision of time can enable participants to meaningfully enact and contextualise findings in their own practices (Keltchermans, 2004).

The active promotion of teacher inquiry within schools provides an opportunity for shared, school-based learning, but does not guarantee its effective implementation. Organisational structures and approaches are needed that foster peer engagement, as traditional dissemination of research findings may not necessarily lead to wider impact. The case study outlined in this paper demonstrates successful collective engagement with teacher inquiry.

2. The policy push towards school-based teacher learning

UK policy context

The UK has seen a shift in policy from traditional teacher training routes, towards school-based training through programmes like Schools Direct, or through School-Centred Initial Teacher
Training (SCITT). This assigns increasing responsibility for the development of trainee teachers to schools. The 2010 DfE report ‘The Importance of Teaching’ focused on the need to improve teacher quality through increased localisation of training, professional development opportunities, and school improvement (DfE, 2010; Clark et al. 2011). The report marks a shift in UK educational policy from ‘centrally-organised, nationally-structured teacher CPD networks’ to ‘in-school, peer-led teacher development networks and localised decision-making on teachers’ professional development’ (Clark et al., 2011:10). The focus which teacher inquiry can provide on students’ learning, teachers’ professional development and school leaders’ strategic planning, provides opportunities to address these shifts in educational policy perspectives (Clark et al., 2011: 10).

3. Methodology

This illustrative case study demonstrates an approach to peer engagement surrounding teacher inquiry (Stake, 1978). The case was identified as part of a wider project, focusing on teacher inquiry process models (Avramides et al, 2015). Researchers worked alongside the research centre of an international school, the Centre for Inspiring Minds (CIM), conducting interviews with teachers engaged in inquiry processes. CIM provides ongoing support for teacher inquiry groups. As part of the wider project, researchers conducted 27 semi-structured interviews (each of approximately 30 minutes in duration) with senior management, CIM inquiry project leaders, project members and members of staff who had initiated an idea for inquiry, but who had not continued with their study. These interviews aimed to understand the research centre’s processes and how they might be developed to engage staff participation in research projects and to maintain staff engagement. The interviews also explored how best to support professional development for staff. A number of interviewees discussed a specific CIM teacher inquiry project (focusing on student dialogue) as an exemplar model of disseminating best practice. Interviews were transcribed, with emerging themes relating to CIM processes documented. Interviews including discussion of the student dialogue inquiry project were also analysed in relation to the design and impact of the lead teachers’ dissemination workshop, with emerging themes noted according to the depth of engagement which the workshop provided for participants.

The Centre for the Use of Research & Evidence in Education (CUREE, 2011) outlines four goal descriptors to describe the depth of engagement CPD activities provide for participants. The descriptors are:

- **Informing**: drawing participants’ attention to new knowledge and considerations in implementing new practice;
- **Influencing**: actively engaging participants with new knowledge, assessment of their starting points and considering application;
- **Embedding**: engaging participants in-depth and through a range of activities with new knowledge, assessment of their starting points, and planning of application; and
- **Transforming**: equipping participants to take control of their own learning, both within and after the provision.


Participant responses were analysed according to the four goal descriptors. The descriptors inform the report structure that follows.

In order to explore the inquiry project that supported peer engagement and led to wider impact, site visits and observations were made over a period of approximately 12 months. Ethical approval was sought and secured from the researchers’ institution, and from the school leadership team. This followed BERA guidelines on issues including anonymity, confidentiality, informed consent and the right to withdraw from research participation.

Instead of framing the study as an ‘outsider’ inquiry (Dana & Yendol-Hoppey, 2008), teachers were involved in reporting the research process, and in the generation and interpretation of evidence in line with the research culture of the school. The lead teachers collected data before and after dissemination workshops, which were held at two of the school’s other campuses across London.

The purpose of the data collected by teachers was to evaluate effective components of the workshop design and delivery, and to obtain an understanding of how likely teachers were to enact research findings within their own classrooms. Data was collected through two questionnaires focusing on the participants’ opinions and understanding of student dialogue as the workshop focus, and evaluated participants’ likelihood of enacting research findings in their future practice.
The lead teachers collected 34 responses to their pre-workshop questionnaire (Appendix 1) and 36 responses to their post-workshop questionnaire (Appendix 2). Workshops took place at two of the four campuses of the international school. The first took place in January 2014 and was formed of two 2-hour workshops, with 35 participants who were employed as Middle School teachers, and the second was a full-day workshop attended by 14 Middle and High School teachers.

Participation in all surveys was anonymous and voluntary, with data collected and analysed using Google Forms.

4. Case context
The inquiry was led by two teachers employed at an international school in the UK to teach Media, and English as an Additional Language, with five participating teachers in the inquiry group. It focused on the effective use of student dialogue in class, and was supported by the school’s research centre (CIM), which offered time and resources to support classroom based-inquiry. CIM provided support to design, conduct and share their research outcomes with teaching colleagues. The teachers started their inquiry by reviewing literature and pedagogical strategies, which would provide opportunities for student dialogue in class, and designed a workshop to share their findings effectively with colleagues. The workshop structure was based on the idea that the lead teachers had only one day to ensure impact of their research findings, and so they decided that a short summary or a didactic presentation would be ineffective. They designed a workshop which would allow the participants to understand the findings of the research, practice it and to envisage where it would fit within their own teaching. Though there were opportunities for the lead teachers to embed classroom-based inquiry into their everyday classroom practices, such opportunities were not available to teachers engaging in the dissemination of the lead teachers’ findings (Rust, 2009). Meaningful engagement in inquiry depends upon time as a resource for teachers, and this is also true for those engaging in the dissemination of inquiry findings. Time and support were provided within the workshop to allow participants resources to embed practice within their own schemes of work.

The lead teachers’ initial project outcomes related to the use of student dialogue activities to enhance lessons. However, the findings of their project are not the focus of the case study reported here — instead, it is the research process level of this inquiry that is of interest, notably the ways in which the teachers’ decisions relating to dissemination demonstrated effective sharing of best practice, and how teacher inquiry can be undertaken in a way which leads to meaningful professional development; with impact not restricted to the few directly engaged in the inquiry. Throughout the case that follows, issues relating to disseminating teacher inquiry findings are placed in the foreground, rather than the substantive findings of the teachers’ own inquiry work on student dialogue.

5. Dissemination of inquiry findings: Workshop Design
The lead teachers drew upon their own inquiry findings on student dialogue, noting that an active dissemination session where participants were moving around, interacting with colleagues and discussing the topic could encourage participants to make a connection with the information and to use it at a later date (Zwiers & Crawford, 2011). As teachers are expected to employ active pedagogies that encourage skilful conceptualisation of curriculum content for their students, the lead teachers sought to apply this to the design of professional development activities to engage teacher participation.

The ‘Talking in Class’ workshop was designed with the idea of maximising time and practicality for the educators who attended, at the same time serving as a model for the student-centred instruction that the workshop was promoting. The lead teachers sought to deliver an innovative, research-based concept that would deliver positive results, guided by experiential activities that made the professional development immediately applicable and did not require entire revision of curriculum. They drew upon their own preferences to work with colleagues in a professional, collaborative capacity, with easy access to supporting resources (including “experts” in the topic); and dedicated planning time/spaces where teachers could work with their own classroom materials, and seek support if necessary. By conducting pre-workshop interviews with the participants, the lead teachers ensured that they could differentiate workshop content to specific participant needs.

Workshop content (the benefits of student-to-student dialogue) was delivered alongside supporting interactive, experiential learning opportunities (Appendix 3). The workshop was held in a space away from the participants’ classrooms and daily responsibilities so as to allow the teachers the freedom to
concentrate exclusively on the workshop content and on collaboration with their peers.

During the workshop, the lead teachers presented an overview of student dialogue key skills, each accompanied by an activity designed to build that skill which could be replicated with students in the classroom (for example, using a topic and sentence starter to converse with peers to identify their place on a continuum), but with topics tailored to suit the professional audience (for example, ‘what is your opinion on international students’ changing their names to suit their current school’s language?’) This enabled the participants to experience the activity in a way that felt authentic to them, and which eliminated the need to role-play their interactions in the role of a young student. After each activity, teachers were asked to discuss where they might see a similar activity fitting into their own subject curriculum, contextualising the workshop content.

The afternoon of the workshop consisted of dedicated planning time; each teacher participant was given an hour to design an activity to build a core skill which could teach or reinforce the subject-area content. The lead teachers provided clarification, guidance and support to the teachers as necessary, ensuring that each participant had access to resources including sample lesson and activity ideas. This enabled differentiation for individual working preferences. Some participants used books, others asked questions, and others used their own material or the internet for guidance. All participants chose to collaborate with colleagues, rather than work independently - opportunities to do so usually tend to be rare. The participants taught different grade levels and subjects, but the common purpose of increasing student dialogue within their own content area was unifying.

The activities developed by the participants varied from five-minute warm-up activities to complete redesigns of unit projects. The workshop closed with a sharing session that provided feedback for each teacher, and a survey that allowed for data gathering on the workshop itself. In the three weeks following the workshops, the lead teachers attended lessons led by the participants and filmed the activities they had designed in the workshop. Because of this short timescale, every person who left created a product that was used with students almost immediately.

The lead teachers considered how best to share the findings of their research project. In addition to running a second follow-up workshop with the teacher-participants, they published an e-book. This acted as a ‘living’ document to which inquiry findings and participant-designed learning activities could be added, and which could be adapted and passed on to share up-to-date research; to provide teachers with ‘a practical way to put educational research into practice’ (Rosch & Gray, 2013:9).

6. Findings

Survey

The respondents were asked to reflect on whether they intended to implement each of Zwiers’ and Crawford’s (2011) five core skills in the class. When addressing the first skill, ‘elaborate and clarify’, 30 respondents (representing 83% of the cohort) suggested that the likelihood of this was 4 or 5, with 16 participants (44% of the cohort) suggesting that they would definitely use this first skill. Plans to embed the remaining four skills were also explored. Plans to embed skills 2 (support ideas with examples) and 4 (paraphrase) in teaching practice was seen as very likely, with 58% of the cohort ranking the likelihood of using skill 2 as a 5, and 56% of respondents saying the same for skill 4.

Questionnaire respondents identified how likely they were to embed student dialogue activities into their teaching practices, enacting pedagogical change as a result of participating in the workshop. They ranked this likelihood on a scale of 1 to 5, with 1 being ‘not at all likely’ and 5 representing a certainty that student dialogue activities would increase in the respondent’s class. 30 respondents (representing 83% of the cohort) ranked this likelihood as 4 or 5, with 13 suggesting that opportunities for student dialogue would definitely increase. Though further evaluative work has not been completed to record whether such changes have been enacted in respondents’ practice, this represents a positive ‘buy-in’ from teachers engaging in the student dialogue inquiry workshop.

Responses indicate that skills 3 (build on or challenge a partner’s idea) and 5 (synthesize) were far more varied in terms of likelihood of teachers embedding these skills into their lessons, however when considering the overall likelihood of teachers using activities developed in the workshop, post-workshop survey data reports that 87% of the teachers who attended are ‘very likely’ or ‘will definitely’ use these activities in their classes.
The workshop provided an ‘endpoint’ for the teacher to have developed a meaningful understanding of the information, accompanied by practical examples of how to apply it in the classroom:

‘you’ve got huge conferences where there’s lots of...people will talk to you for a certain amount of time. Where this is a real mixture of workshops, being involved, trying things out and then making, having something...I walked out of there with something I could try in my lesson. Something new with resources that I was confident that I’d done. And so it was actually like I’d got an end point. I haven’t ended up with a load of leaflets I’ve got to go through just to see the information. So for me that was really valuable.’

The lead teachers included a section of the questionnaire which addressed opinions relating to the need for future support and resources. This explored levels of interest in additional support for student dialogue inclusion through individual discussion time with the lead teachers (10 responding yes, 12 specifying no, and 14 who were unsure) and levels of interest in additional support for student dialogue inclusion through lesson support during implementation (10 responding yes, 13 specifying no and 13 who were unsure). Though there was not a predominant level of interest for lesson support in implementation or through individual discussion time with lead teachers, respondents viewed opportunities for additional support for student dialogue inclusion through collaborative planning time with colleagues as very favourable, with 22 responses specifying that this would be of interest, only 4 who felt it would not, and 10 participants who were unsure. This suggests that collaboration with peers is seen as preferable for teachers, rather than receiving lead teacher support in achieving impact.

7. Interviews

The following findings are grouped thematically according to the four goal descriptors outlined by CUREE.

‘Informing’ – drawing participants’ attention to new knowledge and considerations in implementing new practice

The workshop outlined research findings from the lead teachers’ inquiry. Once the teachers had engaged in discussion and activities relating to these findings, they were provided time to collaboratively discuss ways in which findings could be enacted within their classroom practices. This opportunity for collaboration was discussed favourably by the interviewees. For one, it challenged a feeling of being overwhelmed by the volume of research and number of initiatives that may be effective for her teaching practice. Working collaboratively enabled the teacher to discuss and plan research findings with her colleagues, and to innovate by creating lesson plans based upon this.

The collaborative nature of the workshop also combated issues faced when attending conferences where there may not be time to engage speakers in discussion. The workshop was hosted by the lead inquirers, who were on-hand to assist with questions relating to the research directly. This champions the notion of teachers as researchers who have a unique access and understanding of their own classroom contexts.

‘I can tell you that some of the best ideas I’ve checked out as a teacher have been in workshops where you actually got to talk most collaboratively as a group and share ideas and maybe even have some practice time with something. As opposed to having a speaker who shares a project and there isn’t time to talk about it. Like when you get to talk to other professionals and share your ideas and ask those questions and maybe try – like if they’re presenting to you they give you a chance to try out something that they’re talking about; that makes it a bit more practical I guess to what you want to do.’

There was discussion of how the collaborative aspect of the workshop facilitated a channel of communication for teachers to engage in pedagogical discussion.

‘So the benefit of that side was one, speaking to people I don’t get a chance to speak to; and two, getting a chance to talk about learning as opposed to the jobs that need doing.’

‘Influencing’ – actively engaging participants with new knowledge, assessment of their starting points and considering application.

The lead teachers supported participants to consider the application of the inquiry findings in their classroom practice. This was achieved through a personalised approach to ascertain the objectives which participating teachers hoped to accomplish through attending the workshop. This provides a differentiated approach to professional development, with teachers’ individual needs addressed.

‘So we also did some pre-interviews with [the lead teachers] about what we were going to be doing with our lessons and what we were hoping to accomplish, so we were looking at
some goals for how we thought we might go. And then we got to do the lesson and they would come in during our lesson and see how it went. And they met with us afterwards and we had a chance to talk about how it went; so what was good about it, what was bad, did it work, did it not work?’

Aside from the content of the workshop, one teacher found the workshop process reinvigorating. Despite having initial scepticism about the project and the ways in which it might relate directly to his practice, the teacher explains that the workshop reminded him of ‘the bit I love about teaching’, providing space to reflect away from ‘report-writing’ ‘filing’ and e-mails’.

Another teacher also suggested that the workshop provided a space for reflection:

‘a chance to think about how I teach rather than, this is what I’ve got to get done... it’s that treadmill...OK, next, next, I’ve got to report to here, I need this piece of work and I’ve got exam writing to do here. And to actually have that breathing space to look back and go...oh yes, that’s a really good idea, why don’t I try that? And let’s think about it from a different point of view, where are the kids at this point? And once I try and do that you almost need the space to be able to do it effectively. And to bounce off people, to come up with another idea.’

There was some discussion of whether peer-to-peer learning offered levels of trust and mutual support which may otherwise be unavailable in other situations which aim to nurture change. Interview findings suggested the teachers valued the participation in active learning opportunities which provided them with activities through which they could apply the theory that had been covered in the session. One teacher noted that with her colleagues, she was able to ‘try out each of the different skills [the lead teacher] taught us with each other’. The teachers were able to use the different examples of activities provided by the lead teacher to see how they might work within their teaching practice, but within a trusted environment; ‘you’re trying it with the other teachers but really you’re just looking at how could I implement this with the kids?’

‘Embedding’ – engaging participants in depth and through a range of activities with new knowledge, assessment of their starting points, and planning of application

An interviewee outlined that the workshop enabled her to develop her understanding of student-to-student dialogue, and that this now informs her regular teaching practice.

‘And I implemented their model and they filmed my students using that particular model. And it was fun, the kids enjoyed it, I learned a lot about talking in class. And I try to make the point now that talking in class is as well researched and as beneficial to students and teachers; it’s part of something I use quite regularly.’

One participant described that she felt she was able to build upon existing research, and contribute to the research base. This challenges traditional didactic CPD models, and outlined the positive dialogic nature of the workshop design, as teachers were encouraged to contribute lesson plans to the e-book accompanying the workshop:

‘And I felt, because I was taking a piece of research that was already going on, we were able to add to that research so now other people could look and see how that worked for some other teachers and see if that’s something that they’d want to do. So it’s building on existing research.’

This is something which was identified as valuable on a whole-school level by a member of senior management who identified that the workshop’s use of peer-to-peer learning could be used to contribute to the research base on a range of topics relevant to the schools’ strategic plans: ‘a sort of tick on the shopping list of tangible building blocks that have been out there’.

Challenging didactic presentation of research findings, the lead teachers offered participants an initial idea and then encouraged the participants to make autonomous decisions as to how they would use the idea within their own classrooms. This provided the teachers with an opportunity to take ownership for their lesson plans, and to ensure that it was differentiated for their own needs. One interviewee explained the preference for this approach:

‘the worst case for me is somebody telling me how to do it. It’s much better to give me the idea, give me the kernel so then go away and grow it for me; because you can’t teach for somebody else...’

A participant described the value of autonomy within the session, as she chose what to plan, and was able to use the allocated time for in-depth engagement with the workshop findings.

‘And so in this project [the lead teachers], who were the ones setting it up, set it up so they could teach us and the piece of research that they were looking at... so that was the first half
of the session. We got the second half of the session to choose what we wanted to do and lesson plan there and then, which was nice. So it wasn’t just hearing everything; it was also given the time to actually plan for it and make it happen...It was useful that I was given the time, I got to try something, I did find something useful and that I was able to use again.’

Two teachers described the ways in which other forms of CPD can require time spent outside of the classroom, as well as additional time in terms of being able to create plans to enact findings from conferences or presentations:

‘We are always given time every year to do professional development, which is great; so I can go out and seek out a conference that I want to go to, get some useful resources, but then... And sometimes I have been able to take in some conferences that really mean something to me and implement them. But there are a lot of occasions where things would have been great but I haven’t had – the timing hasn’t been right for me and I haven’t had the time to schedule it in and try some things out. So sometimes it’s more like I’ve had the opportunity to get resources but I haven’t always had the opportunity to implement all the resources I’ve wanted to.’

The workshop provided some space for teachers to explore research findings, and to contextualise these within the context of their classroom, again emphasising the value which the provision of time had in enabling the planning of application of research findings.

‘I like that I was given time to take it in, given time to implement it and given time to view the process of it. All three things were successful for me just because I could do it, I could have the time to kind of look and see does this work, does this not work.’

‘Transforming’ – equipping participants to take control of their own learning, both within and after the provision

One interviewee provided anecdotal evidence as to how she had applied workshop findings in her own practice. This involved drawing upon the research findings communicated by the lead teachers and planning a lesson within the workshop which focused on using word problems to teach long division. The teacher outlined that students found relating maths questions to ‘real life problems’ challenging. After finding that word problems formed part of an effective teaching strategy in engaging her students, the teacher built upon initial lesson plans to reflect ongoing changes in her classroom.

‘This idea kind of grew for me as well. We also had iPads come in last year, so later in the year there is an app ShowMe and it’s where they can create their own video and do problems. So I used another project later in the year and the kids got to go create their own problems. Because they had done it before in the form of long division, they got the idea they were able to do it on the iPad as well. So for me it was more killing two birds with one stone. They got to try making real life examples again but they were utilising the iPads to do it and so they got to put their videos up on the board and show them to the class. So it’s something that we are continuing with the kids. And they loved it.’

Once the students had created their word problems, the teacher planned for the learners to share these with their peers to see whether they were problems which other learners could solve. Word problems were often a ‘huge barrier’ for her students, and so enacting the research findings and collaborative lesson plan in this way contributed to the students becoming ‘enthusiastic and motivated to try it’, demonstrating the impact of the workshop on teaching and learning.

It is important to note the transformative effect which co-leading the inquiry project also had for the lead teachers, which reach more broadly than enacting the research findings. One of the lead teachers spoke about the additional skills which they had developed as a result of co-leading their inquiry, which included leadership skills:

‘This was more of a leadership opportunity. Normally...I’ve been on leadership teams before, but I’ve always been asked to join something that was already going. So this is the first time that I’ve been right there from the ground level and trying to get people onto my team.’

This view was reflected by the second lead teacher’s response, who identified that co-leading the project had encouraged them to further their personal development in their educational career, and to pursue additional leadership positions.

‘I didn’t know what skills I have. Now I know doing this project has encouraged me to move forward in education and in my career, and branch out more and try things and take on more leadership positions.’

Co-leading the inquiry had allowed for the teacher to develop additional connections within their school through collaboration which may not otherwise have been possible:
'I’ve made a lot more connections; I think it has given me an opportunity to work with people that I hadn’t worked with before. And even now we’re talking about giving our workshop to the entire school at [another campus]. So that’s forty more teachers that I would not have had an opportunity to interact with and learn from them.'

This gave the co-lead teacher an opportunity to learn from their school-based colleagues more widely, and to differentiate for a broader range of needs.

Typically, the majority of teachers’ working time is usually spent with students, and not necessarily teaching colleagues. The co-lead teacher discussed how engaging in the inquiry process provided them with experience of dealing with setbacks at a professional level which could be more complex than dealing with issues in the classroom.

‘There were a couple of instances where things we thought were going ahead or were going in one direction, all of a sudden were moving in a different direction. So dealing with some setbacks and then trying to regroup and figure out ways to go forward again...on a bigger scale. Because you can do it with students, but at a professional level it’s a little bit more complicated.’

8. Conclusions

When teachers are in direct engagement with the research process, teacher inquiry can provide rich professional development tailored to their own classroom contexts, with teachers able to enact findings within their own classrooms. Teacher inquiry can also provide lead teachers with opportunities to develop new leadership skills; to engage in broader collaboration across their schools; and develop skills in dealing with professional setbacks. However, in fulfilling the potential which teacher inquiry has for achieving school-based change, additional consideration is essential in ensuring that inquiry findings are valuable for all colleagues, with impact evident across the school.

This case study demonstrates that school-wide impact can be achieved when the contexts of teachers’ roles are considered. The workshop provided teachers with a space for collaborative discussion of research findings and the opportunity to create activities for use in their forthcoming lessons, ensuring that participants left the session with a tangible product, which is informed by inquiry findings and has been designed with each teachers’ specific classroom contexts in mind. Collaboration with colleagues was beneficial to the teachers who engaged in the workshop, especially as this often involved pedagogical discussions with colleagues usually outside of the each teacher’s existing professional network.

Engaging in the workshop provided teachers with autonomy in their own professional practice, converging the roles of teacher and researcher. Teacher inquiry not only allows for researchers to obtain an insight into what actually matters to teachers in the classroom, but also provides the teachers with an opportunity to contribute to the school research base.
References


Rosch, J., & Gray, B., (2013) Talking in Class: Increasing the Quality and Quantity of Student-to-Student Dialogue in the Classroom. ACS International Schools. Available online: www.talkinginclass.com


References


Appendices

In the appendices section you can consult the following documents:

- Appendix 1: Teachers’ pre-workshop questionnaire
- Appendix 2: Teachers’ post-workshop questionnaire
- Appendix 3: Teachers’ Workshop Agenda
Teachers’ as Leaders of Change Suggestions from the Open Discovery Space project large-scale implementation

Training approaches based on teacher networks and the exchange of good practices have emerged as viable alternatives to traditional instructional or seminar-based models. Following this major shift, ‘Open Discovery Space’ adopts technologies and methods that include appropriate and flexible training units, reaching a network of 3,000 schools and 8,000 teachers. This paper describes the innovation model behind the specific initiative and approach for engaging schools and teachers all over Europe, as well as the tools for supporting them in order to embed technology-enhanced learning within a wider school development plan, as well as to design and implement innovative educational activities. Moreover, the paper describes the methodology for organising a set of change management workshops for teachers of pilot schools currently acting as change agents. It also presents the results of the 38 workshops that took place in 19 European countries and concludes to a set of recommendations on the first indications of the gradual change processes brought about in the pilot schools, which can be used both in order to support and validate the Innovation model of this imitative, as well as to be exploited by other projects and initiatives dealing with school innovation and e-learning application.

1. Introduction

Education reform is top of the agenda of almost every country in the world and numerous education reform initiatives in Europe attempt to make schools more effective. Yet despite massive increases in spending and ambitious attempts at reform, the performance of many school systems has barely improved in decades (McKinsey Report, 2007). What becomes apparent at global level is the need for teacher-led innovation (Beard et al., 2015). This type of innovation tends to be collective - teachers working with peers, principals and as part of the school community. In practice, however, attempts to implement change in schools, either come from external forces or from internal forces and lead to different responses from organization members. In fact, it is said that schools can be some of the most conservative organisations (Yılmaz & Kılıçoğlu, 2013). Several recurring reasons have been argued to be associated with schools’ resistance to change, e.g. the purpose is not made clear; the participants are not involved in planning; habit patterns of the work group are ignored; poor communication; fear of failure; excessive work pressure; the cost is too high, or the reward for making the change is seen as inadequate; present situation seems satisfactory; lack of trust in the change initiator (Fullan & Stiegelbauer, 1991). Different types of resistance have also
been identified, e.g. “blind”, “political”, “ideological” resistance (Hambrick & Canella, 1989; cited in Burke, 2008). Another aspect that contributes to resistance to change has been argued to be the perception of teachers about their own position and role in change processes. The NCCA (2008) has observed that “the perception of teachers on the ground is that the change agenda is often set elsewhere, with the interests of teachers as professionals well down the list of prime considerations”. Mitchel and Sackney (2001) also identify that in cases of reform and change “school-based educators have usually been positioned as objects to be manipulated and controlled rather than as professional creators of a learning culture”.

Open Discovery Space (ODS) (Athanasiadis et al., 2014) specifically addresses the challenge of modernising school education by implementing a pull rather than a push approach. It is a European initiative, co-funded by the ICT Policy Support Program spreading in 25 European countries during 2012-2015. It engages teachers, students, parents and policymakers in a first-of-its-kind effort to create a pan-European multilingual eLearning and community-oriented social platform. It supports its target groups to discover, discuss, share, shape and acquire a rich array of teaching, learning and research materials. Key objectives are to promote more flexible and creative ways of learning by improving the way educational content is produced, accessed and used, by fostering sharing and collaboration and by making the teacher the core node and innovator/change leader of a developing community of peers. One of the main aims is to map the change that is intended to take place in schools and to identify strategies for the modernization of school pedagogy and for schools’ and school staff’s continuing development. The innovation model developed is based on the view that sustainable innovation requires understanding of how and why an innovation works over time and across settings. The ODS innovation model also requires engaging the end-users in the design of the innovation and creation of collaborative partnerships that can uncover the variables that come into play in actual learning contexts (Brown & Campione, 1996). The long-term target is to help teachers manage change in a uniform way. Thus, developing skills for managing change in schools is an essential prerequisite in this process in order to ensure the sustainability of the impact of any intervention. It is also a necessary condition within the overall model, which combines the top-down and bottom-to-top approach.

2. Background

The TALIS Report (OECD, 2014) presents the types of professional development activities undertaken in the last 12 months. Participation in networks formed for teachers’ professional development was found to be applicable to considerable percentage of 37% of the respondents. Networks and communities of peers have the advantage of offering multiple types of training, exchange of innovative ideas and practices, access to continuously evolving content, fora where teachers can engage in debates etc. All these attributes and facilities cannot be matched by traditional professional development activities, such as training courses that usually last for a short period of time. Teacher networks that acquire certain formal features, usually a part of national or international initiatives, lead to the creation of a distinguishable community of practice (CoP) (Wenger, 1998). Studies have shown that sharing past experiences leads to innovative future practices and that community members were more likely to develop a more conscious involvement in an activity (Printy, 2008; Barwick, 2009). Moreover, innovative strategies are strengthened within the CoP framework (Sobrero & Craycraft, 2008) and successfully promulgated amongst other teachers, thus increasing the effectiveness of the learning environment. It is within the context of Communities, that the ODS project aims to take forward the agenda of teacher-led change at a European level. This approach to school innovation evolves in three steps, i.e. stimulating, incubating, and accelerating innovation and is strongly driven by users’ needs.

Literature review (DeLong & Fehey, 2000; Riege, 2006) has identified potential barriers to change and innovation on top of barriers to the use and uptake of eLearning resources (Clements & Pawlowski, 2011). Furthermore, different tasks in the knowledge sharing process also cause barriers and resistance, in particular in collaborative settings (Pallot et al., 2010). The barriers also result to requirements and potential negative factors towards change and innovation. Thus, barriers need to be identified and addressed in order to be refined from all stakeholders’ perspectives. The methodology of Pallot (2010) has been adapted in order to explore the key barriers for teachers. For each barrier, an intervention will be developed. Moreover, in Lawson and Price (2003), the key prerequisites for accelerating and establishing change are identified and an effort has been made to address all of them in order to assist the behavioural change and development of teachers. The practical implementation of the ODS approach has been supported by

1 http://portal.opendiscoveryspace.eu/
the development of a network of change agents (see Section 4.1) who will share innovative practices.

The ODS approach to change management is attempting to deal with both external forces of resistance, since it is on the one hand compliant with National Initiatives and Ministries of Education or State Bodies in most of the participating countries. On the other hand, it is also addressing internal obstacles met in schools, such as negative attitudes and issues related with school ethos and organization. In this view, the idea that ODS adopts is in line with the notion that “deep educational change can only happen through teachers and school management and their interactions and relationships with the learner. This kind of change has to see teachers, truly, as the key agents of change” (NCCA, 2008). Likewise, it adopts the notion of the “school as a learning community” as the preferred strategy for school improvement, in which educators are exactly the people who deal directly with the learning of children (Mitchel & Sackney, 2001). Resources and digital tools are thus viewed as the tools through which the schools can evolve in all key areas, i.e. Pedagogy, Organisation and Management, Intra-school collaboration among staff, parents, students, Collaboration with other schools, Professional Development of Staff, Resources and Infrastructure, Opening up to the community. Thus, the term “change” addresses not only the uptake of open educational resources (OER) and digital tools, but also all the above mentioned aspects of schooling that are associated with it. In the following section the ODS Innovation model and infrastructure provided to teachers are presented.

The ODS Innovation Model & Infrastructure

Built upon the understandings and literature review of the process for encouraging schools to become more innovative in the use of eLearning, the ODS innovation model has been initially designed and slightly refined in its course (McKenney S. et al, 2015). The model (Figure 1) and its practical application is a three-step process, aiming to: Stimulate, Incubate and Accelerate the uptake of innovative elearning practices in school communities and national policies.

Figure 1. ODS School Innovation model (McKenney S. et al, 2015)

The first phase of the project was originally planned to address 100 schools that were selected on the basis of their innovation maturity and their staff’s already established interest in future-oriented thinking. During the first phase, the schools were actively engaged also in the process of co-designing the platform by participating in surveys and a string of workshops aiming to record their needs entitled: visionary (Pirkkalainen et al., 2013). The second phase was intended to incubate the uptake of resource-based learning practices and to engage schools in implementing educational scenarios, as well as to reflect through a series of a second row of workshops entitled “Practice Reflection” ones. This phase intends to create the steady and supportive development of new learning methodologies, so that sustained improvement occurs. The objective of the third phase is to accelerate educational changes and to expand them to significant portions of the school. Attention has been given to exploiting knowledge management techniques, synthesizing evaluation; and accelerating diffusion.

ODS Academies and Communities to support the introduction of innovation in schools

ODS deploys an Open Learning Content Infrastructure that aggregates existing repositories and tools into a critical mass of content, covering around 1,000,000 resources from 75 repositories. Moreover, ODS adopts social networking tools, school portals and supports the development of school generated content and the assessment of a school’s digital level (Figure 2).
According to the EPPI-Centre review at the Institute of Education (Cordingley et al., 2005), collaborative professional development was linked with a positive impact upon teachers’ repertoire of teaching and learning strategies, their self-esteem and commitment to continuous development. With an aim to support teachers’ engagement, the Training Academies and Toolbox have provided the starting point for equipping teachers with necessary competences to act successfully as change agents.

The set of resources, tools that have been provided to the members as community support mechanisms are described below.

Content/OER

Recent studies highlight the value of engaging teachers as learning designers (Sagy & Kali, 2014; Voogt et al., 2012). To this end, in order to facilitate the creation of high-quality teacher-generated scenarios, suggested templates capturing popular pedagogical approaches, as well as scenarios and lesson plans, have been developed as demonstrators for teachers (Sotiriou et al., 2011; Hadzilacos et al., 2013; Riviou & Kouroupetroglou, 2014).

School metrics/school e-maturity questionnaire

A crucial tool for assessing the digital maturity or e-maturity of a school is a school self-evaluation survey, based on the work done by the ‘Digital Schools Program’ (2014) in Ireland. Based on the data from schools, analytics are provided and will be presented (Figure 5).

School action plan

As members of the community, pilot schools are asked to cater for a holistic School Action Plan with the use of a provided template. School action plans provide a robust base for facilitating the task of a periodic school self-assessment based on criteria, such as teachers’ development plans and school portfolios. Multiple types of activities, ranging from school-based interventions to collaborative activities across countries designed by schools in collaboration with National Coordinators are included.

In this context the following questions are addressed in this paper:

- What is the impact of the designed innovation model in engaged teachers and schools?
- What are the obstacles and factors in terms of leading change in their schools reported by change agents and are they in line with literature findings?
- Are there differences between European countries in terms of teachers’ attitudes, obstacles identified?

3. Method

A set of change management workshops has been designed and is implemented. The overarching goal was to lay the foundation for creating learning communities within the schools (Mitchell & Sackney, 2000). More specifically, the objectives of the workshops were to: Map the schools’ orientation to change; Mobilize and encourage positive attitudes to change; Set the basis for long lasting change; Inform the rest of the school community and invite them to actively participate; Present and share good practices within the school community. Regarding resistance to change, the objectives were to: i) Build trust; ii) Create a clear change vision; iii) Ensure a consistent implementation; iv) Provide constant support based on Armstrong (2011). Here follows the description of the role of change agents.

The role of teachers as change agents

The workshops were addressed specifically to members of school staff who are acting as change agents and are responsible for ensuring long-standing commitment to our vision, as well as for coordinating the implementation. The role and profile
of this person (Fig. 3) is identified as a pioneering teacher who is already engaged in innovative practices. The mission of the change agent is to:

- take initiative in order to implement innovative practices that aim to have long-term effect on the development of the school as a whole,
- develop a strategy for involving and disseminating the results of innovative practices to the whole school community,
- identify the sources and symptoms of resistance to change and develops a strategy for dealing with it,
- provide feedback on the organisational changes that take place during and after the engagement of the school.

In most countries, the teacher acting as “change-agent” was proposed by the Head of the school. In cases where the schools were recruited through general calls, the National Coordinators (NCs) made sure that they were identified early on. In cases where the NCs approached targeted teachers in the first place, these teachers, who were already known as acquainted with innovative practices, were the ones who undertook this role. Based on adaptation of Moore’s (2013) theory on “Crossing the chasm”, Figure 3, demonstrates the progression of the change-agents’ role in the implementation phase.

![Figure 3: Progression of the change-agents’ role between the ODS implementation phases](http://al.atomiclearning.com/curve)

The general approach in the design and structure of the change agent workshops was based on basic principles of the action learning methodology (Pedler, 1997; McGill & Brockbank, 2004). This approach provides an “open and safe” space for critical reflection. Action learning has proven to be a powerful tool, which increases significant, relevant, and long-lasting learning in relatively short-periods of time, and has wide-ranging application to both learning and action for individuals, teams and organizations. It has been argued that action learning can enable the bridging of varying adult learning theories (Marquardt & Waddill, 2004), while the cyclic approach of action learning sets enables the development of strong relationships of trust and support that can enable real change. In this sense, the design involved the organisation of two phases of interaction/workshops.

A video with teachers’ interviews was produced, that would be used during the workshops, preferably at the start of the first workshop, in order to stimulate discussion and to inspire the change agents. Seven teachers from pilot schools in Romania, Greece, UK, Bulgaria and Portugal were interviewed. The NCs were provided with a core of issues/topics focusing on: a) Teachers’ experiences of trying to change established patterns in schools b) need for change, obstacles met, strategy for overcoming them, was the change sustainable? The edited video has been uploaded on the ODS portal. In order to facilitate the networking a dedicated community has been set up currently counting 112 members. Resources and tools on change management are also made available.

Methodology and structure of workshops

1st Phase of interaction with change agents

The objectives of the first workshop were to gradually guide the participants through monitoring various sources of resistance to change and encourage them to start designing their own change management strategies. These were intended to facilitate the “planning” stage of the action learning methodology and to prepare the change agents to take appropriate action. A basic component was the sharing of experiences and reflection. To this end the NCs facilitating the workshops were advised to invite change agents from various schools, so that different voices could be heard. The structure of this first workshop is outlined in Table 1. Alternatively to the presentation of the video, it was also possible 2-3 change agents to be invited to present their experiences with a particular focus on obstacles and suggestions for overcoming them. After this first part of the workshops, the rest of the participants were invited to reflect and share their own experiences. The intended outcome of this process was to identify a list of factors/types of resistance to change, that the participants were next invited to work on in groups, in order to start designing change management strategies. The desired outcome of the whole workshop was that the participants would

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7 [http://portal.opendiscoveryspace.eu/beta/educational-objects/70112](http://portal.opendiscoveryspace.eu/beta/educational-objects/70112)
set specific goals and identify changes that they would attempt to establish. NCs were advised to circulate a few days before the workshop the tool for mapping the school’s orientation to change (Killion & Roy, 2009) and adapted by Armstrong (2011)8.

- **Duration:** 3 hours
- **Participants:** ~ 25
- **Number of Facilitators:** 2

1. **Introduction** to the workshop and its objectives
2. **Presentation of video** 9: The facilitator directs discussion and keeps notes:
   a) What types of resistance do you recognise?
   b) Have you faced or are you currently facing similar challenges in your school?
   c) How are you dealing with them?
   d) How would you react in a similar case?
   e) According to your experiences, what seems to work?
   f) Can we come up with a set of good practices in dealing with resistance to change? Can we identify a set of components that seem to work in order to overcome resistance to change?

3. **Work in groups—Designing a strategy for improving conditions that foster change:** Each group focuses on a different factor from the list previously identified and will design a strategy. Each group reports on their discussion
4. **Suggestions on how ODS can further support change agents:** The facilitator presents the community setup that will be used for further exchange of materials

<table>
<thead>
<tr>
<th>Table 1. Structure of 1st Phase of interaction with change agents</th>
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<tbody>
<tr>
<td><strong>1. Review of session 1,</strong> factors and strategies identified by the group</td>
</tr>
<tr>
<td><strong>2. Reflection on action:</strong></td>
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<tr>
<td>a) To what extent was the identified change/ intervention achieved?</td>
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<tr>
<td>b) What obstacles did they face and how did they deal with them?</td>
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<tr>
<td>c) How does each individual assess the outcome in their school?</td>
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<tr>
<td>d) Who was benefited?</td>
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<tr>
<td>e) Has the schools’ orientation to change shifted?</td>
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<tr>
<td>f) What amendments in the course of action should be made?</td>
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<tr>
<td>g) What other needs for support did they identify?</td>
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<tr>
<td>h) What are the next steps? Is the team ready to set new goals for further innovations?</td>
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</table>

2nd Phase of interaction with change agents

The objective was to reflect on the course of action that was identified in the first workshop and to consider any amendments in strategy. Approximately a two-month interval took place between the two phases of interaction, during which change agents had attempted to implement the strategy initially designed. Due to the tightness of this period, they were encouraged to report on even minor shifts observed. The outline of the session is presented in Table 2.

<table>
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<th>Table 2. Structure of the 2nd Phase of interaction with change agents</th>
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<tr>
<td><strong>1. Review of session 1,</strong> factors and strategies identified by the group</td>
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3. **Agreeing on support and follow-through via the ODS portal:** Reflection on how the ODS community is working

4. **Results**

A total of 38 change agents’ workshops were organised in 21 countries among Europe and 36 reports were submitted at the time of writing. The overall number of the reported participants was 497, coming from 274 pilot schools. In 2 cases (Bulgaria, Germany) workshops were conducted online. Apart from a few exceptions two workshops have been organised per country with the number of participants varying from 3 (lowest in Spain) to 58 (Portugal). The average number of participants is 26. Two separate reporting templates were provided to NCs which were submitted with use of Google Documents. Qualitative analysis of data has been made manually and answers have been grouped. Additionally, in order to have the initial impact of the designed innovation model (Fig. 1) in participating pilot schools a comparison between schools’ initial completion (phase A) and repeat scores in the e-maturity questionnaire (section 2.1.3) is presented (section 4.4).

1st Phase of Interaction: Results

a) **Types and forms of resistance to change that were identified as more relevant to the change agents**

The types and forms associated with resistance to change in schools that were most frequently reported by participants were grouped in 5 main categories, thus: Attitudinal/psychological types of resistance on the part of teaching staff, pupils and
parents, Resistance associated with school organisation and administration, Resistance associated with education policies and levels of school autonomy, Resistance associated with lack of resources and Resistance associated with school organisation and administration. More specifically, regarding the attitudinal types of resistance lack of motivation for teachers, a sense that teaching profession is being underestimated; Lack of sense of security and trust within the school and the fear of the unknown, reluctance of teachers, difficulties in breaking stereotypes has been reported in five countries, cases. Regarding the resistance associated with school organisation and administration lack of time, associated with pressure from the curriculum and low levels of school autonomy have been reported in 8 cases. Regarding resistance associated with education policies and levels of school autonomy the centralisation of school governance systems-inflexibility of school legislation, lack of school autonomy and slowness of decision-making process have been reported in 8 cases. Resistance associated with lack of resources, infrastructure (hw/sw) and online tools in different languages the lack of funding for teachers’ development, lack of personnel to support the use of technology, as well as lack of instructions/scenarios on how to implement change have been reported as cases. Regarding the resistance identified teachers’ skills lack of training to support innovation and OER, as well as ignorance of the benefits that innovation can bring to the school have been reported. More information is available in Annex I.

b) Good practices for overcoming resistance to change

The following good practices were suggested by the workshops’ participants as ways for overcoming resistance to change. At policy level the provision of systematic training, the provision of greater school autonomy (Italy, Greece), as well as additional funding/monetary motivation to teachers (Greenland, Spain). At school level strengthening of peer support, collaboration, sharing of practices creating a coaching team, internal trainings, strengthening of networking and collaboration among schools and other institutions has been mainly suggested in the case of 11 countries.

c) Factors that foster openness to change

The factors identified by the participating change agent teachers as the ones that can foster schools’ openness to change have been grouped at macro/general educational policy level where the systematic and generalized training both on pedagogy and use of resources and ICT have been mostly suggested and at school level, where organisation of mentoring, practice reflection and job-shadowing, sharing of success stories, not forcing change, organizing multidisciplinary teams of collaborating teachers, ownership of change, support and mentoring from the schools’ management team and selection of change topics that are relevant to pupils and parents and promote collaboration within the school have been suggested.

d) For each one of these factors, what do the participants think that they can do in their schools to help overcome resistance to change? What strategies are they planning to adopt?

Regarding factors identified and in order to help overcome resistance to change participants suggested in 7 cases/countries the organisation of “openseminars”/internal workshops in schools delivered for training on the themes of ICT, OER and exchange of good practices, the existence of an internal mentoring system, and finally the organisation of an internal “kick-off” meeting with the staff in order to generate wider acceptance of the change.
In Greece, Athens (November 10, 2013) - Workshop in Belgium, Universiteit Hasselt (November 16, 2013)

2nd Phase of Interaction: results

The second workshop was intended to get the change agents to reflect on their course of action for implementing change in their schools and to encourage each other’s feedback on the progress of their interventions. In most of the workshops the change agents who attended the first workshop were also present in the second one. Based on the National Coordinators’ reports, the degree to which the decided change strategies had started being put into practice by the date of the second workshop depended on the length of the interval between the two workshops, which varied from 2 months to a few weeks. Naturally, the longer the interval the more likely it was for the change agents to be able to monitor any shifts or outcomes of their interventions. What was reported though indicated that on the second workshop most of the participants had already been in the process of implementing their change processes either by actually putting their change scheme into practice or by at least preparing for this by monitoring their schools’ attitude and readiness to change using the tools suggested to them (Armstrong, 2011). More specifically, the reports brought the following data:

a) Strategies for overcoming resistance to change that seemed so far to be effective

Regarding strategies for overcoming resistance to change that were effective according to participants the following categories have been identified: Investing on equipment and infrastructure, thus integrating smartphones and tablets in classroom activities; Peer-to-peer support, sharing of practices; Clarity in the design of the change, thus identification of a clear plan (objectives, benefits, risks) before approaching the school management; Motivation, thus introduction of reward systems for teachers as incentive and finally Training and support thus the implementation of regular trainings in multiple formats (hangouts, science cafes, master classes).

b) Obstacles faced in implementing so far the change strategy

Regarding obstacles faced in implementing the change strategy the ones mostly reported are school regulations, lack of autonomy, inflexibility of curricula and bureaucracy; lack of training and issues around cost, quality and readiness of ICT infrastructure.

c) How did the workshop participants assess the outcomes of the intervention/change in their schools so far? Who was benefited?

Regarding initial outcomes of intervention/change stakeholders who have been identified regarding teachers themselves sharing experiences seems to be creating more positive attitudes to change, regarding students getting more motivated and enthusiastic as a result of facilitating learning through ICT has been reported and finally parents have been identified as beneficiaries in the case of Greece.

d) Shifts in the school’s orientation to change

Despite the short length of the period between the two interactions, there were quite a few positive indications reported mentioning a positive shift and change initially from a small group of teachers and the management staff in some cases.

e) Amendments in the course of action that the participants discussed in order to better meet the targeted change/ Next steps to take

Regarding next steps to take in order to better meet the targeted change the organisation of activities either online or face to face in order to enhance support, training and the exchange of experience has been mostly reported.

Mapping the change in schools’ performance

The first sample of schools attempting a repeat of e-maturity questionnaire in order to assess any change/impact consists of 203 schools. Overall, results from all repeat e-maturity questionnaires indicate an increase of 5.69% in the digital maturity of schools after participation and implementation in proposed activities, which is deemed to be significant, given the short period of the pilot activity implementation of about one school year. Figure 5 shows a comparison between initial completion (phase A) and repeat scores. The categories in which a more significant increase is demonstrated in the e-maturity of a school are “ICT in the Curriculum” (7.57%) and “ICT Culture” (7.28%). As far as “ICT Culture” is concerned, the innovation model and the ODS communities have been designed with the aim to increase awareness on the role and integration of ICT in education. The increase in this category is an indication that the innovation model, as well as the CoPs have had a noteworthy positive impact.
5. Conclusion and Recommendations

The three foremost identified obstacles to change across countries is lack of infrastructure in schools, lack of quality resources (educational scenarios) and teachers’ lack of time or possible conflict of the intervention with the curriculum. The latter is again associated with issues and levels of school autonomy. There were different perceptions of the role and links with national policies among more and less centralised school systems (e.g. UK-Greece). For countries with smaller degrees of school autonomy, based on the latest OECD (2013) report, there seems to be greater need for increasing autonomy in order to foster change. On the other hand, in countries with a larger degree of school autonomy, it was identified that sustainable change should be linked to the National Curriculum (UK). There is a sense, thus, that although it is understandable by the teachers that any type of school innovation should not be imposed, rather be based on teachers’ initiatives and experiences, the support and official recognition from National Agencies/Ministries still plays an important role for them. This therefore validates the ODS innovation model, in terms of combining top-to-bottom and bottom-to-top practices. Apart from issues associated with school autonomy, the data from the reports did not provide indications of clear differences among countries. So far, there were some initial indications of greater shifts in the schools’ openness to change in Romania, UK, Finland, Serbia and France, compared to more moderate reactions observed in Germany and the Netherlands.

Another noteworthy finding: most of the good practices and intervention strategies that were mentioned in the first session are associated with the central educational system and to a lesser extent with changes at school level. Therefore, there is a sense that initially there was a general uncertainty and lack of confidence in teachers’ own power. However, there are indications that in the second interaction there was greater awareness of change agents’ role and their potential. This could suggest that perseverance; empowerment and support via respective networks and CoPs can have a positive impact.

In terms of change management strategies that the participants decided to adopt in the first workshop, most of them focused mainly on strengthening peer-to-peer support within and among schools, by organising seminars. This was again emphasised also in the second interaction: building trust, opening the school to the community, building synergies with experts/schools at national or international level and finding support (including funding). All these factors have been mentioned as crucial in creating a sustainable culture of innovation which exceeds the changes of staff over time. This is also a long process that requires persistence on the part of the innovators. The participants identified, however, that there are differences among schools in terms of location and size of the local community: rural schools in smaller communities may be more successful in engaging the community. Synergies among schools were thus identified as one of the strongest incentives for innovation. It is important thus to facilitate the search for partner schools attempting to implement similar changes and projects. This could be facilitated by the ODS portal, through the school search mechanism.

Differences were also found between Primary and Secondary Education in terms of openness to change and innovation: resistance from colleagues and parents, lack of trust, fear for the unknown were all found to be much more evident in Secondary schools, due to the pressure for preparing students for the tertiary education entrance examination. There were also indications of a gap of cooperation and communication among the various levels of education. This is also linked to the structure of the curriculum and the overall educational policy. A suggestion that could be drawn is that there is greater need for support and training for Secondary Education teachers.

Providing incentives and motivation in the form of reward has also been mentioned as an important factor that can support change and commitment to innovation. Organising contests for teachers was proposed, which has indeed been taken into account during the implementation: contests such as the ODS 2014 and 2015 challenge on designing learning scenarios for...
entrepreneurship education, the Student Parliament contest in Greece.

6. Further work

The ODS project aims to take forward the agenda of teacher-led change at European level. The methodology and approach of the initiative have been presented, the design and findings from 38 workshops with innovative teachers taking place in 19 countries, as well as the impact of the intervention. These initial suggestions are to be further validated with the completion of the acceleration phase of the innovation model. The findings presented here can be used to provide a set of initial conclusions and recommendations on how and why an innovation works in a school over time in order to be exploited internally, as well as by other initiatives and practices.

Acknowledgment

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References


Mckenney S. (2015) (Ed.) ODS D1.1 Open Discovery Space Innovation Model


Pirkkalainen H. (2013) (Ed.) D2.3 Requirement and Enabler Statement


Annex: Results per phase of interaction

1st Phase of Interaction: Results

e) Types and forms of resistance to change that were identified as more relevant to the change agents

<table>
<thead>
<tr>
<th>Countries</th>
<th>Attitudinal/Psychological types of resistance on the part of teaching staff, pupils and parents:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Italy, Greece, France, Serbia, Bulgaria</td>
<td>Lack of motivation for teachers, a sense that teaching profession is being underestimated</td>
</tr>
<tr>
<td>Greece, Romania, Croatia, UK, Finland</td>
<td>Lack of sense of security and trust within the school</td>
</tr>
<tr>
<td>UK, France</td>
<td>Lack of peer support, unwillingness to share knowledge</td>
</tr>
<tr>
<td>Greenland, UK</td>
<td>Teachers’ low self-confidence in their skills to adopt innovation</td>
</tr>
<tr>
<td>Netherlands</td>
<td>Frustration from former unsuccessful attempts</td>
</tr>
<tr>
<td>Belgium, UK, France, Serbia, Netherlands</td>
<td>Fear of the unknown, reluctance of teachers, difficulties in breaking stereotypes</td>
</tr>
<tr>
<td>Greece, France</td>
<td>Resistance from parents – reluctance towards new practices that are considered risky for their children</td>
</tr>
<tr>
<td>Italy, Greenland, Serbia</td>
<td>Resistance associated with school organisation and administration:</td>
</tr>
<tr>
<td>Greece, France</td>
<td>Lack of support from school management</td>
</tr>
<tr>
<td>Greece, France</td>
<td>Lack of common time for cooperation among staff</td>
</tr>
<tr>
<td>Italy, Greece, Greenland, Belgium, UK, Estonia, France, Portugal</td>
<td>Lack of time, associated with pressure from the curriculum and low levels of school autonomy</td>
</tr>
<tr>
<td>Greece, France</td>
<td>Lack of common vision among staff</td>
</tr>
<tr>
<td>Greece</td>
<td>Constant mobility of teaching staff inhibits innovation sustainability</td>
</tr>
<tr>
<td>Italy, Greece, Spain, Lithuania, France, Serbia, Portugal</td>
<td>Resistance associated with education policies and levels of school autonomy:</td>
</tr>
<tr>
<td>Greece, Romania</td>
<td>Centralisation of school governance systems-inflexibility of school legislation, lack of school autonomy and slowness of decision-making process</td>
</tr>
<tr>
<td>Greenland, Greece</td>
<td>Pressure to stick to the curriculum especially in Secondary Education and to coach students for the higher education examinations – no room for innovation</td>
</tr>
<tr>
<td>Lack of connection between levels of education</td>
<td></td>
</tr>
<tr>
<td>Lithuania, Finland, Italy, Greenland, France, Serbia, Germany, Latvia</td>
<td>Resistance associated with lack of resources:</td>
</tr>
<tr>
<td>Italy, Greenland, UK, Bulgaria</td>
<td>Lack of infrastructure (hw/sw) and online tools in different languages</td>
</tr>
<tr>
<td>Italy, Greenland</td>
<td>Lack of funding for teachers’ development</td>
</tr>
<tr>
<td>Estonia, Cyprus</td>
<td>Lack of personnel to support the use of technology</td>
</tr>
<tr>
<td>Lack of instructions and scenarios on how to implement change</td>
<td></td>
</tr>
<tr>
<td>Finland, Spain, Finland, Serbia, Germany</td>
<td>Resistance identified with teachers’ skills:</td>
</tr>
<tr>
<td>Spain</td>
<td>Lack of training to support innovation and OER</td>
</tr>
<tr>
<td>Spain</td>
<td>Ignorance of the benefits that innovation can bring to the school</td>
</tr>
</tbody>
</table>
f) Good practices for overcoming resistance to change

<table>
<thead>
<tr>
<th>Countries</th>
<th>At policy level:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Italy</td>
<td>The development of a framework of activities - requiring not much class time, and highly rewarding in terms of formation and promotion of the school itself - are seen as a good practice to increase teachers’ involvement in the country</td>
</tr>
<tr>
<td>Italy, Greece</td>
<td>Greater school autonomy</td>
</tr>
<tr>
<td>Greenland</td>
<td>Development of a national curriculum for innovation and ICT that will foster common vision</td>
</tr>
<tr>
<td>Greenland, Spain</td>
<td>Additional funding- monetary motivation to teachers</td>
</tr>
<tr>
<td>Romania, Croatia, Finland, Germany</td>
<td>Provision of systematic training</td>
</tr>
<tr>
<td>Finland</td>
<td>Provision of state-of-the-art infrastructure</td>
</tr>
<tr>
<td>UK</td>
<td>Ensuring the change is described in terms of the national curriculum</td>
</tr>
<tr>
<td>Cyprus</td>
<td>Connection of OER available to national repositories can foster trustworthiness in their quality Organisation of info-days concerning IPR and licencing in order to raise awareness</td>
</tr>
<tr>
<td>Serbia, Bulgaria</td>
<td>Organisation of national contests that involve the production of digital learning scenarios and lesson plans by teachers as motivation strategies//acknowledging and rewarding schools’ participation in national and European projects</td>
</tr>
</tbody>
</table>

At school level:

<table>
<thead>
<tr>
<th>Countries</th>
<th>At school level:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Greece, Croatia, Spain, Lithuania, Estonia, Greece, Serbia, Germany, Portugal, Netherlands, Latvia</td>
<td>Strengthening of peer support, collaboration, sharing of practices and collegiality within the school-organisation of meetings among staff // creating a coaching team, organising internal trainings // strengthening of networking and collaboration among schools and other institutions</td>
</tr>
<tr>
<td>Greenland</td>
<td>Designing a school development plan that includes short and long-term objectives</td>
</tr>
<tr>
<td>France, Portugal</td>
<td>Broadening the school community by actively engaging parents and local community</td>
</tr>
<tr>
<td>Greece, UK</td>
<td>Identifying key people to assist in change// Seeking of support from an expert who will have the role of an 'Innovation advisor'</td>
</tr>
<tr>
<td>Greece</td>
<td>Internal and external dissemination of innovative practices among the staff and community</td>
</tr>
<tr>
<td>Belgium, UK</td>
<td>Getting support from the management of the school - Persuading the principal about the importance of the intervention. In order to avoid the costs for purchase of infrastructure, funding programme could be sought</td>
</tr>
<tr>
<td>Croatia</td>
<td>Listening to students’ voices and needs</td>
</tr>
</tbody>
</table>

g) Factors that foster openness to change

<table>
<thead>
<tr>
<th>Countries</th>
<th>At macro/general educational policy level:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Italy</td>
<td>Provision of time-purpose activities that do not conflict the standard curricular activities</td>
</tr>
<tr>
<td>Cyprus</td>
<td>Provision of funding opportunities for innovative schools</td>
</tr>
<tr>
<td>Bulgaria</td>
<td>Engaging educational authorities in any type of school change</td>
</tr>
<tr>
<td>UK</td>
<td>Seek out external recognition from formal/ external organisations that can be used to validate the change – i.e. badges, awards</td>
</tr>
<tr>
<td>Italy</td>
<td>Acknowledgement/reward for schools’ participation in extra-curricular activities</td>
</tr>
<tr>
<td>Cyprus, Romania, Croatia, Belgium, France</td>
<td>Systematic and generalized training both on pedagogy and use of resources and ICT</td>
</tr>
</tbody>
</table>

At school level:

<table>
<thead>
<tr>
<th>Countries</th>
<th>At school level:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Greece, Lithuania, UK, France</td>
<td>Building of trust and team spirit within the school, involving also parents and pupils, where the change has a direct impact on learning</td>
</tr>
</tbody>
</table>
Romania, Croatia, Belgium, Lithuania, UK, France, Portugal | Organisation of mentoring, practice reflection and job-shadowing // Sharing of success stories//Not forcing change//Organizing multidisciplinary teams of collaborating teachers// ownership of change
Spain, UK, Finland, France, Germany, Netherlands, Serbia | Evident support and mentoring from the schools’ management team
Portugal | Selection of change topics that are relevant to pupils and parents and promote collaboration within the school
UK | Gain input from teachers who have undergone the change and can point positive outcomes
Finland, Estonia, Spain, France | Enhancement of school ICT infrastructure
Lithuania | Provision of resources in native languages

h) For each one of these factors, what do the participants think that they can do in their schools to help overcome resistance to change? What strategies are they planning to adopt?

<table>
<thead>
<tr>
<th>Countries</th>
<th>Intervention/Strategy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Italy, Serbia</td>
<td>Participation in ODS contest, in which the winning teams will be part of a national event, hence providing promotion of the schools as a centre of excellence in teaching and learning, plus the provision of infrastructure</td>
</tr>
<tr>
<td>Portugal, Germany</td>
<td>Participating in teacher trainings organized by ODS (Summer Schools, training academies etc.) and hangouts/webinars</td>
</tr>
<tr>
<td>UK, Romania, Croatia, Belgium, France, Greece, Germany</td>
<td>Organisation of “open seminars”/ internal workshops in schools delivered from peers to peers for training on ICT, OER and exchange of good practices // Internal mentoring system / Organisation of an internal general “kick-off” meeting with the staff in order to generate wider acceptance of the change// Organising teams of teachers in the form of concentric circles, where each circle includes teachers who can contribute</td>
</tr>
<tr>
<td>Netherlands</td>
<td>Seeking external supporters and setting up regular meetings with advisors</td>
</tr>
<tr>
<td>UK, Spain, France</td>
<td>Involving peers in idea generation in order to get them substantially engaged in the change (Netherlands)</td>
</tr>
<tr>
<td>Estonia// Cyprus, Germany</td>
<td>Disseminating the innovative activities implemented to the whole school. Organising regular updates (meetings, newsletter, blogs) and identify the benefits as they arise</td>
</tr>
<tr>
<td>Romania</td>
<td>Actively networking with schools from other countries who are more familiar with innovation and technology // Setting up the school community on the ODS portal, where the change agent teacher will act as administrators, inviting all school staff to register and participate</td>
</tr>
<tr>
<td>Greece, Lithuania</td>
<td>Strengthening of collaboration with parents in order to encourage them to keep up with technology and shed resistance</td>
</tr>
<tr>
<td>Lithuania</td>
<td>There is little that can be done in terms of infrastructure improvement on the part of school staff</td>
</tr>
<tr>
<td>Bulgaria</td>
<td>Approaching school administration in order to engage the whole school community about the interventions needed to be implemented based on the needs of the school</td>
</tr>
</tbody>
</table>

2nd Phase of Interaction: results

F) Strategies for overcoming resistance to change that seemed so far to be effective

<table>
<thead>
<tr>
<th>Countries</th>
<th>Investing on equipment and infrastructure:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Romania</td>
<td>Integrating smartphones and tablets in classroom activities</td>
</tr>
<tr>
<td>Croatia, Latvia</td>
<td>Improvement of IT facilities</td>
</tr>
</tbody>
</table>

Peer-to-peer support, sharing of practices, building trust within the school:
Belgium, Lithuania, France, Greece, Germany, Cyprus: Building trust, opening up to the parents and to the wider community and disseminating the benefits of the change.

Serbia: Gradual introduction of the change in order to build trust. Disseminating examples of successful interventions/changes.

Netherlands: Seeking like-minded colleagues in order to create an initial core of people who are positive to change.

Cyprus, France: Collaboration across schools from different cultures and change management experiences.

Cyprus: Exchanging specific successful use cases and scenarios among colleagues.

UK: Positivity and enthusiasm can be infectious in trying to build momentum for change. Clarity in the design of the change.

UK: Identifying a clear plan (objectives, benefits, risks) before approaching the school management.

Greece: Making the meaning of the change clear.

Motivation:

Italy: Participating in innovation contests.

Croatia, Latvia, Estonia: Introduction of reward systems for teachers as incentive.

Training and support:

Portugal, Croatia, Cyprus, Finland: Regular trainings in multiple formats (hangouts, science cafes, master classes).

g) Obstacles faced in implementing so far the change strategy

<table>
<thead>
<tr>
<th>Countries</th>
<th>Obstacle faced</th>
</tr>
</thead>
<tbody>
<tr>
<td>Romania, Greece, Italy, Lithuania, France, Netherlands, Cyprus</td>
<td>School regulations, lack of autonomy, inflexibility of curricula and bureaucracy</td>
</tr>
<tr>
<td>Serbia, Cyprus</td>
<td>Attitudes of colleagues–reluctance towards the significance of the suggested change, especially by teachers with under-developed ICT skills</td>
</tr>
<tr>
<td>Greece</td>
<td>Creativity and innovation are still associated with the danger of poor cognitive results and inability to respond in the future to the demands and the strict curriculum of Secondary education</td>
</tr>
<tr>
<td>UK</td>
<td>Additional time needed to bring about change. However change that is more clearly linked to the curriculum seemed to be more well received by head teachers, and enthusiasm seen</td>
</tr>
<tr>
<td>Finland, France</td>
<td>Support by the school principal usually teachers seem to be open to change, but the support of the school principal is essential</td>
</tr>
<tr>
<td>Greece</td>
<td>Gap and lack of cooperation between different levels of education</td>
</tr>
<tr>
<td>Germany, Belgium, Portugal</td>
<td>Cost of IT infrastructure and training; the cost could be overcome by ERASMUS+ funding</td>
</tr>
<tr>
<td>Cyprus, Netherlands</td>
<td>Quality and readiness of ICT tools</td>
</tr>
</tbody>
</table>

h) How did the workshop participants assess the outcomes of the intervention/ change in their schools so far? Who was benefited?

<table>
<thead>
<tr>
<th>Countries</th>
<th>Initial benefits for teachers:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Italy</td>
<td>Providing incentives and motivation for teachers by organising for them digital resources.</td>
</tr>
<tr>
<td>UK</td>
<td>The process of trusting teachers as change agents created sense that they are seen in a more positive light for trying although this was accompanied by fear for work overload</td>
</tr>
<tr>
<td>Estonia, Latvia</td>
<td>Sharing each other’s experiences seems to be creating more positive attitudes to change</td>
</tr>
<tr>
<td>Germany</td>
<td>At the moment of the second workshop, some positive shifts towards change, in the form of greater awareness, were limited to change agents and some fellow teachers</td>
</tr>
</tbody>
</table>

Initial benefits for students:
Romania: Students seem to be getting more motivated and enthusiastic as a result of facilitating learning through ICT.

Greece: Two tools were offered and presented to the workshop participants: 1) Assessing the schools’ orientation to change, 2) A force field analysis tool. Pupils have started showing more positive attitudes towards schooling and learning in general.

Italy: Getting the students in the process of collecting digital data within the national context is intended to improve their digital skills.

Portugal: Students was the most frequent answer but also the school and local community were mentioned.

Netherlands: In cases where the new approach was more challenging and interactive, the students were mostly benefited.

Cyprus: The vast majority of teachers expressed the opinion that primarily the students and secondarily the teachers are those benefited the most.

Other beneficiaries:

Greece: Parents and the overall community are also benefited in schools that are open to the community.

i) Shifts in the school’s orientation to change

<table>
<thead>
<tr>
<th>Countries</th>
<th>Shift</th>
</tr>
</thead>
<tbody>
<tr>
<td>Belgium</td>
<td>There are positive indications that in a lot of schools teachers are willing to work together and to try-out new activities</td>
</tr>
<tr>
<td>Greece</td>
<td>Change is starting from a small group of teachers who are motivated and disseminating the first outcomes. There seem also to be some first indications of shifts on the part of parents</td>
</tr>
<tr>
<td>UK</td>
<td>The school management teams that have been approached seemed to be more open to change than was anticipated. Whether this will continue is another matter, but it is a big hurdle out of the way</td>
</tr>
<tr>
<td>Finland</td>
<td>The teachers have been very positive since the beginning</td>
</tr>
<tr>
<td>France</td>
<td>Becoming more aware of the benefits of ICT: More colleagues are getting gradually inspired and interested in getting involved in using digital tools and resources. Since fall 2013 (2nd pilot phase) a certain number of teachers have volunteered to participate in the creation and development of more innovative projects. Getting involved in these projects has helped in improving the image/reputation of the school on a local, national and academic level</td>
</tr>
<tr>
<td>Germany</td>
<td>At this moment it is way too early to monitor any changes, but the first indications could be seen in schools’ greater openness</td>
</tr>
<tr>
<td>Serbia</td>
<td>All participants have noticed improvement. Most of them have noticed changes related to developing school teams, involvement of the principal. Many schools have expressed their impression that a part of the employees who have so far expressed resistance now start participating. An interesting change that has occurred in several non e-mature schools is the organisation of internal seminars</td>
</tr>
<tr>
<td>Netherlands</td>
<td>Although there have been no major changes in the schools orientation towards change, teachers have been given more freedom to expand their creativity, e.g. with use of social media</td>
</tr>
<tr>
<td>Romania</td>
<td>Definitely yes, ICT is bringing added value and is promoting learning through discovery</td>
</tr>
</tbody>
</table>

j) Amendments in the course of action that the participants discussed in order to better meet the targeted change/Next steps to take

<table>
<thead>
<tr>
<th>Countries</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Netherlands</td>
<td>Being more open. Teachers together are able to bring change in class</td>
</tr>
<tr>
<td>Greece</td>
<td>Empowering a supportive network of committed teachers. Organising joint activities with other schools (also Latvia, Netherlands). Enhancing parents’ awareness about innovation and engagement</td>
</tr>
<tr>
<td>UK</td>
<td>Seeking funding support, possibly from the EU, for training and infrastructure</td>
</tr>
<tr>
<td>Country</td>
<td>Activities</td>
</tr>
<tr>
<td>---------</td>
<td>------------</td>
</tr>
<tr>
<td>Cyprus</td>
<td>Planning web conferences between schools</td>
</tr>
</tbody>
</table>
| France  | Creating an intervention “brigade” which could act in several schools  
Seeking assistance from external experts |
| Serbia  | Organising internal training  
Organising individual peer-to-peer support for teachers with lower ICT competences |
| Germany | Organising a school conference to share experiences |
Reframing engineering curriculum with integrated education to foster future innovation ecosystems

Today’s industrial environments and the grave economic situation are pushing organizations towards innovation ecosystems and other novel types of research or business alliances. Innovation ecosystems are emergent collaborative arrangements that benefit from a mix of different organizations, each enriching the joint venture with their unique strengths, while offering gains that the partners would not have access to alone. As a whole, innovation ecosystems materialize the principles and objectives of the triple helix, integrating expertise from research, education and industry, and effectively promoting new knowledge creation, knowledge dissemination and innovation. This emerging operating mode poses requirements for team diversity, collaboration, business thinking and innovativeness, challenging educators to update their offerings in ways that meet real-life industrial requirements. This article presents a case study of a recent pedagogic endeavour, the Integrated Industrial Communications course, as an effort to integrate working life skilling into degree studies. The ultimate aim is to educate engineering graduates that are equipped to foster such critical components of innovative ecosystems as diversity, collaboration, organizational safety and socio-emotive capacity.

1. Introduction

Such innovation- and technology-oriented higher education institutes as the Finnish Aalto University are facing an increasingly explicit requirement for educational practices that educate graduates holistically for societal and industrial needs. This demands not only domain-specific expertise and substantive knowledge but also behavior, values, ethics and traits that allow employees to benefit the wider context as members of their future workplaces, networks and ecosystems flexibly and in an agile fashion. In engineering education, in particular, this has meant a shift in pedagogic emphasis from calculation to problem-solving skills and innovation abilities. Creativity in human thought is presently recognized as a source of industrial, national and global competitiveness, inviting syllabus design to elevate such thinking abilities as imagining and innovativeness to leverage organizational brainpower. (Badran, 2007; Lappalainen, 2013)

Although innovation curricula are gaining popularity in engineering syllabus design, effective pedagogy promoting innovative thinking remains poorly defined and even more poorly implemented. On a higher level, university policies pursue the knowledge triangle in theory, appreciating the synergies between education, research and innovation that
promote economic and societal growth. (Lappalainen, 2015) On the grassroots-level of teaching, industry-university partnerships have been seen as a way to bridge theory with application, to add authenticity to university education, to build future communities of practice, and to augment industrial innovativeness and economic vitality (Bozic & Dunlap, 2013). Other researchers advocate organizational structure, team composition, leadership and organizational learning as factors critical for innovation activities. And yet others view innovation as a social phenomenon requiring team collaboration and drawing the pedagogic attention to competences facilitating trust, influence, decision making, negotiation and relationship building. (Sleipian, 2013). All these findings question the effectiveness of traditional content-based technical education.

Especially in engineering, classroom pedagogies are edging from emphasis on knowledge transmission towards instructional and learner- or learning-centred orientations. Recently, pedagogical leadership has taken precedence as a holistic approach to creating and sustaining an effective learning environment that prioritizes knowledge creation and management over knowledge transmission. It extends the previous models of instructional teaching by adding emphasis on the relationships involved in the learning process. (Male & Palaiologou, 2012) This development has shifted the educational focus from curriculum to pedagogy, that is, from content definition and design to student engagement and motivation, and from learning outputs to learning processes. (Heikka & Waniganayake, 2011; Brodie & Porter, 2008; Fernandez et al., 2009) Resultatively, educational foci have tipped from judgement based on such criteria as study times, knowledge memorization, information retention and student attainment towards economic arguments and national competitiveness, pushing universities to critically examine their curricula.

As a remedy, classroom management strategies that foster productive rather than receptive student practices need to be systematized to enhance student empowerment, self-management tactics, collaborative learning and project- or problem-based learning as venues exposing students in a more versatile manner to their domains. () Among emerging pedagogies, this article proposes Content and Language Integrated Learning (CLIC) methodology (Merikivi & Pietilä, 2014) as a channel disseminating novel educational values that promote future ecosystems and materialize the emancipatory and societal objectives in curriculum design. This writing showcases an educational endeavour pursuing a socio-cultural environment that draws upon authenticity and prepares students for industrial innovation ecosystems.

2. Innovativeness as a learning objective

Societal mega-trends are altering the demands posed on citizens and employees, shifting emphasis from linear conception to systems-level thinking and understanding. (Zhou, 2012) Among the emerging requirements, innovation ability constitutes a key organizational asset driving economic development, determining corporate life cycles and technologi-cal breakthroughs, and promoting commercialization and industrialization in pursuit of higher profits. (Luoma-aho et al., 2012) Innovation is also instrumental for entrepreneurship and therefore implies societal impact and significance. To secure positioning and innovation capacity in the fiercely competitive markets and severe economic climate, organizations are forming new types of alliances, innovation ecosystems, to seek competitive advantage through synergy. (Spivack, 2013)

As innovation does not just happen, it needs to be driven and managed, which necessitates a more in-depth understanding of creativity and organizational innovation ability. These terms can or cannot be applied interchangeably depending on definition, e.g. whether we wish to make a distinction between new-creating activities or novel approaches and slow or accelerated incremental development (Badran, 2007).

Earlier research has credited organizational innovativeness to two types of sources: employee creativity and organizational processes. On the level of organization, innovations stem from an organization’s technical and industrial conditions, financial strength, and organizational safety (Lu, 2008). Leadership is also known to either enable or inhibit creativity; empowering, servant, transformational and benevolent leadership styles effectively mediate innovation processes by positively coloring the leader-member exchange and organizational culture (McMahon & Ford, 2013). A healthy and supportive socio-cultural environment is likely to foster innovation, which is embedded in social structures, and these social mechanisms also facilitate institutional change. Additionally, innovations necessitate networks that provide the social capital pivotal for research and development. (Hautamäki, 1998)

Some of the factors promoting or hindering innovation lie on the level of individuals, in employees’ personality dispositions: risk taking, originality, problem-solving, adaptivity and teamwork. Innovative individuals are known to search for new angles and
sources of information to in-vent new ideas; they think outside of the box. They integrate both cognitive and affective processes in new-creat-ing activities; creative thinking is cognitive activity but on the affective level they pos-sess the self-confidence, persistence and persuasiveness required in understanding and nurturing innovative endeavours. (Akay, 2008; ur Rahman, 2009; Nederström, 2013) These individuals willingly take initiative and demonstrate entrepreneurial and extraordinary attitude and thereby over-achieve and inspire also others to do the same. (Goleman, 1998)

Among attitudes, optimism has been recognized as a component of new-creating activities. Ideally, organizational members harness realistic optimism, enabling opportunity-seeking behavioral patterns. Some argue for learned optimism, as there is evidence of pessimists and neutrals learning to become optimists through self-reflection and diagnosis of self-defeating beliefs. (Luthans et al., 2001)

Besides personality dispositions, there are interaction traits that promote innovativeness. Individuals who are high on agreeableness add team safety by helping remove barriers to open dialogue and communication and by reducing interlocutors’ fear of being judged. Approachability is particularly crucial when encouraging unconven-tional or innovative ideas and de-inhibiting others from fear or expression. (Byrge & Hansen, 2009)

Conclusively, organizational innovation capability rests largely on individu-als’ broad, multidisciplinary capacity and systems thinking, on such personality traits as optimism and openness, and on skills like communication. (Silva et al., 2009) Many of these can be learned, developed and taught, which suggests new learning objectives for higher engineering education to unleash the creative intelligence of the young that the classical teaching approaches neglect to support.

3. Integrated teaching as a venue for educating engineering professionals

European higher engineering institutions have a solid tradition in imparting an education that equips engineering graduates with a broad base of knowledge, skills and attitudes pivotal to success in industrial processes. (EUR, 2008) However, the incorporation of working life skills has remained underappreciated, despite recent understanding that they serve as the carrier transforming individual engineers’ substantive knowledge into collective resources that yield organizational gains and profits. (Lappalainen, 2012)

An effective method for such inclusion could be found in CLIL or integrated teaching, in which content-based syllabi are integrated as by-products that bring relevance and authenticity to the language and communication studies. The functionalist view emphasizes concrete gains when prioritizing productive abilities over receptive skills; in the context of CLIC, this means that functional language competence simulating working-life discourse takes priority over native-like ability (Perez-Canado, 2014). For example in engineering, exposure to non-technical and non-engineering subjects such as language and communication accustoms graduates to operating at the intersection of technical and non-technical attributes and accumulates their aptitude holistically. (Akay, 2008) Some researchers have found indication of enhanced thinking, strategic and comprehension skills, as well as higher levels of learner motivation and achievement when adopting CLIC (Perez-Canado, 2014). Previously, technical writing served as a rare pedagogic playground implementing the principles of CLIC, integrating domain expertise in the form of technical content and communicative aims in the form of reader impact and usability (Heylen & Sloten, 2013).

Encouraged by the positive learning outcomes related to CLIC, the use of language and communication education as a vehicle of transmission can be stretched also to other domains. When pursuing innovativeness, the mandatory, curricular language studies could serve as a venue for skilling in the area of working life abilities. In fact, research indicates that teaching within the context of a subject area and using case studies drawing from real-world phenomena is the most effective way of enhancing such competences required in engineering communities as critical thinking, insight and creativity. In addition, analyses of authentic cases that mirror reality encourage students to apply their knowledge of theory to practice. (Garside, 1996; Kreps et Lederman., 1985) Application of real-life cases is also a means of securing the relevance of the study material in a way that meets a student’s personal and career needs and goals, which mediates student motivation and empowerment. (Frymier et al., 1996) Further, students require practice in the real world to become prepared for such demanding and multi-disciplinary work environments as innovation ecosystems (Fernandez et al., 2009) and to facilitate the transition from university to professional life. Case studies, in addition to offering models of situations students are likely to face in their professional lives, also help them develop both short-range strategies for
innovatively solving organizational problems and long-range strategies for preventing such problems from reoccurring. (Kreps & Lederman, 1985)

Integrated pedagogy poses heavy demands on the teacher, in addition to substantive expertise. More specifically, five teaching skills are required of the lecturer especially in the debriefing of case analyses. First, tolerance for ambiguity allows for in-depth learning from the different interpretations and unpredictable analysis outcomes produced by the students. Second, formulation of relevant questions forces students to probe their thinking and stimulates them to articulate their own understanding. Third, the ability to explore student answers to questions is a way of guiding students to develop a sense of what constitutes a good, complete answer. Fourth, the teacher must be sensitive to student learning styles to know who need pushing and who need more indirect postures. Finally, teachers are to demonstrate a sense of timing and judgement to know when and how to guide, allow multiple interpretations, and direct student thinking towards preferred outcomes. The teacher is increasingly expected to act as a facilitator, resource and discussion leader, rather than as a judge and evaluator. (Kreps & Lederman, 1985)

4. An integrated course preparing students for innovative work communities

In the global economic turmoil and fiercely competitive industrial markets, entrepreneurship and innovation are taking center stage also in the education sector. To prepare and orientate engineering graduates for the larger societal setup and ways of working in engineering industries, Badran (2007) proposes the inclusion of personal communication within curricula. To experiment with such an implementation, the Industrial Communications course was designed for Aalto engineers in 2009.

This 3 ECTS master’s-level course aims to bridge the gap between degree studies and industrial application to help students assume an engineering identity and to adopt membership in their communities of practice, which will increasingly constitute multidisciplinary innovation ecosystems in the future. Essentially, English language learning provides the platform for the integration, but additionally, the course revolves strongly around communication and collaboration, with professional behavior as the overarching ability that allows engineers to harness their knowledge and expertise for the benefit of their work communities. Finally, as substantive topic areas, the lessons cover such themes pivotal for industries as leadership, managerial communication, ethics and values, strategy and finance. Each topic offers research-based theory and findings from engineering, group activities promoting problem-based learning and public presentations, and individual written and oral assignments enhancing communication skills. The ultimate goal is to provide organizations pursuing innovativeness with employees who know how to ensure collaboration and organizational safety in their work communities.

The course extends over six weeks, 36 contact hours, and the assignments are not rated merely for their content but also for novelty, creative integration of disparate elements, and perceived effort and trial. Aesthetic value or layout issues are not overlooked, either. As the guiding mainstream ideology, students are given an extreme amount of latitude in determining how they materialize their assignment outputs, in what form, channel and style. Reflective practice is encouraged and radical and extraordinary approaches rewarded. To accustom students for diversity, the course welcomes students from all engineering fields to ensure cross-disciplinary group make-up.

The following six key themes form the substantive foundation for the course:

**Topic 1: Strategy - global trends and changes in engineering communities**

Changes in corporate strategy talk and in the strategic thinking it reflects are presented. Industrial skilling requirements are viewed against the background of globalization and the consequent trends in engineering communities. Key future engineering competences are introduced and analyzed within competence frameworks; individual students identify their key strengths and weaknesses.

**Topic 2: Finance and economy**

Students become familiar with the key financial terms used in industry. They analyze differences between internal and external financial reporting and examine how trends are described in financial texts. In small groups, they analyze and present to others the financial status and recent trends in the financial reporting of their case company and compile a finance glossary.
Topic 3: Socio-emotive skills in engineering industries

This section is dedicated to emotional intelligence and some relevant frameworks examining social and emotional skills and abilities. Students analyze the role of intra- and interpersonal skills in working life and identify their personal development goals against the intentional change theory. Organizational safety and individuals’ role in it are discussed to deepen understanding about each employee’s responsibility for organizational socio-emotional climate.

Topic 4: Role of personality in today’s working life

A research-based personality framework is explored to understand the make-up of work personality, as well as recruitment and corporate HR processes. Job interviews are simulated to allow students to articulate their traits orally and also to critically reflect on their career choices and ambitions.

Topic 5: Leadership and managerial communication

Leaders’ competence requirements and, in particular, managerial communications challenges are examined through authentic problems. The role of emotional intelligence in successful leadership is discussed. Students analyze various leadership styles and the related communications patterns in small groups and engage in a self-leadership exercise. Particular emphasis is put on communication styles that support group safety and creativity.

Topic 6: Engineering ethics and values

These sessions focus on engineering identity, professional ethics and industrial working morale. Students analyze authentic ethics cases challenging today’s corporate managers and write their own value statement.

Table 1 summarizes the three integrated components of the Industrial Communications course and their main learning takeaways.

<table>
<thead>
<tr>
<th>English language</th>
<th>Working life skills</th>
<th>Substantive topics</th>
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<tbody>
<tr>
<td>Structure</td>
<td>Work personality</td>
<td>Strategy</td>
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<tr>
<td>Coherence</td>
<td>Socio-emotive skills</td>
<td>Finance</td>
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<tr>
<td>Argumentativity</td>
<td>Self-leadership</td>
<td>Leadership</td>
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<td>tactics</td>
<td>Collaborative skills</td>
<td>Managerial communication</td>
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<tr>
<td>Audience impact</td>
<td>Presentation skills</td>
<td>Ethics and values</td>
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<tr>
<td>Professional style</td>
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Table 1. The components integrated in the Industrial Communications course.

The course feedback has been extremely positive, ranging on average from 4.5-4.9 / 5.0. The course drop-out rate is close to zero, and the class attendance rate exceptionally high. Sometimes the course is not full upon start as it is not a core offering, but having 18 out of the 20 seats filled on average is more than satisfactory. In written feedback, students frequently accentuate how easy it is to forget stage fright or anxiety when focusing on authentic, industry-related and relevant contents. They also regret not having more options for studying leadership skills at the university, as most of them will likely end up in managerial tasks.

5. Conclusion

The third mission of Aalto University to pursue societal impact pushes its educators towards demand-driven syllabi that accommodate to the needs of innovation ecosystems. As national competitiveness requires higher social and economic value of its industries, individual and organizational innovativeness needs to be ensured immediately upon student entrance to working life, accentuating pedagogic leadership and the role of universities as enablers.

Unfortunately, the current higher education still relies heavily on the tradition of homogeneous classroom compliance (Lee et al., 1997) Moving away from compliance towards diversity-oriented teaching necessitates an enlargement of teacher repertoires of classroom management techniques. This cannot be achieved by authoritarian or modelling teacher roles but instead the student should be placed at the centre to facilitate self-directed and student-centred learning (Lu, 1997), promoting active rather than reactive learning. (Brodie & Porter, 2008) Acknowledging that the pedagogue is not the only knowledge administrator in the classroom allows students to take ownership and stretch the boundaries of their capabilities, potentially also unleashing their creativity. (Vazquez & Gaustad, 2013)

To respond to industrial calls for working life skilling, integrated teaching has been experimented with at Aalto University, with convincing results. This particular endeavour shows that teachers need to move away from didactic modes to more discursive and argu-mentative modes of teaching to encourage students to participate, defend their positions and question their opinions, thereby fostering critical thinking, reflective practice, self-leadership and purposeful learning, not just mere memorization. For this to materialize, the pedagogue
needs to create a nonthreatening climate, emphasize genuine communication, associate learning with actual, productive uses, welcome unconventional thinking modes, and serve as a model in creating a socio-emotionally safe and inspiring environment. This way the students will feel free to risk, challenge and question – all essential elements of organizational innovation activity.

References


A project-based MOOC to facilitate teacher-led innovation

The HANDSON MOOC is a continuous professional development course for educators of all sectors. Based on the First Principles of Instruction and the Learning Design approach, the course premises are that teachers are designers and the key drivers to promote innovation via the inclusion of ICT in education. Key figures from the last edition of the HANDSON MOOC are presented to proof its usefulness as an on-going CPD activity.

1. Introduction

The HANDSON MOOC is an online course that promotes the inclusion of ICT in education by empowering teachers as designers. It is a 5-week online course that walks participants through the process of designing an ICT-based learning activity. The course was designed following the Learning Design Studio approach (Mor & Mogilevsky, 2013) and is project-based: starting from each participant’s individual educational challenge, participants are asked to design, evaluate and refine an ICT-based learning activity.

The MOOC was implemented twice (Spring and Autumn 2014) with several changes between the two editions. The second edition (running from October 27th to November 28th) ran in Canvas, was offered in seven languages in parallel, and participants received a certificate of participation from the HANDSON project.

2. Pedagogic value

This project-based course addresses educators from all sectors. Its design is based on the following set of ‘first principles of instruction’ (Stoyanov, Sloep, De Bie, & Hermans (2014; see also Margaryan, Bianco, & Littlejohn, 2015; Merrill, 2013) :

- Confront learners with a problem, issue, or challenge, preferably, a real-life one
- Consider the problem from different (criss-cross) perspectives
- Divide the problem into sub-problems/tasks
- Provide for each task explicit support in terms of background information, examples, procedures, methods, techniques, and tools
- Accommodate learning preferences
- Draw upon learners’ experience
- Stimulate learners to reflect on their experience, to share it and discuss it with others
- Practice and create artefacts in a deliberate fashion

In designing the course we also took into account the behavioural patterns that have been identified in MOOCs (Bayne & Ross, 2014; Cross, 2013; Kop, Fournier & Sui Fai Mak, 2011).
We should expect that less than 10% of attendees would complete the course. Some people would only be active in one or two activities. A third group would only download some of the resources. A fourth group would passively be observing what is happening.

3. A valuable CPD tool

2,632 people filled in the Join Us form (available as a Google Form from June 2014). This form was the first step to register for the MOOC. 18 participants were returning educators that had already been active in the previous edition of the MOOC. The main goal of the participants, as expressed by them in a survey, was to “improve their knowledge of ICT in education”, which is also HANDSON’s main goal.

161 participants completed the first week’s module of activities among which the 92 “Designers” that eventually completed all the modules of the course and were awarded a certificate of participation. The Designers represent 6.1% of the initial 1515 participants (those that created a username in Canvas). Differences between language groups could be observed in the way participation developed over the 5 weeks of the MOOC; early predictors of these different behaviours could be identified as soon as the first days of week 1.

Similar to Diana’s Laurillard (2015) statement in her report “Anatomy of a MOOC for Teacher CPD”, we consider “activity in week 1 as a much better indicator of intention to follow the course than ‘registration’ at the very beginning: registration for a MOOC is not equivalent to registration for a normal university course”. On that account, 161 people actually enrolled. Taking this number as a reference and the 92 people that obtained a certificate for participation, the completion rate past week 1 (92/161=57%) was actually quite high.

The course received an excellent appreciation from the surveys’ respondents, with an overall satisfaction increasing from a 64% to a 90% rating during the MOOC; early designers and non-designers responses were included. Similarly, the comfort level with the environment (Canvas, ILDE) increased during the 5 weeks.

The highest agreement rates with general questions were with the following survey items:

- I plan to reuse some of the techniques I learned during the course (78.1 %)
- I enjoyed being part of a multilingual MOOC (75.6 %)
- I learned about ICT tools that I did not know before (71.9 %)

Participants agreed with many statements about the course and its approach, but the highest agreement rates were with:

- Overall, the course activities have been useful (85.4 %)
- The fact that this course was offered massively to teachers from around the world has been positive (84.2 %)
- The course material were useful (81.7 %)

If we look at the negative side, the highest disagreement rates were with:

- The pace of the course has been adequate (14.6 %)
- The feedback I received from the peers helped me with my learning activities (14.6 %)
- The course has promoted valuable interaction with my peers (11.0 %)
- I used the further readings page (10.9 %)

4. Feedback on the Learning Design Studio Approach

The Learning Design Studio approach was very highly appreciated; it was perceived as a useful tool to include ICT in education. As seen in the results from the Join Us form, “To learn about Learning Design Studio” was the second highest motivation to register for the MOOC.

The Learning Design Studio was seen as a useful approach. Highest rates of agreement applied to the following statements:

- The Learning Design Studio is a valuable resource to include ICT in education (78.1 %)
- The tools and templates provided to work with Learning Design Studio were appropriate (74.4 %)
- Using Learning Design Studio can help me improve my educational practices (73.1 %)

Besides matching the expectations of the MOOC participants, a key goal of the HANDSON MOOC was to ensure knowledge transfer; that is, to ensure that educators apply in their classrooms what they learnt.

5. Knowledge Transfer

The MOOC learning activities were perceived as highly useful. Especially important to assess the success of the MOOC was the response to the question: “Will you use in your classroom the learning activity you have created during the MOOC?” 95.5% of the respondents answered affirmatively. This is an increase if
we compare it to the response in the previous edition, where 88.5% of the respondents answered affirmatively. This might be related to a lower comfort level in ICT expressed by the first edition participants.

6. Conclusion

The HANDSON MOOC is a valuable continuous professional development tool for educators. Importantly, it is not a one-time course but one that may be taken as often as some participant wants to design an ICT-based learning activity or course. Following a Learning Design Studio approach, the MOOC leverages the experience and expertise of peers and the design skills of educators. To ensure proper dissemination, the course materials are available on the project website (http://www.handsonict.eu/) under a Creative Commons License 3.0 BY-NC-SA.

The “Hands-On ICT: Learn, practice and teach creativity and activity” is a project funded by the EU under the Lifelong Learning Programme (http://handsonict.eu/).

References


Towards innovation in digital and open scholarship for non-rivalrous lifelong learning and supporting open learning: The case of the Open Scholars Network

The Open Scholars Network was created with an agenda to respond to the increasing inaccessibility of higher education to underprivileged learners in Rwanda, and to the need for open scholarship and digital scholarship development among academics in this country. The network emerged from a study on opening up higher education. It consists of academics/teachers who are trained or are willing to develop competences in open education, distance education, eLearning, open scholarship and digital scholarship via non-rivalrous lifelong learning. In this paper, definitions of the open scholarship and digital scholarship concepts in the relevant literature are noted. Then, the study results and contextual challenges that led to the creation of the Open Scholars Network are presented. Finally, the current and envisaged contribution of the network to open/digital scholarship development and opening up higher education is discussed. This article may be beneficial to educators, open scholars and digital scholars in both well-resourced and under-resourced settings.

1. Background

The Open Scholars Network started as a Facebook community that emerged from a PhD study that focused on opening up higher education in Rwanda. Part of this study was conducted at the University of Rwanda. The researcher had taught in one of the public higher education institutions that were merged into the University of Rwanda; the only public higher education institution in this country since September 2013. The study had a “transformative mixed methods” design (Creswell, 2014, p.16): Beyond research results based on qualitative and quantitative data, the study intended to catalyse action that contributes to opening up higher education, through enabling policies and practices. The study results that led to the creation of the Open Scholars Network are presented after a brief exploration of the definitions of open scholarship and digital scholarship in the literature.

2. Open scholarship and digital scholarship

The concepts of open scholarship and digital scholarship have been defined in diverse ways in the related literature. According to Weller (2011, p. 51 and 98), the two concepts can be seen as almost synonymous. However, Weller (2014, p. 135) clarifies the difference between digital scholarship and open scholarship:
'Digital’ and ‘open’ are not necessarily synonymous of course – someone could create all their outputs in digital format but store them on a local hard disk, publish in journals that are not open access and not establish an online identity.

While the purpose of the current paper is not to provide comprehensive definitions of the two concepts, it is worth exploring briefly some of the most inclusive definitions.

Veletsianos & Kimmons (2012, p. 168) include publishing in open access journals, maintaining a digital presence by writing blogs and microblogs, participating in social networks, contributing and using Open Educational Resources (OER) a well as leading and engaging in open courses among the main characteristics of open scholarship. In a similar direction, Weller (2011, p. 99-100) proposes characteristics of open scholarship which include having a distributed online identity, participation in and regular contribution to social networks via Twitter, Facebook or similar media, engagement with open publishing, trying new technologies and using new technologies to support teaching and learning. Similarly, Weller (2014) includes networked practice, academic identity built on values and a new/unique approach to research among components of open scholarship. Weller (2014, p. 150) argues that the key characteristic of open scholarship is the freedom it offers. As for digital scholarship, it may include curation and collection of digital resources, building digital collections of information for analysis, creating tools for such collections, generating new intellectual products from those collections, preservation of digital artefacts, digitisation of content etc. (Weller, 2011, pp. 42-44). Weller (ibid) notes that the interpretation of digital scholarship may vary across disciplines (p. 44). Open scholarship and digital scholarship practices within the Open Scholars Network are discussed in a later section in this paper. Before discussing those practices, however, it is worth having a look at a constellation of the PhD study results and other factors that led to the network creation.

3. Some of the research results and factors behind the Open Scholars Network creation

The main focus of this paper is the Open Scholars Network, rather than the discussion of the study results that catalysed the creation of this network. However, for a better understanding of the network’s agenda and its potential contribution to teachers’ professional, open scholarship and digital scholarship development, it is worth having a look at some of the results.

Academics’ willingness to engage in open scholarship and digital scholarship development

In an email questionnaire addressed to academics (mostly teachers) to investigate their potential contribution to opening up higher education, the majority of participants had expressed the willingness to engage in open scholarship and digital scholarship practices if this engagement is supported by an institutional policy. Out of 85 participants who completed and returned the questionnaire, 47 of them (about 55.3 %) reported that they would participate in open courses and evaluate the quality of these courses. Fifty participants (about 58.8%) would engage in aggregation of OER while 56 participants (about 66.8%) would engage in OER and open course adaptation. Fifty-two participants (about 61.2%) would design an OER-based open course, 42 (about 49.4 %) would tutor an open course for credit and 40 (about 47%) would assist a tutor in an open course for credit. Moreover, 61 participants (about 71.7%) were willing to contribute OER by publishing their own work under an open licence as long as no cost is incurred, and their published work leads to promotion.

Academics were also willing to engage in open scholarship and digital scholarship by using different social media to support open learning. Figure 1 illustrates the extent to which academics were willing to use social media for supporting open learning in four ways: dissemination of important information to open learners (1), discussion of the learning content with open learners (2), mentoring open learners (3), and assigning collaborative work to open learners (4). Overall, an overwhelming majority of participants expressed willingness to use different social media to support open learning in one or several ways. Proportions of participants who would never use social media to support open learning were low: about 27% for Wiki, about 26% for Viber, 20% for LinkedIn, about 19% for Facebook and blog, about 16.5% for Twitter, about 10.6% for Skype and WhatsApp and about 9.4% for Google Docs. Arguably, academics’ use of different social media to support open learning would help develop open scholarship and digital scholarship among learners.
Some academics had expressed the need for training in using social media to support learning, or had requested the researcher to organise a workshop on opening up higher education. In his three month field work, the researcher had planned related presentations at various University of Rwanda’s campuses and three presentation sessions were held. No academics attended the first session. The second session was attended by 8 academics while the third one was attended by 23 academics. Parallel meetings and clinical supervisions were the main inhibitors to academics’ attendance. More importantly, some sessions that had been scheduled were cancelled, often on short notice, because the presentation venue had to host other events that were given more priority.

Policy environment at the University of Rwanda

1. The Open access policy and procedures and its potential implication

In March 2015, the University of Rwanda published an open access policy and procedures document (The University of Rwanda, 2015a). In this policy document, the university expresses its commitment to encourage its researchers (most of whom are also teachers) to publish their work in open access journals (p.1). Weller (2014, p. 7) distinguishes three open access publishing routes: the Platinum route, the Gold route and the Green route. In the Platinum route, an article is published in an open access journal with an open licence and the author or her/his institution is required to pay Article Processing Charges (APCs). In the Gold route, an article is published in an open access journal or a proprietary journal under an open licence, but the author or her/his institution is required to pay APCs. By default, the Gold open access publishing route shifts the financial burden from institutions that have traditionally been paying subscription fees to access bundles of academic articles or books published with All-right-reserved to authors who are required to pay APCs to publish their work with an open licence. Well-resourced institutions relieve their employees from this financial burden by paying APCs on their behalf. In the Green route, an article is published in a proprietary journal with All-right-reserved, but its earlier version is uploaded on authors’ websites or their institutions’ repositories. Publishers may impose an embargo for a specific period before authors are allowed to release the earlier version under an open licence. In the University of Rwanda’s open access policy and procedures, the Platinum route is confounded with the Gold route.

At this university, research funds are so limited that a huge number of academics would have to cover APCs, on their own, to publish within the Gold open access publishing route. The confusion of the Gold and the Platinum open access publishing routes in the university’s open access policy and procedures may expose these academics to predatory and vanity publishers (Brown, 2015). The Gold route seems to offer a safe haven to such publishers who tend to have maximisation of profits as priority over the quality of published articles. Authors who do not have enough information on different open access publishing routes may be easy prey for predatory and vanity publishers. In the context of Rwanda, academics may end up paying up to the sum of their six month salaries. This was the case for one teaching staff member who invited the researcher to co-author a journal article, the invitation declined after noting that the publishers charged exorbitant APCs. Instead, the researcher co-authored the current article with other teachers who are members of the Open Scholars Network since it would be published within the Platinum route.

Unlike the Gold route which seems to be favourable to predatory and vanity publishers and the Green route that grant publishers the power to monopolise ownership of or financial benefit from the content, the Platinum route seems to be safe and of most (financial) benefit to authors (and their institutions). In the Platinum route, no payment of APCs is required from neither authors nor their institutions, and this may guarantee that the publication within this route is based on the quality of the articles rather than the money paid by the authors or their institutions. In addition, institutions have an open access to articles published within this route from the day the articles are published, without incurring any cost to any member of respective institutions’ communities. Moreover, authors who publish within the Platinum route often remain copyright
holders who voluntarily share their work under an open licence without being charged money for their open sharing practice. This contributes to the distribution of power and freedom between the publishers, the authors and the users of the content.

The University of Rwanda’s commitment to pay APCs for its employees who want to publish their work under an open licence may lead to cost recovery by increasing tuition fees. This would exacerbate inaccessibility of higher education in Rwanda. In this setting, financial difficulties already inhibit the inclusion of an overwhelming number of secondary education graduates who qualify and wish to attend higher education. One of the University of Rwanda’s teachers who had participated in the study that informed the start of the Open Scholars Network shared a link to an article of a local online newsletter that covered the growing socioeconomic inequality in terms of access to higher education. According to Igihe (2015), a University of Rwanda’s senior official revealed that about half of 11,788 students who had been admitted at this university were unable to register and attend classes due to financial difficulties. This information was corroborated by the University of Rwanda Registrar’s office and the university’s 2015 statistics. According to the statistics, only 6756 students (57.3 per cent of the 11,788 students who had been admitted) registered in 2014/2015 (The University of Rwanda, 2015b, p. 20). In a similar direction, one of the students who participated in the study mentioned that many of the students who were admitted at the university based on their high performance in the national exams were denied student loans, and consequently, they were unable to register and attend classes.

Despite the commitment to promote open access publishing and encourage its employees to publish their research articles in open access journals explicitly expressed in the University of Rwanda’s open access policy and procedures, no effort was made to raise awareness of different open access publishing routes among this university’s academics. An interview with a University of Rwanda’s official revealed that raising this awareness was not on agenda. “We do not focus really on open access or not... we would like our staff to publish in credible journals... whether they are open access or not, it doesn’t matter as far as we are concerned”, so stated the informant when the researcher asked her the university’s position on raising academics’ awareness on the Platinum route. This official recognised that some open access journals are highly credible though.

2. General academic regulations for open and distance learning programmes

In most of its part, the document that contains the “general academic regulations for open and distance learning programmes” (University of Rwanda, 2014) copies practices from traditional education. In this document, open and distance education strategies the university intends to use to open up education to more learners in need are not clarified. As discussed in the previous subsection, academics expressed willingness to engage in different open and digital scholarship practices to support open learning. However, the institutional support/recognition of engagement in those practices is not specified in this document. The policy document has a section dedicated to assessment. The focus of this section seems to be assessment in the traditional education context, and it is not clear how this apply to open learning. Procedures to assess the accomplishment from open learning practices are not included in this policy document. Challenges that inhibited the accommodation of a significant proportion of learners who had been admitted on merit basis at University of Rwanda (as discussed previously) relate to the shortage of financial resources. When the demand is higher than the availability of financial resources and other rivalrous resources discussed in the following section, those resources cannot be accessed and used without preventing a certain proportion of people in need from enjoying the same privilege of access and use. This seems to be what happened to secondary education graduates who had been admitted at the University of Rwanda on merit basis but were denied student loans, which led to their drop out. The “general academic regulations for open and distance learning programmes” document does not indicate any plan to innovate beyond the rivalrousness of such resources to open up education to more learners in need are not clarified. In this document, open and distance education strategies the university intends to use to open up education to more learners in need are not clarified. The document that contains the “general academic regulations for open and distance learning programmes” does not indicate any plan to innovate beyond the rivalrousness of resources to open up education to more learners in need are not clarified. The policy document has a section dedicated to assessment. The focus of this section seems to be assessment in the traditional education context, and it is not clear how this applies to open learning. Procedures to assess the accomplishment from open learning practices are not included in this policy document. Challenges that inhibited the accommodation of a significant proportion of learners who had been admitted on merit basis at University of Rwanda (as discussed previously) relate to the shortage of financial resources. When the demand is higher than the availability of financial resources and other rivalrous resources discussed in the following section, those resources cannot be accessed and used without preventing a certain proportion of people in need from enjoying the same privilege of access and use. This seems to be what happened to secondary education graduates who had been admitted at the University of Rwanda on merit basis but were denied student loans, which led to their drop out.

4. The Open Scholars Network and its agenda to innovate beyond rivalrous resources

The Open Scholars Network was created by teachers who want to innovate within the prevailing shortage of resources that inhibits access to higher education as well as teachers' professional development opportunities. It started in June 2015 and adopted the motto “Innovating in non-rivalrous higher education and lifelong learning”. Response to the needs...
expressed by teachers who participated in the study from which the network emerged and the increasing inaccessibility of higher education to underprivileged secondary education graduates in Rwanda are among priorities on the network agenda. Its activities are mediated in a private Facebook community that is exclusively open to teachers and other stakeholders who have demonstrated interest and abide to the network’s agenda.

Members of this network intend to develop and expand open scholarship and digital scholarship competencies (Weller, 2011; Veletsianos & Kimmons, 2012; Weller, 2014) in order to move beyond the contextual barriers. To reach their objective using limited resources available, they avoid an overreliance on rivalrous resources that are already in shortage in the target setting. As opposed to non-rivalrous resources (Weller, 2011, p. 85) which are accessed and used without preventing others from accessing and using the same resources, access to and use of rivalrous resources often entail competition and sometimes exclusion. Nkuyubwatsi (2015, pp. 47-48) identified five categories of resources needed for open education and discusses their rivalrousness. Those categories include political resources which encompass powers vested in people, boards, commissions and institutions and are used to formulate the politics, visions, missions, agendas, policies and strategies that govern education. These resources are rivalrous, but they can contribute to non-rivalrous education if they are used to develop policies that underpin open licensing on educational resources as well as assessment and credentialisation of accomplishment from open learning. Other categories of resources include financial resources (rivalrous), technological resources (rivalrous), pedagogical resources (some are rivalrous, other are not) and heutagogical resources (non-rivalrous). A sixth category of resources, Infrastructural resources, can also be distinguished to encompass resources related to physical infrastructure which was also discussed in Nkuyubwatsi (ibid). Infrastructural resources may include offices, examination rooms, tutorial session rooms, laboratory rooms, computer lab rooms, seminar rooms, etc. While the main focus of this paper is not on a detailed discussion of those resources, Figure 2 encapsulates them, their rivalrousness and stakeholders who control/manage them.

Although the network is still in its infancy, it has already started moving beyond contextual barriers to make the intended contribution. The current article was co-authored through a virtual collaboration of members of the network who were located on three continents. All the co-authors were linked to the University of Rwanda (or a former public higher education institution that was merged to others to form this university) as teachers, but some of them were on leave for more advanced studies. This is what led to their dispersion across three continents. The virtual collaboration between the co-authors mediated by Internet and digital technologies is arguably another aspect that can be accommodated in digital scholarship in its broader sense (Weller, 2011, p. 4). This collaboration happened with a minimal consumption of rivalrous resources. Moreover, the Platinum open access publishing route within which the article is published enabled the co-authors to publish in an open access journal; one of open scholarship practices (Veletsianos & Kimmons, 2012).

The current article will hopefully raise awareness of the Platinum open access publishing route and its benefits at the University of Rwanda and other settings. This awareness is already needed at this university, especially in academia, but it could not be raised due to the rivalrousness of infrastructural resources in the institution. As discussed earlier, the lack of information on this open access publishing route constitutes a danger to academics who may be targeted by predatory and vanity publishers (Brown, 2015). Members of the Open
Scholars Network could not afford to wait for the University of Rwanda to organise a workshop/seminar or a related event for its teaching and research staff to receive related training/information. As noted earlier, an interview with the university’s official who participated in the study from which the network emerged revealed that the institution had no agenda to raise such awareness.

The Open Scholars Network is not expected to be affected by the rivalrousness of political and infrastructural resources since it is not subjected to a hierarchical and bureaucratic system. The network abides to open sharing of knowledge and information. It uses web 2.0 technologies (starting with Facebook) that democratically enable any member to contribute to the network anytime, anywhere and as much as s/he likes. Such technologies enable the network to overcome bureaucratic and hierarchical barriers and challenges associated with physical infrastructure and competing parallel events. Activities of this network will not need to be cancelled and members of the network will not miss those activities because of competing or parallel events as it was the case for presentations that relied on bureaucratic arrangement and physical infrastructure. The web 2.0 technologies the network relies on enable asynchronous participation and contribution. Members of this network envisage taking advantage of these technologies and similar mobile technologies to create opportunities for underprivileged learners who qualify and wish to attend higher education but have not been included yet. While the network is still forming, it is too early to predict the exact outcomes of its practices. At the moment, however, there is at least certainty that the network has already started its contribution. The current article is one of its early contributions to advancing knowledge in the fields related to open education, open scholarship and digital scholarship.

5. Conclusion

The Open Scholars Network emerged from a research study on opening up higher education in Rwanda. The network intends to foster academics’ professional development in open scholarship, digital scholarship, open education and eLearning without relying on rivalrous resources. This development may help the network members contribute to addressing the increasing inequalities in higher education linked to the shortage of funds for student loans. The ultimate goal of the network is to innovate in open scholarship, digital scholarship and non-rivalrous education with an agenda to contribute to the accommodation of secondary education graduates who qualify and wish to attend higher education but have not been included in the system.

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References


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Barriers and solutions to innovation in teacher education

This article proposes how mobile technologies are being employed innovatively in teacher education across the European Union, contributing to an adjustment in teacher training models. It identifies various barriers and challenges to innovation and illustrates how teacher educators have addressed these in the first year of an Erasmus+ funded project.

1. Introduction

The modernisation of pedagogical practices in Higher Education is identified as a key Horizon 2020 priority by the European Union since it promises to enhance the skills and understandings of university graduates making them more employable and competitive in the global economy (European Commission, 2010). In Europe the preparation and development of new teachers is situated mainly within universities and therefore teacher education is seen as having the potential to make a major contribution to this European wide priority. This is apparent in the outcomes of the first Erasmus+ call (2013-2014) in which a project like the Mobilising and Transforming Teacher Educator’s Pedagogies (www.mttep.eu) was funded to develop a mobile learning network for teacher educators to support them in transforming their pedagogical approaches and practices with mobile technologies. This article draws upon data collected from the first year of the project which focuses on the challenges and barriers that face teacher educators as they attempt to innovate their practice using mobile technologies.

2. Context

The MTTEP project brings together teacher educators from five universities in (UK, Norway, Germany and Australia), along with three school-based partners involved in the professional development of teachers (Norway, the Netherlands and Germany). It seeks to transform the pedagogical practices of teacher educators and teachers by encouraging them to join a European wide mobile learning network and use a variety of new resources (a mobile learning toolkit) to assist them in benchmarking, evaluating and developing their use of mobile learning pedagogies.

The project has adopted a design based research (DBR) methodology to develop and refine the first elements and phase of the mobile learning toolkit which is a series of exemplar eBooks (see Anderson & Shattuck, 2012; Mor & Winters, 2007; Sandoval & Bell, 2004; Spikol, Bergström, Eliasson, Nouri, Olofsson, & Lindberg, 2012). These illustrate a range of alternative pedagogical approaches in teacher education including the concept of knowledge building,
and authentic assessment. The purpose is to encourage teacher educators to reconceptualise their pedagogical practice by exploiting the affordances of mobile technologies to transform rather than replicate existing pedagogies. The following case studies are both drawn from data collected during the first year of the project (2014-2015) when teacher educators and their students have concentrated on the construction of eBooks. The first case study features two teacher educators from the UK who worked with approximately forty of their own preservice trainees in English and Science. They collaborated with two high school teachers from Norway and twenty of their ‘A’ level students studying science and English. The second case study features one teacher educator who worked with twelve preservice history teachers. The following narratives show how this has not been without its problems which highlights some of the challenges that face teacher educators in introducing innovative new practices into universities.

3. Case studies

In one example UK preservice teachers and teacher educators from two contrasting disciplines (English and Science) worked transnationally with their counterparts in Norway to co-author their own, unique eBooks designed for an audience of ‘A’ level students. The production of these books was preceded by a visit to a local aquarium in the UK where the preservice teachers worked as mentors with the Norwegian students to gather artefacts and data about the maritime environment to incorporate into their eBooks. They constructed the eBooks on their iPads using a simple, intuitive App, called Book Creator. The process involved several iterative stages of development including the acquisition of original multimedia artefacts (e.g. short videos, audio recordings, voice-overs, etc), the crafting and refinement of purposeful text and signposts (including some bilingual recordings) and the testing and evaluation of the final eBook. The iPads were also used to facilitate language translation issues, translating various terms and phrases that were needed to express scientific and technical terms, or expressing points with the appropriate level of formality or informality. This was considered to be a highly authentic task for both the preservice teachers who were working with real students and the Norwegian students who were able to work with native English speakers, thus improving their language skills.

The second example features the work of history preservice teachers in the UK who also used Book Creator to author an original narrative about the life and death of a hitherto unknown British soldier from the First World War. The tutor responsible for the group modified the assessment requirements for his programme to accommodate this new ‘artefact of achievement’, awarding marks for the quality of the eBook itself as well as a more traditional reflective piece of writing completed afterwards. To complete the task students were required to undertake authentic research, searching through online databases such as the Commonwealth War Graves Commission website to piece together the fragmentary evidence about their selected soldier. Students then participated in an educational visit to the battlefields and memorials of Belgium and France where they used their iPads to capture and record original material related to their chosen soldier such as their grave site and the locations around where they had fought and died [https://goo.gl/9Almm4 ]. Back in the university these digital artefacts were woven together as a coherent single eBook which some students took with them into their teaching practicums to use with pupils.

4. Barriers and solutions to innovation in teacher education

Although these case studies illustrate how the use of personal mobile technologies can support innovative pedagogies they are not unproblematic and this final section explores some of the more common barriers which teacher educators face when they work like this and some of the solutions which have proved effective.

Authoring and co constructing eBooks requires that preservice teachers have access to suitable hardware and software at the point and time when they need it, not just in an institutional computer lab. These were previously barriers to innovate work of this kind but students are increasingly likely to have their own mobile technologies capable of undertaking these activities in class thus requiring only minimal institutional and technical support such as the provision of robust and ubiquitous wi-fi connectivity, and the availability of loaned devices for those without access. Whilst in the past access to affordable software might have been a serious obstacle, the emergence of the App ecosystem has significantly reduced or even removed this barrier allowing students to author their own eBooks with intuitive and affordable or free tools such as Book Creator.

Shortage of curriculum time, however, has always been identified as a barrier to innovation of this kind and constructing
eBooks, particularly as a collaborative activity, is certainly more time consuming than traditional activities. In both of these case studies students were therefore required to undertake additional work outside of their formal teaching sessions but ultimately time can only be made available by the reprioritization of other activities and this has been one of the most significant transformations to date as teacher educators on the programme have reconceptualised the traditional role of large lectures and teaching sessions. Therefore first order barriers – those external to the teacher such as resources, infrastructure and time – have been significant but not intractable.

Second order barriers - those internal to the teacher such as their self confidence, personal skills and pedagogical beliefs and attitudes related to the use of technology – are more demanding, ongoing challenges. Those teacher educators involved in the case studies above are not typical innovators or early adopters but it is likely their own beliefs and attitudes about learning are sympathetically aligned with the constructivist philosophy which underpins the construction of eBooks. Hence they have also been more inclined to attend training and support sessions offered by experts within the Faculty and have found the time and space to teach themselves the basic skills required to stay abreast of what their students are doing. Extending these behaviors and mindsets across the Faculty and beyond is a major challenge that remains ongoing but it will be greatly accelerated by the very positive and encouraging feedback from the students and tutors who have worked on the project to date.

<table>
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<tr>
<th>First order barriers (external)</th>
<th>Second order barriers (internal)</th>
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<tr>
<td>• Shortage of resources (e.g. mobile devices or software)</td>
<td>• Lack of self-confidence and belief</td>
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<tr>
<td>• Infrastructure issues (e.g. lack of wi-fi)</td>
<td>• Shortage of skills in using mobile devices</td>
</tr>
<tr>
<td>• Shortage of curriculum time</td>
<td>• Negative attitudes towards using technology in teacher education</td>
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Figure 1: Barriers to innovation in teacher education

5. Conclusion and next steps

To date the MTTEP project has demonstrated the motivational benefits of engaging preservice teachers in authoring and constructing their own eBooks which are popular with students and highly authentic as a form of assessment. The next stage of development will be to extend the scope of this activity beyond the early adopters and engage wider faculty in this process. The barriers to innovation which have been outlined in this article are unlikely to change but the outcomes reported here suggest that unlike previous technology initiatives some of the most persistent will not be technical or infrastructures issues (i.e. first order barriers) but rather second order issues such as the digital skills sets of lecturers and their prevailing attitudes and beliefs towards technology. Our findings indicate these are significant but not intractable barriers to innovation in universities.
References


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Innovative Teaching of Responsible Research and Innovation in Science Education

This study investigates how the ENGAGE HUB can support teachers’ to develop new strategies to equip students with knowledge and skills. The European project ENGAGE (engagingscience.eu) aims is to increase awareness of Responsible Research and Innovation (RRI) through Inquiry Based Learning (IBL) by reaching 12,000 teachers and 360,000 students in 14 countries. It combines OER, MOOC and CoP (Community of Practice) and targets three components: students’ interest, science knowledge and inquiry skills. This qualitative analysis focuses on the first year of ENGAGE HUB in the UK with 3,500 teachers and 18,000 materials downloaded. Findings indicate more than seventy strategies shared by teachers on how students are engaged through dilemma materials. Teachers’ examples present evidence that learning science concepts can be set within the context of its implications to society. Their innovative practices suggest ENGAGE lessons help students think, discuss and extend their knowledge through possible future scenarios that make the pros and cons of technology more concrete. In this context teachers play an important role for making science more relevant to students’ concerns, which are known to be future orientated. This might increase the likelihood that students can apply what they have learned outside school and respond to societal challenges.

1. Introduction

The 21st century is marked by the fast advancement in Science and Technologies. Latest discoveries related to various emergent fields such as nanotechnology, artificial intelligence, biotechnology are frequently announced to citizens through science-in-the-news. These daily innovations indicate various issues closely connected to citizens’ lives, for instance, food security, enhanced health, energy and environment. On the other hand, the impact of scientific innovations is unpredictable and implies scientific knowledge and skills for reflecting on social and ethical implications. This requires societies being able to deal with promises and uncertainties, particularly to develop better understanding of its potential benefits and risks (Sutcliffe, 2011; Von Schomberg 2013).

Education plays an important role in this contemporary scenario (Ratcliffe & Grace, 2003). The European Commission has highlighted the importance of Responsible Research and Innovation (RRI) in Science Education through its Science in Society programmes (FP7 and Horizon 2020) (Sutcliffe, 2011). Thanks to various European projects, teachers have been able to foster development of students’ inquiry based learning (IBL) skills, enabling them to discuss socio-scientific issues (Okada et al, 2015). Some of recent initiatives have been also highlighting the importance of students developing evidence-based opinion related to...
science in their lives, such as the ENGAGE project (Sherborne et al., 2014).

The ENGAGE project aims at spreading the teaching and learning of RRI at scale, by connecting cutting-edge Science and Technology with inquiry based learning. This study describes the ENGAGE HUB framework, which integrates “educative materials (OER) for students, communities of practice (CoP) and Open Online Courses (MOOC) for teachers. This qualitative investigation focuses on how the ENGAGE HUB can support teachers’ to develop new strategies to equip students to apply science knowledge and develop RRI inquiry skills (Fig. 1). A big challenge for teachers is to change how science is taught (Hoban, 2002, Dwyer et al., 1991). This requires innovating teaching’s practice. That means moving from teaching focused only on science as a body of content to equipping students with knowledge, skills and values to use science in society. In order to tackle this issue, our research questions focus on what the challenges and opportunities are for teachers to innovate their practices through the ENGAGE HUB.

2. Integrating Responsible Research and Innovation and Inquiry Based Learning

The RRI curriculum developed by ENGAGE (Fig. 1) presents a framework which integrates science-in-society knowledge and inquiry skills. It is based on European curricula and the US Next Generation Curriculum Science Standards (NGSS). Science-in-society knowledge refers to four key areas: Technology impact, Big Science, Values thinking and Science-Media.

- **Technology Impact**: Technological and Scientific developments are the basis for a better future but must be planned carefully in order to maximise the benefits and reduce risks, particularly any harmful impact.

- **Big Science**: Science is no longer an individual search for knowledge, but a collaborative and complex enterprise, done in teams. Funded largely by corporations and governments and politically determined, it favors practical applications and key areas in society. This means responsible innovations must address societal needs in accordance with societal values such as people, environment and economy.

- **Values thinking**: In emerging science and technology, there are often uncertain issues with unclear implications that require socio-ethical thinking. Decisions should be made by taking into account the views and concerns of various perspectives and actors in societies.

- **Science-Media**: Much of our scientific information is interpreted by the media, who may give an unbalanced, biased, black and white or sensationalised account. The source of information needs to be assessed in terms of its purpose, scientific credentials and topicality. Critically read media reports about science, identify the data, evidence and values thinking used to back up the claims, as well as evaluate its strength in terms of repeatability and reproducibility.

![Fig. 1. RRI curriculum: Science knowledge and Inquiry skills (Okada et al, 2015)](image)

RRI consider that technology and science progress are the basis for a better future. However innovations must be planned carefully to address societal needs in accordance with societal values in order to maximize the benefits and reduce any harmful impact. Therefore, citizens should be involved in understanding these four areas and develop inquiry skills to form evidence-based opinions on societal needs and social values. With this purpose, scientific inquiry skills integrated to RRI focus on eight abilities listed below:

1. **Interrogate Sources**: questioning different sources and assess their validity and trustworthiness by judging the reliability of the source, check for bias and evaluate evidence for claim.
2. **Use ethics:** understanding that scientific reasoning can help to identify implications of certain applications but decisions about whether certain actions should be taken will require ethical and moral judgements which are not provided by knowledge of science.

3. **Examine consequences:** evaluating the merit of a solution or competing solutions to a real-world problem, based on scientific ideas and principles, empirical evidence, weighing up benefits and risks and/or logical arguments regarding relevant economic, societal, environmental and ethical considerations.

4. **Estimate risks:** measuring risks and benefits by assessing its probability. To weigh up a risk means combining its probability and the scale of the consequences, and balancing against the benefits to the individuals or groups affected.

5. **Analyse patterns:** interpreting observations and data in a variety of forms to identify patterns and trends, making inferences and drawing conclusions.

6. **Critique claims:** check strength (quality accuracy and sufficiency) of evidence provided and identify lack of clarity of justification. Comment on whether the reasoning follows logically from the evidence, and provides strong support to the claim.

7. **Justify opinions:** synthesising scientific knowledge, implications, and value perspectives into an informed opinion describing key arguments supported by empirical evidence and scientific reasoning, and identifying values based thinking, to support or refute a viewpoint on an issue or a solution to a problem.

8. **Communicate ideas:** Being able to effectively describe opinions and accomplishments with text and illustrations, both orally and in writing, in a range of formats, using the major features of scientific writing and speaking.

The ENGAGE project offers three kinds of OER for teachers to support students to develop the RRI inquiry skills described above:

I) **Dilemma lessons:** refers to a short lesson based on a set of activities to engage students with productive socio-scientific issues and support them to extend and evaluate their learning with group discussion. Various online multimedia resources are included in the ENGAGE materials, for instance, slide presentation with activities for students, guidelines for teachers with pedagogical suggestions, and web links with science-in-the-news or video clips with scientists. These OER refer to controversial socio-scientific issues related to applications and implications of science introduced to students at the beginning of a lesson.

A scientific dilemma must be engaging, authentic, controversial, covered by the curriculum, social and related to RRI. Its aim is to provide a productive learning context to capture students’ interests to discuss and extend their understanding for developing evidence based opinion.

**Group Discussion** refers to a small team with 3 to 4 students whose aim is to share understanding about a scientific dilemma and practicing arguing and reasoning together. For that, students will need prior knowledge to extend their learning and articulate their own ideas with their peers. They can check evidence, evaluate arguments and compare solutions together using online templates.

For instance, in the following example (Fig. 2), students are presented with PowerPoint slides presenting GM technology in a negative light to add controversy and provoke discussion. They are then given the dilemma ‘will you buy GM cereal?’ Then, students work in groups looking at statements about GM food. After reading each one, they discuss the question “does the statement support the claim that eating GM free cereal is a risk to your health?” The group needs to reach a consensus before moving onto the next statement.

![Figure 2 - ENGAGE dilemma material: GM decision (EngagingScience.eu)](image)

II) **Problem-solution lessons:** refer to a series of two or more lessons with more advanced activities also presented with PowerPoint slides to teach inquiry processes, help students...
explore ways to solve problems and explain solutions through argumentative conversations. It refers to provocative problem emerging from a real life issue. The requirements for the problem are similar to the six criteria for a ‘scientific dilemma’, but it includes also “Need to know”. It covers the whole inquiry process and science concepts for students to solve the problem. Students will gain insight into not only the skills, but also the science concepts and principle involved in carrying out the processes (e.g. data analysis).

Conversation refers to whole class debate based on four steps sequences of questions for argumentative thinking with the aim to support students develop evidence based solution. First, teachers select questions designed to activate or provide students with the essential background knowledge. Second, they organise concepts and facts into evidence. Third, they elaborate opinion and justification using argumentation (claim, evidence and reasoning) Fourth, the teacher organises a whole class debate through some suggested or adapted methods. The aim of the conversation is to support high quality argumentation and final outcomes, which explain problems-based solutions.

For instance, in the following example (Fig.3), students are set the problem of deciding whether they would sign a petition in support of a ban on animal testing. In the first lesson, students apply their knowledge of the gas exchange system to explain what causes asthma and why new drugs are needed to treat it. They look at scientific evidence to decide how essential animal testing is in the development of new asthma drugs. This is designed to put the problem into a scientific context relevant to the curriculum. In the second lesson they are introduced to three types of ethical thinking through a game based on a reality television show. The aim of this is to introduce a new skill through a familiar and engaging setting. They then apply these principles and practice the skill of ethical thinking by looking at ethical arguments for and against a ban on animal testing, which they use in a class debate (conversation). By the end of these two cycles, the students are equipped with both the scientific concepts and principles which they need to respond to the original problem.

III) Scenario-based topic: refers to a group of lessons to teach science content and inquiry skills ending in a performance assessment. Students will investigate more independently by practicing inquiry skills, applying science concepts and developing awareness of responsible actions. Scenario-based learning helps teachers to create inquiries which blend content and process teaching into a compelling scenario about contemporary science. Instead of having purely academic goals and largely disconnected lessons, a Scenario-based topic weaves the content and process teaching into the scenario, as waypoints towards achieving the goal. The scenario is structured into stages, where a question or need for information launches a teaching episode, or student inquiry.

Performance assessment helps teachers and students use ENGAGE tasks to assess students’ learning of RRI/inquiry processes and content. It aligns curriculum and assessment, taxonomy of learning objectives and uses rubrics to assess student work.

3. The ENGAGE HUB for Teacher's professional development

The ENGAGE HUB (EngagingScience.eu) provides IBL focused OER for developing pupils RRI skills and MOOC for teacher’s professional development. This online environment was developed using WordPress for just-in-time OER production based on Science-in-the-news. It was configured as a network of sites (WPMU) in order to have a site for each language and linked to social media platforms, e.g. SlideShare, YouTube,
Pinterest, Facebook and Twitter. The EdX MOOC login system was integrated to the WordPress with automatic authentication to facilitate user access to online courses. Its video library was setup on YouTube and is focused on teachers’ interests, needs and productions. MOOC was designed to support teachers’ best practices and promote knowledge exchange to foster their CoP. A set of widgets was embedded around content for teachers to share preferences, opinions and reviews. Their user profile was extended to include their professional development pathway based on their interactions on both the OER and MOOC environments (Okada et al., 2015).

The Knowledge Hub (Fig. 4) is open to any visitors to access OER and its reviews by the community. After signing up, participants as members can use, adapt, rate and comment on three types of OER and apply its respective RRI tools. Open online courses provide teachers with opportunities to understand the principles related to each RRI tool and develop teaching skills efficiently. These mini open online courses were designed to be short and address teacher’s needs to embed OER successfully in their lessons particularly using toolkit to innovate their practice as reflective practitioners.

Teachers can act as reflective practitioners (Shulman, 1986), by keeping their professional development pathway updated in the CoP through self-assessment and own online portfolio of OER that they have adapted. These features aim to build a sense of community by facilitating interaction between members and rewarding committed practitioners. The platform gathers evidence on OER usage and comments or reviews posted about achievements with OER or in the MOOC environment. Through accumulated interaction with the ENGAGE Hub they can also be recognised as experts within the CoP.

Teaching in a RRI context requires teachers to learn new skills and a significant teaching change. There are various barriers pointed out by previous ENGAGE research in eleven European countries related to embedding RRI in science curriculum (Kikis-Papadiskis & Chaimala, 2015). For instance, schools must follow a predefined curriculum, teachers do not have much flexibility to implement new lessons, national curriculum exams focus on science content and in general educators are not prepared nor do not feel confident to change their practice.

In order to face all these challenges, the ENGAGE RRI HUB was designed, to support the teachers’ CoP to facilitate the growth of teachers’ conceptual and practical knowledge through OER and MOOC gradually by the following three stages: adopt, adapt and transform (Aikenhead, 1994). These three stages indicate the degree to which science and society content is integrated with traditional science content for learning:

- **Stage 1 Adopt**: minor change – extending topics already taught with dilemma lessons. It presents little RRI content for motivational purposes to be applied in short lessons.
- **Stage 2 Adapt**: significant changes – teaching inquiry processes with problem-solving lessons. There is a casual infusion of more RRI content but with no explicit purpose.
- **Stage 3 Transform**: major changes – teaching science content with a Scenario-based topic. There is a purposeful infusion giving even more time to RRI.

The ENGAGE RRI HUB considers, firstly, teachers might adopt new teaching strategies to their repertoire by using an easy-to-use material for one short lesson. This might add extra benefits, such as “topical dilemma materials” for attracting students to extend their learning through group discussion. Secondly, teachers might feel more motivated to adapt their existing practice to fit more exciting “problem solving materials” including argumentative conversations into their curriculum. Once teachers are aware that they can integrate RRI and IBL in their lessons as well as address the national curriculum needs; they might be able to complete the transform stage. This means to equip students for integrating conceptual knowledge, inquiry skills and societal values in order to solve “controversial scenarios related to socio-scientific issues”. Additionally, through assessment performance, they might also be able to assess students’ innovative learning and provide evidence of innovative teaching.
4. Methodology

The qualitative approach based on virtual ethnography comprises of four steps. First, this study investigated online comments, discussions and suggestion shared by teachers in the OER and MOOC. Second, data from surveys available in both environments, WordPress and EdX, was analysed. Third, quantitative data from its users’ analytics was also considered to identify most popular and commented OER (materials and tools), including teacher’s strategies. Fourth, the application tool LiteMap was used to categorise data, visualise patterns and support qualitative analysis. This tool provides a dashboard with various visualisation which was used to analyse the ENGAGE CoP collaboration.

Qualitative data comprise comments and reviews about OER by teachers in the CoP (June 2014 to June 2016) and MOOC (July 2015). Teachers’ suggestions and strategies were categorised and grouped in categories based on the “short” inquiry cycle: ENGAGEMENT <=> EXTEND <=> EVALUATION (Bybee, 2006) for 1 lesson:

- **Engagement**: activities are designed to help teachers promote curiosity and elicit students’ prior knowledge. Students are encouraged to make connections between past and present learning experiences, expose prior conceptions, and organize their thinking toward the learning outcomes.
- **Extend**: activities also support teachers to challenge and extend students’ conceptual understanding and skills. The students are asked to apply their knowledge and skills for elaborating questions, comparing facts and opinions, and develop their evidence-based conclusion.
- **Evaluation**: activities also encourage students to assess their understanding and skills. It also provides opportunities for teachers to evaluate students’ progress toward achieving the learning outcomes.

Teachers’ comments in the OER Hub and MOOC environment were also analysed through LiteMap (http://litemap.net) a mapping application for mapping collective knowledge of online communities. These comments were classified in 6 categories (see Fig.5): (pink) materials, (purple) year group, (brown) strategies, (green) benefits, (red) challenges and (grey) learning outcomes. LiteMap provided useful visualisation about these categories emphasizing nine materials.

5. Findings

During the first year after the launch of the OER platform shows that ENGAGE UK reached beyond its target with 3,125 teachers registered and 18,368 materials downloaded. The three most accessed materials had more than 1600 visits and the four most popular materials shows more than 250 files downloaded. Approximately 60% of users access various resources and 75% return to the website. The average time of users on the website is 5 minutes.

Qualitative data from comments and reviews about OER by teachers in the CoP (June 2014 to June 2015) and MOOC (July 2015) showed evidence on how they have been using dilemma material and group discussion to innovate their practice. It was possible to map strategies, challenges and benefits. The majority of teachers who used ENGAGE declared that OER were effective for engaging students with the activities, including videos and resources on both OER portal and MOOC environment. There were three key categories that emerged from data analysis used to highlight evidence about how teachers are using ENGAGE HUB to innovate their practices. To illustrate those categories a few examples were extracted from a list of more than 70 strategies (Okada et al, 2015) as evidence on how teachers are moving from instructional lessons based on delivering science concepts to promote engagement with dilemma discussion for student applying knowledge and skills.

5.1 ENGAGE

a. Use scientific dilemma for activating students’ curiosity and interest:

- Make the context more fun with real demonstrations OER (Eat Insects) 03/07/2015 AL
- Create opportunity for students to ask more questions than look for answers MOOC(UK01) 10/07/2015 JW

b. Set science-in-context to capture student’s attention with Science:

- Making the newspaper articles ‘consumable’ for student annotation. OER (Giant Virus) 27/06/2014 PH.
- Promote student’s reflection on various perspectives of socio scientific issues presented by real people on resources (e.g. Youtube) talking about the real problem MOOC (UK01) 27/07/2015 JDI
5.2 EXTEND

a. Help students apply their knowledge to develop their own opinion:
   - Apply easy-to-use templates and worksheets suggested in the materials OER (Take test) 24/02/2015 HK
   - Be aware of ongoing research that can be useful to extend the topic OER (Grow your body) 15/05/2015 CB

b. Guide students to apply inquiry (RRI) skills to find best solution or evidence-based opinion
   - Ask students to choose favourite outcome: report, online news, presentation. OER (Ban-the-Beds) 14/09/2014 BE
   - Identify skills that students need or want to practice e.g. of interpretation, data analysis, discussion MOOC (UK01) 18/07/2015 JL

5.3 EVALUATE

a. Get feedback to improve performance:
   - Discuss with students skills that they developed or need to improve: data analysis, arguments, conclusion MOOC (UK01) 20/07/2015 JU
   - Ask a department discuss how the lesson could be expanded to include fieldwork, numeracy, PSHCE etc. MOOC (UK01) 10/07/2014 Y78

b. Teachers will also need to reflect on what their students learned from the lesson and how:
   - Identify and discuss about misconceptions MOOC (UK01) DE
   - Reflect with students: what different ways could they assess the outcome of their learning? MOOC (UK01) 18/07/2015 JW

Figure 5 created through LiteMap tool shows teacher’s comments on specific OER (pink circles). The most popular resource in the UK was “Eating insects” with more than sixty five comments. Teachers mentioned that they applied this lesson with three curriculum groups (purple circles): Year 7, Year 8 and Year 9. For each year group, they highlighted some benefits (green circles), such as “useful science-in-the-news weblinks” and challenges (red circles) such as “I had to modify it to fit better to Y9”. Then, some strategies (brown) were mentioned related to each benefit or challenge, for instance “web links suggested in the resources help teachers to set up science in context” some of them with learning outcomes (grey) such as “Students were really engaged in discussion using persuasive language”.

In general, the majority of teachers highlighted diverse benefits (green circles) about materials related to students’ engagement, useful resources, flexible materials, up-dated content, exciting multimedia, and meaningful activities. A few challenges were mentioned by teachers (red circles): some activities were short for the lesson; motivated students could work more, students that do not have enough knowledge on the topic find it difficult to participate in the dilemma lesson and group discussion, more guidance in assessing students’ learning would be useful.
In the ENGAGE CoP, teachers provided evidence about positive outcomes (grey circles) with clear examples, such as students developed various skills particularly debating, arguing, evaluating and writing. The comments below extracted from data analysis were selected to illustrate teachers’ achievements related to the 8 RRI skills:

- **Interrogate Sources**: Students commented that they could have been reading different stories! At this point I (teacher) explained that they were the same “issue” but in different papers. OER (Giant Virus) 27/06/2014 JT
- **Use ethics**: The series of lessons offered an extra dimension for the students to hook their knowledge and understanding scientific issues, for example: genetic inheritance onto, the dilemmas of taking a test, the ignorance of some and possible “prejudice” of others. OER (take test) 21/04/2014 GZ
- **Examine consequences**: Students were stimulated to look at all the issues surrounding the dangers of this virus and vaccination pros and cons. OER (Ebola) 31/10/2014 LE
- **Estimate risks**: A lot of pupils knew benefits but not the risks of scientific issues, e.g. they were able to explain what a tanning bed is, but none the danger linked to it. OER (Ban-the-Beds) 14/09/2014 PC
- **Analyse patterns**: Students used real data suggested in the materials to bring questions, analyse and interpret OER(Solar roadways) 17/12/2014 LE
- **Justify opinions**: Students were able to integrate science knowledge and inquiry procedure, for instance, to elaborate the menu for the canteen by describing sourcing the insects with detailed information. OER (Eat Insects) 17/07/2015 BE
- **Critique claims**: Students questioned other groups’ beliefs and the level of concerns OER(Giant Virus) 27/06/2014 JT
- **Communicate ideas**: Students practiced various inquiry skills: elaborating argument, arguing and communicating science MOOC (UK01) X1

### 6. Discussion

This study focused on how the ENGAGE HUB can support teachers’ to develop new strategies by using dilemma OER which integrates RRI integrated to IBL, supported by MOOC and CoP for professional development. Various investigations highlight the importance of CoP for continuing professional development (Buyssse et al. 2003; Wenger, 1998) and supporting teaching-led innovation (Burden & Hunt, 2010; Toole & Louis, 2002; Little, 1982 and Rozenholtz, 1989). Some of these studies indicate that teaching is more effective in schools, which operate as professional learning communities, where all participants learn with each other (Little, 1982; Rozenholtz, 1989; Grossman et al., 2001) or innovation ecosystems - interconnected learning for improvement (Hannon et al., 2011).

The ENGAGE CoP is still in its initial stage of development between coalescing and maturing (Wenger, 1998) So, ENGAGE members are still building relationships mainly through MOOCS and workshops. Participants are still discovering what useful knowledge can be shared (Shulman, 1986) and their key drivers for innovation. Hargreaves (2004) highlights various drivers for teachers’ innovation combined with network communities: teachers often adjust materials and share new strategies to help students learn. They also look for creative opportunities for improving professional skills especially to meet changing circumstances. Innovation can be considered a way of learning professionally, it empowers teachers to enrich their practices to improve students learning including their own innovations to succeed at their studies, work and life.

Innovative CoP takes time to consolidate, the ENGAGE facilitators and researchers will be investigating together how to build stronger bonds among the teacher community to create enough energy and momentum to sustain inter-action and identity during the next two years of the project. As Nuffield Review (2009) has pointed out, educators need the kind of professional development and resources that meet their teaching concerns and enrich their knowledge of addressing the learners’ needs.

During this investigation based on the first year of ENGAGE in the UK it was possible to identify that there is not enough research to know the effects of communities of innovative teachers on student’s innovative learning (Muijs & Harris, 2003) and how to scale up innovative classroom practices.

In ENGAGE, evidence shows that teachers in the UK started to share not only benefits or challenges they faced to innovate their practices, but also examples on how materials, tools and their strategies can be used for their students’ innovative learning. Excellence in education according to Hattie (2009) occurs through visible teaching for visible learning when teachers are able to see learning through the eyes of their students and prepare students to see themselves as their own teachers. Teacher’s strategies and examples shared in the ENGAGE Hub indicate that dilemma lesson allow them to identify what students understood from science concepts when
they applied knowledge and skills to discuss the dilemma. Teachers mentioned that they were also able to identify misconceptions and gaps. Their comments also suggested that efficient procedure for Inquiry Based Learning might help learners to understand how to learn and teach themselves. In addition strategies and outcomes of group discussion in dilemma lessons indicate that individuals and groups can learn from each other as well as from their own reflection particularly during evaluation activities.

However, the examples provided by teachers are not enough to assess the impact of RRI teaching on students’ learning. Most of the teachers’ comments generalise the outcomes for the whole class, and just a few of them were able to mention outcomes of specific students. The current challenge for teachers is to be aware of what each student, group or whole class is thinking and knowing (Hattie, 2009; OECD, 2014). So teachers must establish success criteria for their lessons, create opportunities for learners to construct and reconstruct knowledge and ideas, and provide meaningful feedback for each student progress on their learning goals. In ENGAGE, this will be expected during the transform phase with scenario-based topic and performance assessment, where teachers will prepare a set of lessons for students to develop knowledge and skills, interact with experts or scientist; and be aware about their learning achievements.

7. Conclusion

This research is timely since Responsible Research and Innovation (RRI) in Science Education is emerging and there is a lack of studies in this field. Although there are various RRI projects funded by European Commission such as ENGAGE (engagingscience.eu), most of these initiatives are recent. It is clear that there is a need for further research, particularly on the effect of teaching innovation of RRI and IBL for equipping responsible innovative learners at scale.

Previous research (Kikis-Papadakis & Chaimala, 2015) shows various barriers and challenges for teachers to innovate RRI teaching in Europe. By discussing together both the ENGAGE framework for teachers’ CPD, which consider those challenges, as well as, strategies suggested by the own teachers of ENGAGE CoP; we hope to find practical ways of approaching the initial key issues in this area: How could teachers start their teaching innovation with RRI and IBL? What might be the initial effect of teaching innovation through dilemma and group discussion on students’ learning? What are the next challenges for ENGAGE CoP of innovative teachers?

Our findings related to one year of the ENGAGE project are encouraging. Even though the teachers’ CoP in the UK is on its initial stage of development, participants’ comments show various strategies about how to innovate with dilemma and group discussion as well as a few challenges and positive outcomes on students’ learning. The next stage of our work is to integrate the research outcomes of the ENGAGE consortium, which includes 14 countries. Our next investigation will also focus the uses of ENGAGE CoP during the Adapt phase with problem-based solution materials and the argumentative conversation tool. If ENGAGE CoP can be fostered successfully, this might help a higher number of teachers to reach the Transform phase. Therefore, it will be possible to find new ways to address the problem outlined at the beginning of this paper - how to equip the next

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References


LiteMap(2015) Engaging Science Maps https://litemap.net/group.php?groupid=137108145210855988001438171247&isgroupadmin=false&start=0&max=20&orderby=date&sort=DESC&filternodetypes=MAP#-1

Okada, A. (2015). Responsible Research and Innovation in Science Education. The Open University UK KM.
Ratcliffe, M., & Grace (2003), M. Science Education for Citizenship. Open University Press
Shulman, L. S. (1986). Those who understand: knowledge growth in teaching, educational researcher, 4-14

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“Let’s do this together and see what we can come up with!”
Teachers’ Views on Applying Game-based Pedagogy in Meaningful Ways

Game-based pedagogy offers a promising approach to renewing school education and making it more engaging. However, teachers’ ways of using game-based pedagogy have been rather traditional, not making use of its full potential. This paper presents initial findings on the experiences of teachers who participate in a project that aims to promote the meaningful use of game-based pedagogy. The findings suggest that game-based pedagogy could indeed play a key role in changing traditional practices in schools. Game-based approaches can support differentiated instruction, enhance pupils’ motivation and effort, provide new perspectives to assessment, and transform traditional roles in the classroom by encouraging pupils’ active participation and by giving them more responsibility and independence. However, in order to use the full potential of game-based pedagogy, a broader range of new approaches should be used, including not only educational games but also entertainment games, gamification, and activities where students make their own games.

1. Introduction

Many areas of culture and society are being exceedingly penetrated by playfulness, or ludification (Frissen et al., 2013). At the same time, researchers have highlighted the need to renew education with pedagogical innovations that make learning more meaningful, enhance motivation, and support learners’ confidence in their own competences (e.g., Kupari et al., 2013, p. 70). As game-based approaches have been shown to have potential in terms of both learning outcomes and motivation (see e.g., Connolly et al., 2012), they provide a promising approach to enriching school education. In the development and successful implementation of new educational innovations, teachers play a key role. In this paper, we will examine how teachers have applied game-based pedagogy and discuss its potential for enhancing and renewing education.

1.1 Game-based pedagogy

Van Eck (2006) has defined game-based learning to include 1) educational games, 2) the use of entertainment games in education, and 3) learning by making games. Game-based pedagogy can also make use of 4) gamification – the use of game elements in non-game contexts (e.g., Deterding et al., 2011; Kapp, 2012). Figure 1 illustrates these four different forms of game-based pedagogy.
Figure 1. Different forms of game-based pedagogy.

The most common approach is the use of educational games that aim to deliver “specified learning goals, outcomes and experiences” (De Freitas, 2006, p. 9). Educational games have had positive effects in many school subjects; for example, they have improved mathematics achievement (Kebritchi et al., 2010; Shin et al., 2012) and helped students understand certain scientific phenomena better than traditional teaching tools (Corredor et al., 2014). Especially with skills that require plenty of repetition, such as early literacy and basic arithmetic skills, educational games have shown a great deal of potential in motivating the learners to keep practicing by dynamically adapting to their skills (e.g., Richardson & Lyytinen, 2014, Shin et al., 2012). However, the main challenge with many educational games is that once the novelty wears off, the motivational effects may not be very long-lasting (Ronimus et al., 2014).

To expand the scope beyond educational games with specific didactic goals, we can use entertainment games for educational purposes (Van Eck, 2006). They have been applied especially in subjects like history and social studies (e.g., Charsky & Mims, 2008; Fisher, 2011). One of the main reasons for bringing entertainment games into the classroom is their flexibility: it is up to the teacher how and when the game is used and integrated into other practices (e.g., to introduce a new topic, to illustrate and provide practical examples, or to synthesize things that have been learned) (Van Eck, 2006). However, as entertainment games are not intended as educational tools, they usually need to be complemented with additional activities that connect the game to the content (Charsky & Mims, 2008). Ideally, these activities are part of the game world or shared narrative so as to not interrupt the game flow (Charsky & Mims, 2008; Van Eck, 2006).

A third approach to using games in education is having learners build their own games (Van Eck, 2006). In many cases, making games can be a more efficient way to learn than merely playing them because in the process of creating a game, the learner constructs new relationships with knowledge (Kafai, 2006). Several studies support this view, providing promising results on the usefulness of game creation, for example, in terms of motivation and deeper learning strategies (Vos et al., 2011) as well as critical thinking and academic achievement (Yang & Chang, 2013). Moreover, game building taps into several different areas of interest. For example, it may help promote boys’ interest in creative writing and girls’ interest in ICT (Robertson, 2012).

Finally, gamification refers to using game thinking and game design elements in non-game contexts with the aim of engaging and motivating people – and, especially in the context of education, to encourage learning (Deterding et al., 2011; Kapp, 2012, pp. 10, 15-16). Gamification is often associated with mere mechanics such as points, badges, and rewards, neglecting elements like storytelling, challenge, problem solving, and character development even though the latter aspects are often more crucial for the learner’s engagement (Kapp, 2012, p. 12-13). In education, the role of gamification can be related to guiding learners through the process of mastering a new skill (cognitive area), providing learners with positive emotional experiences and encouraging them to try without fearing failure (emotional area), or allowing learners to try on different roles and providing opportunities for receiving recognition from others (social area) (Lee & Hammer, 2011). Especially the emotional and social dimensions of gamification have been found effective (Domínguez et al., 2013). Despite the increasing amount of research, few schools have thus far made game-based activities an integral part of their everyday activities. While teachers do acknowledge the usefulness and motivational benefits of games, in practice the ways of using games are still fairly limited and traditional: games have mainly been used as light snacks between “serious” tasks in order to make classes more fun, or as tools for revising things that have already been taught using traditional methods (Nousiainen, 2013). Thus, we need to focus on examining how to translate the educational potential of games into practice on a broader scale.
1.2 Teachers’ views and attitudes toward game-based pedagogy

According to Dondi and Moretti (2007), there are three types of teachers in terms of integrating games in education: 1) those who use games as an integral part of their teaching and have a good understanding of their potential, 2) those who have discovered one game or one type of games that they find useful but are reluctant to venture beyond this comfort zone, and 3) those who are not at all interested in trying games and do not see games as a serious approach to learning. The point is that we cannot only count on the most active user category to make game-based pedagogy a more widespread practice; instead, we will have to address all these perspectives (Dondi & Moretti, 2007). Moreover, technological tools and resources (including game-based ones) are not always used very creatively. The ways of using these tools are static and unidirectional despite the fact that their creative potential is seen to manifest especially in such situations where learners are allowed to explore them in an open-ended way (Cachia et al., 2010).

When it comes to spreading game-based pedagogy and other innovative pedagogical approaches, the challenge often lies in the notion that the teacher must be more competent than the learners – while, in fact, the greatest potential for learning may emerge from exploring things together (Cachia et al., 2010). According to a recent survey (Hamari & Nousiainen, 2015), teachers’ openness towards technology and the extent to which they saw technology as compatible with their own teaching had an effect on both the perceived value and the actual use of games in education. The actual use of games was also influenced by a supportive school culture and the teacher’s ICT self-efficacy (Hamari & Nousiainen, 2015). The results of the international Innovative Teaching and Learning Research (ITL) study showed that innovative teaching flourishes in school environments with a collaborative and supportive overall culture especially in terms of 1) peer support and sharing, 2) teachers’ direct involvement in practicing new teaching methods, and 3) a common vision that encourages novel approaches (Shear et al., 2011). A key question is what kind of approaches and practices facilitate the spreading and application of game-based pedagogy in schools in such a way that both teachers and pupils see value in it.

2. Case ‘Game-based Pedagogy and Portfolio-based Learning’

In this paper, we will present initial research findings from a project called Game-based Pedagogy and Portfolio-based Learning (2013-2016) carried out in Helsinki, Finland. The project involves 15 comprehensive schools, 32 teachers, and approximately 700 pupils (between 6 to 16 years of age). The main goal is to develop teaching practices that enrich learning and make learning more meaningful by using game-based pedagogy.

Each school has prepared their own development plan based on their pedagogical goals, general interests, and specific challenges they want to address with the aid of game-based pedagogy. On the basis of these plans, the teachers develop their teaching methodology together with experts of game-based pedagogy and different companies operating within the field. These new teaching methods are applied and experimented with in authentic teaching/learning situations. Experiences and results are then shared through open blogs, seminar presentations, and study visits to other schools.

3. Methodology

To examine the use of game-based pedagogy in the schools participating in the project, we have used a mixed-methods (Creswell & Plano Clark, 2007; Johnson et al., 2007) approach, collecting both qualitative and quantitative data. This section presents the process of data collection and analysis.

3.1 Data collection

Overall, our data consists of online questionnaires to teachers and pupils, thematic interviews with teachers, as well as teachers’ portfolios and fixed-format activity descriptions. The data was collected in May–June 2014. This paper is based on the initial analysis of two the aforementioned data sets: teacher questionnaire and teacher interviews. The aim of the questionnaire was to ask the teachers of each school about their activities and experiences regarding the use of game-based approaches. The questionnaire included quantitative Likert-scale items as well as open-ended questions. In order to delve deeper into teachers’ approaches, we selected teachers from four schools for additional interviews. Due to the small number of participants, the emphasis is on the qualitative data, and the quantitative data serves to illustrate the overall picture.
3.2 Analysis

The aim of the analysis was to shed light on two themes: 1) the types of game-based pedagogy used by the teachers and 2) the teachers’ views on the role and value of game-based pedagogy as part of the school culture. The analysis was conducted in two cycles: we started by analysing the questionnaire data (N=19), and this initial categorisation was complemented and expanded with the interview data (N=6).

**Analyzing the types of game-based pedagogy:** The categories presented in Figure 1 (i.e., educational games, entertainment games, making games, gamification) were used as the framework of analysis. Altogether, four questionnaire items were included in the analysis. A quantitative Likert-scale item (To what extent have you used the following types of game-based pedagogy) demonstrated the frequency of each type of activity. Three open-ended questions (Briefly describe one or more particularly positive experiences on implementing game-based pedagogy; Briefly describe one or more particularly challenging or problematic experiences on implementing game-based pedagogy; General comments or feedback related to the project), along with the interview transcripts, were coded using the aforementioned categories in order to provide qualitative descriptions of how the different game-based activities were carried out. The results are presented in Section 4.

**Analyzing the value of game-based pedagogy:** The perceived value of game-based pedagogy was analysed using a data-driven approach, categorising qualitative questionnaire and interview data into themes emerging from the content. The data consisted of the three aforementioned open-ended questions and the interview transcripts. The first cycle of analysis (the questionnaire items) yielded three main categories, and a fourth category emerged from the analysis of the interview data. Finally, we conducted one additional cycle of analysis in order to uncover the teachers’ views on the main barriers and challenges to adopting game-based pedagogy. The results are presented in Section 5.

Table 1 shows the gender, job type, and age distribution of the teachers who responded to those questionnaire items that were included in the analysis for this paper. The language of the questionnaires and interviews was Finnish. The direct quotes included in this paper have been translated by the authors.

### Table 1. Questionnaire respondents

<table>
<thead>
<tr>
<th>Gender</th>
<th>Type of job *</th>
<th>Age</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>Class teacher (primary)</td>
<td>under 30, 1</td>
</tr>
<tr>
<td>Female</td>
<td>Subject teacher (primary)</td>
<td>30-39, 11</td>
</tr>
<tr>
<td></td>
<td>Subject teacher (lower secondary)</td>
<td>40-49, 2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>50-59, 4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>over 60, -</td>
</tr>
</tbody>
</table>
*Some teachers belonged to more than one category

4. Results: Types of game-based pedagogy

The first question to address was the extent to which the different types of game-based pedagogy (see Figure 1) manifested in the activities carried out in this group of schools. Figure 2 illustrates the frequency of each type of activity, based on the responses of 19 teachers.

As Figure 2 shows, all four types of game-based pedagogy were present. The use of educational games was clearly the most prevalent approach but a majority of the teachers had also carried out activities in which the pupils were creating games themselves. Entertainment games and gamification were used less frequently. In the following subsections, we will present each of these categories in more detail.
4.1 Educational games

Educational games were widely used: 16 out of the 19 teachers (84%) had used them at least somewhat extensively, and none of the teachers said they had not used them at all (Figure 2). In the interviews and open-ended answers, the teachers particularly emphasised the potential of educational games for differentiated learning due to their ability to adapt to the pupils’ skills and motivate them to practice more.

With second-and-third-graders, learning multiplication tables is one of the key things, and that’s where a game like SumDog works really well. It’s all about repetition, repetition – but because it’s a game, it’s fun and you want to keep going. – Primary school teacher, F

Many of the positive examples described by the teachers were related to learning mathematics (using games such as SumDog, King of Math, and 10Monkeys). This reflects the suitability of educational games for such topics where repetition and rehearsal play an important role, and where there may be considerable differences in learning pace between individual pupils.

4.2 Entertainment games

As stated above, the use of entertainment games was not as frequent. Five teachers (26%) had used them very or somewhat rarely and two (11%) not at all, while seven teachers (37%) had used them extensively or somewhat extensively (Figure 2). Also in the interviews and open-ended responses, the teachers mentioned fewer examples of using entertainment games than they did of using educational games. When entertainment games were used, they were integrated as one element in broader gamified activities where their role was to establish a narrative context or provide a mystery for the pupils to solve.

In human biology, I’ve used [a game based on the television series] House, M.D., which basically works very well as a role-playing game for the pupils. The very best feedback I have ever received in my job was when [we were using the game] to find out what had happened to Mr. Mäkinen who was hosting a travel programme and got sick. – Primary school teacher, M

4.3 Making games

More than half of the teachers (58%) had at least sometimes carried out activities related to making games (Figure 2). Based on the interviews and open-ended responses, these activities ranged from the creation of GPS-based outdoor learning paths (see quote #1 below) to the use of visual programming tools to create playable digital games (quotes #2 and #3). Visual programming was used in several ways: after-school clubs, optional courses, cross-curricular projects, and even as peer tutoring where a group of pupils taught pupils from another school to make games.

[1] The kids designed a ‘signs of spring’ game with me, using a tool called ActionTrack. They were very excited to borrow nature-related books and to design tasks for the game. They successfully played their games in pairs or small groups in the vicinity of the school. – Primary school teacher, F

[2] A year ago we started doing visual programming with Scratch. It started out as a club, and then it was made into an optional subject that we have tied with other classes, mainly history. We have also visited another school to teach programming to another 5th-grade class. – Primary school teacher, M

[3] Kodu generated a lot of collaboration, [pupils] began to help each other. I hadn’t used the programme myself for more than an hour or so […], so they have more experience with it than I do. – Lower secondary school teacher (mathematics, computer science), M

4.4 Gamification

Gamification was an infrequent approach as well: as many as 27% of the teachers had never tried gamification and 16% had used it very rarely (Figure 2). It is noteworthy, however, that there was a small but very active group of teachers who had adopted gamification as an integral part of their teaching: 14% of the respondents used gamification very extensively. The qualitative data revealed that the gamification activities entailed various types of role-play and story-based activities as well as collection of experience points based on different criteria (mastery of subject content, active participation in class, good behaviour, etc.). In terms of scope, gamification varied from activities related to one school subject (e.g., history, see quote #1) to gamifying nearly all classroom activity (quote #2). In some cases, gamification provided a framework for collaboration across different grade levels (quote #3).

[1] In history class, we had a role-playing game that began in the Middle Ages. We created a narrative about a fictional village, and the pupils were members of that society. The pupils were
assigned different estates, and based on those, they started writing characters for themselves, coming up with a backstory, personal characteristics, and things like that. – Primary school teacher, M

[2] I have gamified pretty much everything starting from regular classroom activities, and experimented with collecting experience points based on good behaviour in class. The pupils set goals for themselves and got experience points. It worked very well but required a lot of work. In a way, [assessing and giving feedback on pupils’ behaviour] is something you’d do anyway – but now they have this extra incentive that they can use their experience points to buy something for their character. – Primary school teacher, M

[3] We had an extended space adventure between second-graders and fifth-graders. The fifth-graders organized it, implemented it, and designed the tasks. Second-graders were ‘space agents’ and solved different kinds of tasks. We experimented with many different methods, using digital tools too. – Primary school teacher, M

5. Results: The value of game-based pedagogy

The second main focus of the analysis was examining teachers’ experiences on the value of game-based pedagogy for enriching school education. This analysis was conducted using a data-driven approach in two cycles. First, in the analysis of the open-ended questions from the questionnaire, three main categories emerged: 1) supporting differentiated learning, 2) the ability of games to motivate pupils and to meet individual abilities and preferences, and 3) the role of games in transforming and challenging existing classroom practices. The analysis of the teacher interviews provided support for these three categories and yielded an additional one: 4) bringing new approaches to assessment. We further complemented the analysis by establishing a separate category for 5) the main barriers to adopting game-based pedagogy.

5.1 Differentiated learning

One of the reasons for using games was their usefulness for differentiation. This applied particularly to educational games. On the one hand, fast learners were able to independently proceed further at their own pace with the aid of a game, and on the other hand, pupils that struggled with learning were motivated to practice more.

We were practicing exponentiation [with the aid of a game] before a test, and the fastest pupils proceeded beyond the things we had studied in class. Together, they managed to work out the exponent and root rules by trial and error. – Lower secondary school teacher (mathematics, physics, chemistry), F

5.2 Motivation and individual preferences

The main value of gamification, entertainment games, and making games was seen to lie in the ability of these activities to motivate and engage even those students who had difficulties focusing on traditional classroom activities. Teachers reported improvement in the classroom climate and enhancement in collaboration between students, and several teachers had noticed that the pupils put more effort into their tasks during game-based activities (e.g., quote #1). The increase in motivation and effort was also reflected in learning outcomes (quotes #2 and #3).

[1] They actually come here in their free time, or stay after school, to make [their games], saying ‘we want to finish this!’ And we’re not talking about one or two active students here, but the whole group. – Primary school teacher, M

[2] Role-playing games enhance immensely the quality and length of writing tasks. – Primary school teacher, F

[3] The pupils’ performance level has improved when their tasks have been game-based. – Primary school teacher, M

5.3 Challenging the traditional roles of students and teachers

The dynamic and open-ended nature of game-based pedagogy also challenges the traditional unidirectional relationship between pupils and teachers. Especially gamification and making games allow students to learn to take more responsibility (quote #1); to reflect on their own characteristics, strengths, weaknesses, and preferences as learners; and to share their knowledge and skills with others (quote #2). At the same time, the teachers are challenged to rethink their established practices and to reflect on their teacher identities (quotes #1 and #3).
The emphasis has been especially on [the pupils] doing things for themselves and taking responsibility. And [the teacher] has to learn to give responsibility – that’s another aspect in it. – Primary school teacher, M

Pupils who play games a lot and are really enthusiastic about it have received positive feedback from their classmates and shared their knowledge to the benefit of the whole group. – Primary school teacher, F

The project transformed my teacher identity a lot, and the game-based activities will continue! – Primary school teacher, F

Transformation is not only happening between teachers and students but also among teachers. The introduction of game-based pedagogy, and especially establishing it as a sustainable practice, requires increased collaboration. The teachers saw mutual support, collaborative idea creation, and demonstration of concrete practices as key aspects in spreading game-based pedagogy and making it sustainable.

I think the key [to encouraging other teachers to try game-based pedagogy] is to involve them, like ‘let’s do this together and see what we can come up with’ [...] If you only give a fifteen-minute or half-an-hour lecture on what you have done, the other teacher will certainly feel a bit left out. – Primary school teacher, F

5.4 New approaches to assessment

Many educational games collect usage data and include learning analytics that enable teachers to monitor their students’ results and progress. However, this is not the only way in which game-based pedagogy can support assessment: gamification and making games allow the teacher to observe the whole learning process – not just the final product – and thereby gain new insight into their students’ skills (quote #1). The open-ended nature of these activities makes it possible for the pupils to demonstrate their abilities in ways that are compatible with their styles and preferences, and as a result the teacher may be able to identify hidden potential that has not had an outlet before (quotes #1 and #2).

You can better assess how active and how interested the students are, and what their interaction skills are like. [...] Also, some surprising skills may emerge in some students that are not revealed in normal classroom situations, and that can, of course, affect assessment just as much. And why not, if someone turns out to have more skills than he/she [normally] shows. – Primary school teacher, M

They have had quite a lot of freedom in planning the final outcomes of these game-based projects. [...] Is it a video, is it a presentation, is it a game, is it some kind of a booklet. They’ve been free to reflect on what their particular strengths are. – Primary school teacher, M

5.5 Barriers and challenges

Finally, we examined the data from the point of view of barriers and challenges, aiming to uncover the main issues seen by the teachers as hindrances to the use of game-based pedagogy. By far the most frequent concerns were related to technology (e.g., lack of devices or suitable apps/games, unreliable network connections, inadequacy of technical support).

When the network or the devices don’t work, the pupils get frustrated very easily. [...] One teacher isn’t always enough to solve all problems and simultaneously come up with an alternative plan if the original one doesn’t work. – Primary school teacher, F

Student-related issues were also mentioned. Some teachers had observed significant differences between pupils in terms of how successful the game-based activities were and how the pupils experienced them. Despite the positive experiences with most students, not all of them preferred game-based pedagogy; some pupils would rather have studied using traditional methods of instruction instead. For some of them, the reason for this was that they did not consider game-based activities a serious method of learning (quote #1) whereas for others, these activities were too dynamic and they were missing the familiarity and stability of traditional classroom instruction (quote #2).

Pupils who are used to ‘basic school assignments’ did not get that the game-based tasks were also school assignments, and they didn’t complete them. The same pupils keep asking for normal ‘fill-in-the-book lessons’, as they call them. – Primary school teacher, M

I have a few pupils in my class who have autistic characteristics. For them, it was extremely difficult to participate in games they could not directly influence. Also, whenever situations changed within the game, they were not able to adapt [to the changes]. – Primary school teacher, M

Pupils who play games a lot and are really enthusiastic about it have received positive feedback from their classmates and shared their knowledge to the benefit of the whole group. – Primary school teacher, F

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Transformation is not only happening between teachers and students but also among teachers. The introduction of game-based pedagogy, and especially establishing it as a sustainable practice, requires increased collaboration. The teachers saw mutual support, collaborative idea creation, and demonstration of concrete practices as key aspects in spreading game-based pedagogy and making it sustainable.

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Finally, the respondents identified some barriers related to teachers and school leaders. It was pointed out that even though close collaboration between teachers can make plenty of difference, not every teacher is going to feel at home using game-based pedagogy (quote #1). In some cases, the more active teachers also felt a lack of involvement and support from the school leadership and/or the school community at large (quote #2).

[1] *This might not be an approach that suits all teachers, and I think that’s something we just need to accept.* – Primary school teacher, M

[2] *Everything works great with those classes that participate [in the activities] but not at all on the level of the whole community in our school.* – Primary school teacher, F

6. Conclusions and implications of the findings

Pedagogical innovations that enhance the meaningfulness of learning and promote learners’ engagement and confidence have been called for (e.g., Kupari et al., 2013). Our initial findings suggest that game-based approaches could have potential for changing traditional practices in schools in terms of motivation and effort, learning results (e.g. by supporting differentiation), assessment, and the role of students (responsibility, independence, active participation). Thus, game-based pedagogy could be one of those pedagogical innovations that play a key role in renewing school education. In the following, we will discuss the implications of the findings for adopting game-based approaches in schools.

**Clear goals and a matching approach:** Due to its broadness, the concept of game-based pedagogy might initially seem overwhelming to someone who is new to the topic. For teachers, one way of approaching the idea of game-based pedagogy is to think about some key scenarios in the classroom where games might bring added value. For example, if some pupils are struggling with learning basic skills (or if some fast learners are getting frustrated not having enough to do), a good subject-specific educational game could both get the former group to practice more and give the latter group some extra challenge. There is evidence to support the usefulness of educational games especially in terms of literacy and mathematics (see e.g., Kebritchi et al., 2010; Richardson & Lyttinen, 2014; Shin et al., 2012). In another scenario, if some students are showing lack of effort and motivation, not using their full potential in a traditional classroom setting, they might get excited by a task that is set in the world of their favourite video game, helping the characters solve a mystery they have encountered. If the teacher wants to help his or her pupils learn self-reflection and teamwork, a *joint project involving game building or other creative, gamified activities* could help them combine their individual skills and strengths with those of others in a meaningful way.

**Thinking outside the educational games box:** Many people (teachers and pupils alike) still equate game-based pedagogy with educational games. This was reflected in our data as well: educational games were the most common approach in this group of teachers. There are more studies and practical examples available of the use of educational games than of any other type of game-based pedagogy, and because they have specific didactic goals (see De Freitas, 2006; Van Eck, 2006), they are easy to take into use even with little or no prior game-related experience. However, focusing only on educational games limits the potential, application contexts, and perceived value of game-based pedagogy. As the findings suggest, in order to use the full potential of game-based pedagogy, it is worth looking beyond “the educational games box” and try new ways of bringing games into the learning process: applying entertainment games for educational purposes, gamifying classroom activities in different ways, and having students make their own games. The adoption of game-based activities does not have to be a huge leap into the unknown; various game-like elements already exist in school education (tasks, rewards, points, stories, etc.) and these can be made even more appealing and engaging for the pupils (see e.g., Kapp, 2012). Game-based pedagogy also offers an excellent platform for applying blended learning (cf., e.g., Garrison & Kanuka, 2004; Käse, 2010; Vesisenaho et al., 2010), connecting the possibilities of technological environments and face-to-face situations both simultaneously and non-simultaneously. This will bring a new “layer” to learning situations and allow creating flexible ways to support learning, varying from simple drill-and-practice activities to collaborative, authentic learning practices.

**The potential for assessment:** Assessment might not the first thing teachers think about when considering the use of games. In fact, as seen above, the versatile potential of game-based pedagogy for assessment has sometimes taken teachers by surprise: they have noticed how game-based activities have allowed them to observe and evaluate the whole learning process in a different way than traditional activities have, and how these activities have given some students an opportunity
Giving responsibility to pupils: Helping pupils learn to take responsibility has emerged as one of the key purposes for applying game-based pedagogy and especially for implementing broader game-based projects. There is a connection to many of the elements included in the frameworks for 21st-century skills and key competences: sense of initiative, self-direction, collaboration, decision-making, problem solving, creativity, productivity, and accountability (Binkley et al., 2012; European Parliament and..., 2006; Partnership for 21st Century Learning, 2015). Moreover, as we have pointed out above, game-based projects can give pupils a chance to identify their own strengths as learners, to use them to complement those of others, and to learn from their peers during the process. In other words, they can address the important competence of “learning to learn” (Binkley et al., 2012; European Parliament and..., 2006). From the teacher perspective, this requires a certain mindset when it comes to the role of the teacher: trusting the pupils with more responsibility while observing the activities very closely in order to know when a group or an individual pupil needs support and guidance. The same principles apply to all group-based work but the particular characteristic of game-based activities is their potential for uncovering some unexpected skills and roles among the pupils, which can be rewarding both for the pupil and the teacher.

Collaborative and supportive school culture: Above, we presented Dondi and Moretti’s (2007) characterisation of the three different types of teachers. Presently, the most active group of teachers are already very experienced, innovative, efficient, and “fluent” users of game-based approaches, knowing how to best adapt and apply them in different contexts – and also when not to do it. In accordance with Shear et al. (2011), we believe that a supportive and collaborative school culture – involving teachers, students, and school leaders alike – is in a key role in spreading the approach beyond the earliest adopters. In the study of Hamari and Nousiainen (2015), teachers’ perceived educational ICT self-efficacy was a predictor for the actual use of game-based learning but not for its perceived value: in other words, although teachers who are not confident in their technological skills are often hesitant to start using games, they might still be open to their potential. For these teachers especially, encouragement from the social environment is important, and they might significantly benefit from concrete examples of successful practices and from one-on-one peer collaboration. Opportunities for such collaboration, for its part, are greatly facilitated by school leaders’ support both on attitudinal (displaying interest and encouragement) and practical level (e.g., enabling new contacts with teachers from other schools) (cf. Shear et al, 2011).

7. Limitations and future research

As we have pointed out, these results are based on the initial analysis of one part of our data, and we will continue examining the whole data for a more fine-grained analysis of the ways of implementing game-based pedagogy. It should also be noted that the findings of this paper are not directly generalizable to all teachers: the focus is on the views of teachers who are more active than average in using game-based pedagogy (for a more general view on the adoption of game-based learning among Finnish teachers, see Hamari & Nousiainen, 2015). Moreover, in this paper we have only focused on the teachers’ point of view. In the future, we will also present findings based on the analysis of the pupils’ survey, focusing especially on motivational factors.

This paper is based on data collected during the first part (2013-2014) of the Game-based Pedagogy and Portfolio-based Learning project. Whereas the goal of the first two years was to encourage individual teachers to try using game-based pedagogy in different ways, the latter half of the project aims to go beyond single experiments, making game-based pedagogy an established approach in the schools participating in the project. Therefore, our future data collection will focus especially on the factors that contribute to making these practices sustainable in the longer term. Furthermore, the initial findings have highlighted the need to examine some types of game-based pedagogy more closely: for example, there is already plenty of research on the effects of educational games, while gamification on a broader scale (i.e., efforts to gamify most classroom activity) is still a rather new area to be studied. To address this gap, we will also conduct case studies focusing on a specific type...
of game-based pedagogy, aiming at triangulation of different perspectives including teacher and student experiences, documentation, and classroom observation.

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References


Kapp, K. (2012.) The Gamification of Learning and Instruction: Game-Based Methods and Strategies for Training and Education. Hoboken, NJ: Wiley.


