**ITEC - WP 2**

**D2.4 - FINAL REPORT ON THE PEDAGOGICAL SCENARIO BUILDING PROCESS**

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| ABSTRACT    | This report will draw final conclusions on WP2 scenarios alongside the Final Evaluation Report from WP5. The development of scenarios can be considered as the process of their creation as well as the product – the scenarios themselves.

Given the primary audience of stakeholders rather than academics and reviewers it recaps material from earlier reports around the theoretical underpinning behind using scenarios, maturity models, and what innovation is. It briefly considers the structure of the Future Classroom Scenarios Toolkit from the perspective of the user.

Next, it analyses the shortlisted scenarios from the five cycles. WP5 worked with stakeholders who used the toolkit to reflect on the process; whereas this report analyses the product. However, a caveat must be given in that the scenarios created are adapted within the classroom and the impact of the scenarios can be found in D5.5.

Finally, the report concludes with areas for future development within the toolkit.

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<tr>
<th>AUTHOR, COMPANY (First draft)</th>
<th>Dr Mary Ulicsak</th>
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<td>REVIEWER, COMPANY</td>
<td>Jim Ayre, Roger Blamire, Will Ellis</td>
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1 PU = Public
PP = Restricted to other programme participants (including the EC services);
RE = Restricted to a group specified by the Consortium (including the EC services);
CO = Confidential, only for members of the Consortium (including the EC services);
INN = Internal only, only the members of the consortium (excluding the EC services)
Overview

Aims and Audience

This report does not repeat the detailed description of the scenario development process over the five cycles of the Innovative Technologies for Engaging Classrooms (iTEC) project and the relationship between work done and the initial Description of Work found in previous reports. Instead it is designed as a resource for stakeholders who have not necessarily read the earlier reports but who will be using the Future Classroom Scenarios Toolkit and wish to deepen their understanding of the rationale and functionality. These include:

- School leaders and teachers - for example, when a school is considering investment in technology, or changing the curriculum or school layout;
- Advisers at regional or national level – as a change management tool particularly when deploying technology;
- Technology providers, consultants and other stakeholders – to provide support and guidance to schools on how to develop their ICT strategy and to guide their own product and service development.

Drawing upon previous research and findings from the project, this report has sections covering the need for innovation within classroom practice and the role of scenarios to assist this goal; the tools developed to support the creation of relevant scenarios - including the Innovation Maturity Model; and the underlying process developed for the future creation of scenarios found in the Future Classroom Scenarios Toolkit - the legacy of WP2 within iTEC. It also reviews the “top” scenarios generated over the course of the five cycles. The purpose of this being to emphasise that scenarios need to be innovative, but not necessarily cutting edge; to be useful the scenario should result in change of practice that improves the pedagogy, technology, assessment or management of the classroom, local or national area.

Summary of the evolution of the pedagogical scenario building process

To date, while ministries of education have occasionally engaged in futures thinking as a critical part of their strategy for curriculum development, curriculum planning at the local or individual school level tends to be both backward looking (e.g. reviewing the last set of test scores) and shaped by current delivery mechanisms (such as the resources currently in the school). iTEC was designed to address this issue by encouraging stakeholders to consider trends and challenges in order to develop realistic yet innovative future scenarios. These could then be used as a stimulus for designing learning activities to bring innovation to learning and teaching, and also as a way of creating a multi-stakeholder vision of learning and teaching that responds to emerging needs and challenges that impact their education system.

Initially these scenarios would be developed by iTEC partners and invited experts to become the basis of the Learning Activities which would be piloted in classrooms across Europe., They would become legacy of the project, with teachers continuing to use them beyond the end of the project, once the funded period was complete. However, an
analysis of the scenarios raised questions over the nature of innovation being achieved in pilots. To address this, the term innovation was refined to include absolute innovation – innovative in any context, and relative innovation – which was more innovative than current practice. This idea of incremental innovation can be expressed in maturity models – an idea used in business generally as well as education. These models take the shape of a matrix, with descriptions of levels against process and outputs that give a structure for development of process and output.

To ensure that the scenarios are relevant they must reflect trends and challenges that are relevant to the stakeholders. Trends are factors that affect and are affected by education and which will have a long term impact – although they may not necessarily be immediately evident. They can be abstract, e.g. to implement personalisation of assessment or take account of technology developments outside the education environment, such as tools to enable peer to peer learning. Challenges are often more apparent and can be generic or unique to the context, for example, the creation of a new ICT laboratory in a school, the introduction of a different syllabus, or an influx of students who have the native language as a second language.

The combination of: the need for scenarios to be bespoke to the context to ensure they are not reduced to the lowest common denominator; that they incorporate trends and challenges that need addressing to prevent the scenarios being abstract; and that to fulfil the aims of the project they must be innovative – and be shown to be innovative - in at least one area; defined the criteria for the creation of a toolkit to guide users in the creation of scenarios.

The Future Classroom Scenarios Toolkit therefore needs to be structured to: ensure relevant stakeholders are included; relevant trends are identified; an assessment of current and desired innovation is made; and that the resulting output contains all the information required to develop Learning Activities or to inspire teachers. The toolkit can also be used at the policy level to support policy change, particularly involving deployment of technology. To summarise, the toolkit enables the goals of using scenarios within education, namely:

- Explore and illustrate the potential interactions of the many factors such as technology, pedagogy and policy that seem likely to shape the future and how this will impact the classroom
- Be adopted by those involved in education to develop and evaluate their own visions while avoiding undesirable futures
- Provide tools to allow those with differing backgrounds, such as policy makers, educators and academics, to engage in strategic dialogue around the direction of policy and practice

The resulting toolkit was trialled in Cycle 5 and was found to be useful in the creation of scenarios with a degree of innovation, as anticipated. The Scenario Development process was viewed as innovative by policy makers, teachers and stakeholders, but further work was recommended in order that it can be integrated into practice across the EU (Lewin and Nichols 2014).
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1 Rationale and overview of scenarios and scenario development in iTEC

1.1 Background

Until fairly recently curriculum planning has responded to the present needs of learners; yet the profound economic, social and technological changes of recent years have left few in doubt that the school of the future needs to be different than the school of the past. To accommodate this shift, the Innovative Technology in Engaging Classrooms (iTEC) project arose. iTEC was designed to address the need to bring about incremental but sustainable change in the education system which was felt to be missing despite years of investment and research. At the level of individual schools, school leaders need a framework for deciding on how to develop curriculum delivery and classroom design and practice, for example, when a school is considering investment in technology, or when a school is making changes to the curriculum or school layout. As part of this, stakeholders (e.g., school leaders, advisers at a regional or national level, and technology providers - as well as teachers) have to recognise the needs of students in this environment of tomorrow, and the analysis needs to inspire all teachers to change their own practices appropriately. There was also a need for an effective methodology for change management to ensure that key stakeholders are consulted and their support secured. Finally, looking at the regional and national level, there is a need for countries to support policy change, particularly involving deployment of technology. In each case the fundamental principles of creating a shared and reliable vision of the future education situation is consistent – and this can be in the form of a shared scenario.

While scenario planning is well-established outside the education sector, its use within the sector has tended to be limited to forward-planning at the national/ministry level. The iTEC project recognises that, as the pace of change accelerates, critical areas of decision making need to take place at the local level. This represents a significant cultural shift in schools and a challenge for teachers. Rather than being deliverers of well-established curricula, they become curriculum innovators in their school context, developing insights into the future needs of their students and rethinking their classrooms in the light of global and local challenges.

1.2 What are iTEC scenarios?

Scenarios in this situation are defined as narrative a description of learning and teaching that provide a vision for innovation and advanced pedagogical practice and in which technology is used effectively. Scenarios are designed to be adapted by teachers according to their circumstances – they are not lesson scripts; thus, if there is a suggestion the students log data, some may use a spreadsheet while others may use 3D modelling software.

Scenarios are built upon specific trends and challenges. These are defined as external economic, social or technological factors that: (i) are recognised as important and (ii) will influence the learning environment in which the scenario is based. Scenarios themselves are structured to describe the different elements within the learning environment – which is not necessarily a classroom. These are: the activities and tasks (what happens in the scenario); environment (where the scenario is happening); roles
(who is involved in the scenario); interactions between the other elements (how the scenario happens); and resources (what is required to support the scenario). Within iTEC scenarios can be used as the inspiration for the creation of specific Learning Activities by teachers\(^2\) or as the starting point for the creation of lesson(s) or a curriculum within the school, or at a local or national policy level.

### 1.3 How scenarios reflect innovation and its assessment

Over the course of the project it became clear that scenarios cannot just be considered on their degree of absolute or radical innovation – that is, how positively different they are from all existing practice through their use of new technologies or pedagogic techniques, but also on their relative or incremental innovation – how positively different they are from current practice. The latter would vary depending on context. For example, in one of the cycles, scenarios around the introduction of Interactive Whiteboards were shortlisted by stakeholders. However, as they are common practice in other classrooms they were not seen as an absolute innovation but rather relative reflecting the differing contexts across the 17 countries and over 2,500 classrooms involved in the project.

It also became clear that some of the scenarios created by experts in the first four of the five cycles were not relevant to stakeholders across Europe. Teachers had been selecting learning activities (based on the scenarios) which are easy to understand and fitted in with their curriculum. For example, not all schools have access to 3D printers, or have the ability to develop cross-curricular projects. It was therefore important that there was a shift from scenarios produced by experts (as described in the original proposal) to scenarios produced by the stakeholders that were not only innovative but appropriate to their individual contexts to provide greater choice\(^3\).

### 1.4 How scenarios influenced the scenario development process

To address these two issues Futurelab@NfER proposed and designed an **Innovation Maturity Model** to help recognise absolute and relative innovation, and a **Future Classroom Scenarios Toolkit** to support stakeholders create scenarios. The latter not only contains the maturity model and scenario template but also tools to identify trends and relevant participants in the design process. These were used in the final cycle and are designed to be used after iTEC has been completed so that iTEC has a lasting legacy.

A maturity model was developed as they have successfully been used in multiple industries as well as in education to support organisational change\(^4\); they show innovation as a change or movement between levels in a matrix as well as describing the ”highest” level. The model broke down an iTEC scenario into three main areas:

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\(^2\) They can be used as the input to Edukata, the toolkit produced by Aalto University as part of Work Package 3 within iTEC.

\(^3\) This need for an increasing range of scenarios that involve stakeholders in the school or region is discussed in the Cycle 3 Evaluation (Lewin et al, p13).

\(^4\) Further details on Maturity Models in general can be found in Section 2.4.1 The Innovation Classroom Maturity Model
1. Product/Outcomes (learning objectives)
2. Educational processes (subdivided into Pedagogy; Learner role; Management of teaching, learning and assessment)
3. Resources (underpinning technology)

Each area in the model was subdivided into five levels which described the practices found. The model could be used as:

i. An assessment tool for relative innovation if the prior and current state were ranked;
ii. An assessment tool for absolute innovation by looking at the scenario against the top level (although, it should be noted that the content of each level is constantly evolving in order to take account of future developments)
iii. A design tool to highlight factors that the scenario should contain to ensure that innovation occurred

The Innovation Maturity Model became a key element in what was to become the Eduvista: The Future Classroom Scenarios Toolkit produced jointly by EUN and NFER/Futurelab. This is a modular set of activities developed in a user-centric fashion by adapting activities performed in workshops with experts that occurred in the first cycles of iTEC. Stakeholders can follow the entire process or select the modules appropriate to their circumstance. The modules include: identifying participants – those from academia, local industry, parents, students etc, identifying trends, assessing context using the maturity model, creating or adapting a scenario, reviewing the scenario against a set of criteria as well as the maturity model. These are described in depth in the following sections. In the final year of the project, as part of the Work Package 11 mainstreaming activity, Eduvista: The Future Classroom Scenarios Toolkit, was further developed by European Schoolnet, bringing in elements from the other iTEC Toolkits (Edukata from Work Package 3 and the technical toolkit Eduteka) together with guidance on piloting and evaluation. Extensive work was carried out on the Innovation Maturity Model in particular. This final toolkit, developed for exploitation, has been named the Future Classroom Toolkit, and the final version of the maturity model, named the Future Classroom Maturity Model. Further detail of this final development is provided in the final project Exploitation Plan (D11.5.4).

This document focuses on the development and use of the original Eduvista: Future Classroom Scenarios Toolkit, as the toolkit used for Work Package 2 within the project. However, the same design elements and considerations have been carried over from Eduvista to the final Future Classroom Toolkit.
2 Theoretical basis for iTEC scenarios and their construction

The previous section introduced the concept of scenarios and how they are used in iTEC. This section looks at scenarios in greater depth. Why are scenarios useful in futures work? What makes an iTEC scenario? In particular it focuses on the trends and challenges that underpin iTEC scenarios. These ensure that the resulting scenario addresses the concerns that stakeholders identified as important so that it is meaningful in that context. The section finishes with a discussion around innovation within scenarios. The same scenario can be innovative in one classroom and normal practice in another – therefore there needs to be a method for stakeholders to design and assess a scenario to ensure that it is innovative to them and their students.

2.1 Why are scenarios useful for future planning?

Scenarios have been used in multiple projects as a tool to consider the possible future of education. Scenarios are not "prescriptive, predictive or descriptive" (Wood 2002, p3) but allow us "to shape, not predict, the future" (OECD 2006b, p3). According to Bell (2003), the scenario provides a unity within futures’ methodology given the considerable methodological diversity within the field. Similarly, Sandford and Facer (2008) have noted that the scenario is the ‘base unit of futures work’.

Scenarios are flexible. There are no predefined formats or timescales they must cover; in education they range from describing the situation in a few years – such as the work by David Wood in 2002 looking at the role of technology five years in the future - to 15-20 years on – as done by the OECD in 2006 or by the Beyond Current Horizons (Facer 2009). Neither are scenarios limited to the description of preferable futures, although this is the case in iTEC; instead it is possible to consider undesirable narratives (eg Facer 2009, Wood 2002, OECD 2006a, 2006b). Finally, scenarios cannot be assessed for accuracy: when the predicted date is reached, actions may have been taken to avoid undesirable outcomes or the circumstances may have been impacted by unforeseen events.

The three predominant aims of scenarios in education can be summarised as:

- Explore and illustrate the potential interactions of the many factors such as technology, pedagogy and policy that seem likely to shape the future and how this will impact the classroom
- Be appropriated by those involved in education to develop and evaluate their own visions while avoiding undesirable futures
- Provide tools to allow those with differing backgrounds, such as policy makers, educators and academics, to engage in strategic dialogue around the direction of policy and practice

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5This is an abridged version of the rationale given in D2.1
2.2 Scenarios within iTEC

Scenarios provide a means of thinking about the needs of future students and can act as an inspiration for teachers. However, scenarios within the iTEC project were designed partly in response to other more ‘blue sky’ scenarios in which the classroom and school have disappeared and the scenarios are very detached from current realities (eg the IPTS project described by Ducatel (2010)). They focus on addressing trends and challenges that relate to pedagogical or technological shifts at a national, local or classroom level that are relevant to the context where they will be used.

In addition to the three general aims of educational scenarios described previously, scenarios within iTEC can be used as the basis for creating Learning Activities and to describe desirable technologies that need to be created. A Learning Activity is a: “Detailed description of novel teaching and learning in classrooms” (Keune et al 2013, p.10). They are created in the Edukata process within iTEC in which an inspirational scenario is considered by the stakeholder with respect to the personal interests and needs of students, and the classroom context in which the scenario is to be used. An example of how scenarios can lead to new technology can be found in the first cycle. A review of the ten selected scenarios showed a focus on collaboration and team work. Consequently, the TeamUp tool was created in the project in order to assist teachers in selecting groups that reflect a range of abilities or that are truly random, and then to monitor the groups.

A template was created to ensure that scenarios can easily be shared across the EU and that the designers take into account factors needed for implementation, such as the subject, the trends or challenges it addresses, the participants, technology etc. This was iteratively developed over the five cycles. As, for example, a review of Cycle 1 scenarios found, they focussed on project and problem based learning; to encourage identification of other pedagogic formats, the headings of the template were re-labelled and a briefing document was produced. This was important to guide participants to consider wider approaches, as effectively the headings influenced thinking. So in order to ensure that ‘Resources’ did not only focus on technology, it was changed to ‘Resources (including technology)’ in the second iteration, and by the fifth had been split into ‘Technology’, and ‘Other resources’. In later cycles the scenario development process was revised to consider how effectively the scenario addressed the trends or challenges it was based on. In the first cycle the trends were not explicitly recorded but in later cycles they were to assist this process.

The scenario template used within the Future Classroom Scenarios Toolkit in Cycle 5 had three parts. In the first the trends or challenges to be addressed by the scenario are written down in a succinct format – these could be generic concerns – such as ensuring students have 21st century skills such as collaboration, a need to address an area of the curriculum, a set of activities that use a technology newly available6. Then questions around the who, why, where, what and technology are considered (see Table 1 below).

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6 A detailed definition of trends and challenges and how they are identified can be found in the next section.
**Who** is involved in the scenario? (e.g. teachers, students, school librarians, members of the community, remote experts) What are their roles?

**Why** have those involved decided to change their practice? In response to which particular aspects of your future education landscape? What is the core purpose of your scenario?

**Where** does the scenario take place? (e.g. school classroom, local library, outdoors, in an online space). Describe the environment.

**What** happens? What are the people in your scenario doing? List all the activities they might undertake. What sorts of interactions are there between the people in your scenario?

**Technology:** What technology is used in your scenario? How is it used? (remember to refer back to the iTEC Innovation Maturity Model to see how technology can be used at the stage you are moving towards)

**Other resources:** What other resources are needed in your scenario?

### Table 1: Areas to consider within a scenario

The third part for those developing the scenario was to write a narrative, for example, “a day in the life of” or a story style narrative showing what would happen. As previously stated, this is an inspirational story designed to be adapted to the context rather than a set of detailed instructions, see below for an example:

A keen member of the RSPA Karl was made aware that the local sea shore was being picked clean of large shells as hermit crab owners needed shells to replace the outgrown shells of their pets. This was detrimental to the local crab community. He suggested to his school that they hold a design competition around habitats for animals.

His teacher invited in the Royal Society of Protection for Animals (RSPA) and the Royal Society of Protection for Birds (RSPB) and other local community members to give a talk around issues in their area. As a consequence the students were told about the decrease in hedgehogs in the area, the fluctuating bird population and the increase in gulls eating from bins amongst other things.

After the talk some time was set aside in class for the students to select one area of concern and consider how they would address it. This involved researching further the various issues, visiting the sights to see the issue for themselves, and by emailing or visiting experts. Thereafter the students were encouraged to work on it in a specific project time and at home.

Students were encouraged to use a variety of methods to tackle the problem they had chosen – it could be to publicise the issue further or to tackle the problem itself. Karl decided to model and then uses the school 3D printer to create waterproof shells for hermit crabs while his friend, Ian, decided to trial various bin lids to be
used along the beach to keep out gulls.

Once Karl had created the shells he asked experts from the RSPA for feedback and then trialled some at the beach – observing whether or not they were used by hermit crabs over a period of a week. He collated this evidence and created a poster for the design competition describing the problem, his simulations, feedback from the experts, and showing how his shell had been used in the wild. All the work was displayed in an electronic and physical exhibition space with the experts, parents and teachers invited to come round and give feedback.

Karl was awarded a prize for this work.

Box 1: Sample narrative – from Practical 3d Projects (a scenario from the experts workshop in Cycle 5)

The final version of the template is included within the Future Classroom toolkit, with some minor changes based on the experience and feedback from the fifth cycle of pilots.

2.3 Trends and challenges within scenarios

2.3.1 What are trends and challenges?
As previously discussed, what makes iTEC scenarios useful is that they are built upon trends and challenges felt important by the scenario designers within their context. The broader theoretical principle behind the approach to trends’ analysis is that, whilst the future is unknown, it is dependent upon current actions. Therefore, whilst accurate predictions of the future are impossible, there are possible realistic alternatives based upon changes or factors that can be envisaged or are known now and that are felt to be important or within iTEC should be encouraged.

Trends are factors that affect and are affected by education and which will have a long-term impact – although this is not necessarily immediately evident. For example, the introduction of 21st century skills such as problem solving, collaboration and negotiation, the idea that schools will cater for students with a range of ages, or that assessment will become more personalised. Trends could take account of technology developments outside the education environment. They may relate to physical devices such as 3D printers or include an increasing use of web 2.0 collaborative tools to enable peer-learning; technology which can automatically adapt to the ability of users – already a feature of many electronic games; the inclusion of repositories on the web where contents are well-organised, and checked for quality and reliability.

Challenges are often more apparent and can be generic or unique to the context, for example, the creation of a new ICT laboratory in a school, the introduction of a different syllabus, or an influx of students who have the native language as a second language.
2.3.2 Trends and challenges in iTEC

In the first four cycles generic trends were identified from a range of sources. Desk research identified factors from other projects that looked at education in the future. To ensure that a wider set of perspectives about trends and drivers were included, iTEC partners were asked to also highlight trends in education and/or technology that they were particularly familiar with or interested in. Given the number of potential trends, they were classified according to themes. These were:

- Changing roles of teachers and learners
- Curriculum and assessment
- Knowledge and skills
- Learning spaces
- Technology

Before being presented to experts taking part in the workshops, the trends were presented to stakeholders across the EU in focus groups and through online surveys to give feedback on content and to select areas they felt particularly important. Students used Power League to compare trends which over time ranks the list of factors by importance.

Although the trends identified will continue to be valid for a few years and are thus included in order to ensure the sustainability of the toolkit, it was clear that trends evolve and future trends would need to be identified. In order to achieve this, further desk research was carried out, this time looking at organisations that would, or could, list the types of changes that would impact education. This includes the OECD, Pew Research, Eurydice etc. In addition, given the focus on technology, areas that could impact learning were also identified, namely:

- Augmented reality
- Block programming and apps
- Cloud computing
- Games and game based learning
- iTEC tools
- Learning analytics
- Neuroscience

For Cycle 5 links to these organisations and areas were accessed from the Future Classroom Scenarios Toolkit so that the trends continue to evolve as does technology and policy. In the final Future Classroom Toolkit links to trends are given through a dedicated section, maintained by European Schoolnet, to ensure trends remain relevant.

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7 For example: Beyond Current Horizons programme (Facer 2009); The Future of Learning: European Teachers’ Visions Report (Ala-Mutka et al. 2010); New Assessment Scenarios (Perrotta & Wright 2010); The Horizon Reports (New Media Consortium 2009, 2010)

8 This is an online tool designed to stimulate discussion by asking students to order particular items by preference. The Power League categories were based on the trends identified in Cycle 1 and gathered data on students’ preference for learning and the use of technology in classrooms. A summary report of the results is found in Appendix 7 in Deliverable 2.1 (Cranmer and Ulicsak 2011)
and up to date. There is also an online survey maintained in five languages, showing an ongoing ranking of key trends (English: http://bit.ly/fcl-trends-EN).

2.3.3 Trends and challenges within a scenario

Trends and challenges can be related to elements required in an iTEC scenario. For example, in the “who” area of the template it is important to consider the roles of the participants. ‘Roles’ refers to the potentially changing roles of teachers, learners and other actors within the trend. In iTEC several pedagogic trends emerged, and which were also considered important by teachers and students, that would be included in this area. In desirable futures, teaching is seen as child-centred with the teacher providing the child with more opportunities for self-direction, self-organisation, autonomous, independent learning. Teachers as facilitators then build on children's own interests to deliver the curriculum tailored to children's own pace. Learners have access to other learners in other places facilitated by technology. In addition to this, learners can access formal education at any time of the day and in other places which enables more flexible ‘anytime, anywhere’ learning.

Another set of identified trends relates to ‘curriculum, assessment, knowledge and skills’. These reflect the changes to teachers’ and learners’ roles detailed above but in relation to the curriculum and assessment. For instance, some of the trends focus on objectives being more concerned with: project-based, authentic learning to ‘tackle real challenges’ enhanced by technology; and more creative approaches to be used in education and development of ‘21st century skills’. One of the trends notes that influential corporations and global organisations have ‘agreed standards of 21st-century skills, such as problem solving, collaboration, negotiation’. Another focused on the trend for increased teaching of new media literacies. Other trends are concerned with assessment and using more personalised and creative methods. Finally within this section, one of the identified drivers for education is seen to be that schools will cater for a variety of ages of learners, including older and younger students than typically seen.

Similarly a set of trends discuss space – relating to “where” on the template. These focus on the emergence of flexible, better equipped and designed school spaces. These include more inclusive designs which take better account of special educational needs in relation to classrooms, furniture and technology. Learning spaces can be adapted to accommodate different learning activities. For instance, the school library becomes much more of a multipurpose learning space. The boundary of home and school becomes ‘seamless’ enabling much better flow of information, possibly enabled by digital technologies.

Finally the ‘Technology’ and ‘Other resources’ trends (see Section 2.2) clearly link to those places on the template. These would include any physical device being developed; the ones that emerged frequently in iTEC discussions were 3D printing and QR codes to augment reality. However, it also includes the shift to “bring your own devices” to school – which is becoming more prevalent now that many institutions have realised the potential within students’ mobile devices rather than viewing them as purely disruptions. Whereas other resources could relate to partner organisations where there is a challenge to work together or it might tie into materials produced for a nationwide competition or that exist in a non-technology format. An example of this would be a scenario in Cycle 2, “Using multiple resources and technology to research a common topic” which was
comparing data found online about the school with the original documents and recollections of previous pupils, to aid students in assessing the validity of various formats.

2.4 Innovation within scenarios

The schools’ landscape has been described as islands of innovation in a sea of ‘business as usual’. Where innovation takes place it is often felt to be idiosyncratic and does not spread far beyond its context of development; while the pressing concern in many schools is simply managing current priorities. ITEC’s aim is to drive innovation by developing and trialling future approaches to teaching and learning enabled by technology.

However, to achieve this it was first necessary to ensure that scenarios could not only be adapted to fit in the various learning environments across the EU but that they were innovative. And to achieve this it was first necessary to define innovation. At a simple level innovation is a change that brings about a positive result in learning and teaching. These positive outcomes ultimately result in improved learning achievement, and include better student engagement, greater inclusion of 21st century skills through advanced pedagogical practices, more effective use of ICT, etc.

It’s also important to remember that innovation does not necessarily relate to the outcome; for example, the result of a scenario might be students doing a presentation to illustrate their understanding of biodiversity. A presentation is not particularly innovative, but if the students were responsible for identifying the research questions, designing interview schedules, collaborating to devise and run experiments etc the process might be highly innovative. In contrast, placing QR codes around a historical part of town describing the importance of the buildings might be an innovative outcome, but if in previous years the same information appeared on a paper map, the process is not innovative. This concept can be found in the ‘Oslo Manual’: THE MEASUREMENT OF SCIENTIFIC AND TECHNOLOGICAL ACTIVITIES, PROPOSED GUIDELINES FOR COLLECTING AND INTERPRETING TECHNOLOGICAL INNOVATION DATA. It makes a helpful distinction between technological product and technological process innovations that can be transferred to the context of education. The product is the learning outcome as expressed as a teaching objective, such as the teaching of new subject content and new skills, or content and skills that have to date been beyond those expected of a particular group of students. Innovation in educational processes includes changes in pedagogy, the learners’ role and how learning is managed and assessed – see Table 2 for a summary.

<table>
<thead>
<tr>
<th>Planning</th>
<th>Process innovation</th>
<th>Product (scenario content) innovation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Curriculum planning based on future needs and opportunities identified within trends and challenges</td>
<td>Scenarios for future teaching and learning.</td>
</tr>
</tbody>
</table>
Teaching and Learning

**Greater personalisation through considering how to seamlessly integrate new technologies and approaches.**

Learners developing new knowledge and capabilities, including 21st century skills.

### Table 2: Process and output innovation summary

What became clear early on was that scenarios selected for further development by stakeholders reviewing those created for likelihood and desirability was that there was a discrepancy in what experts viewed as innovation – either in process or product - and what was innovative to teachers and other stakeholders. Thus scenarios looking at the introduction of whiteboards, the validity of online data, using maths as a language to integrate students who have the native tongue as a second language, are not viewed as innovative as they already occur in some European classrooms. From this it was clear innovation should also be considered context specific, i.e. a learning scenario that is considered an innovation in one country or school is not necessarily considered to be so in another. This conclusion is not surprising given the Knowledge Map (Lewin et al 2011) produced by Manchester Metropolitan University. This found in some countries Information Communication Technology (ICT) is taught as a discrete subject, in others it is part of a wider brief – for example in Design and Technology, while in others it has been adopted in an almost cross curricular fashion and is used across subjects. Similarly, teachers across Europe have different attitudes and training in technology which influences how it is used and integrated.

To reflect this discrepancy the definition of innovation was further refined. A scenario which would be new and more advanced in terms of outcome, process or by its use of technology would be **relatively innovative** in that context. Regardless of the fact it may be common practice in other contexts. While a scenario that results in an outcome all feel is new, or uses a process or technology that all would consider cutting edge would be **absolutely innovative**.

### 2.4.1 The Innovation Classroom Maturity Model

As mentioned initially there was concern that the scenarios generated were not absolutely innovative and it was clear that a way was needed to show the innovation of a scenario and to prompt more innovative thinking. It was therefore decided to draw upon maturity model theory. Initially the concept of ‘maturity’ models was developed at Carnegie Mellon University in the 1970s. They are now used in a variety of fields but fundamentally they set out the stages in an organisation’s development of its capacity and capability to exploit new opportunities afforded by, for example, technology, in pursuit of its objectives. In this sense, maturity refers to the co-occurrence of systemic, economic and individual factors that enable a certain innovation or a cluster of innovations to become established, in the words of James Utterback (1994) to form the “dominant design”.

A simple example would be at the first stage replacing a paper form with an electronic one and then printing, a higher level of maturity would be to have that form automatically populated using data from existing sources, higher still to automatically collate and analyse the forms and so on. Thus maturity models in the form of a matrix provide organisations with a tried and tested ‘route-map’ for developing their use of...
technology. For example, the Carnegie Mellon University Software Engineering Institute (SEI) has developed a Capability Maturity Model for the software industry which has been used by over 1000 businesses in 19 countries.

Within iTEC the following five levels of maturity for technology use were initially identified:

<table>
<thead>
<tr>
<th>Stage 1 Exchange</th>
<th>Localised use</th>
<th>Where technology is used within current teaching approaches, learning is teacher-directed and classroom-located and the learner is a ‘consumer’ of learning content and resources.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stage 2 Enrich</td>
<td>Internal Coordination</td>
<td>Where technology used interactively to make differentiated provision within the classroom, it supports a variety of routes to learning and the learner is a ‘user’ of technology tools and resources.</td>
</tr>
<tr>
<td>Stage 3 Enhance</td>
<td>Process redesign</td>
<td>Where teaching and learning are redesigned to incorporate technology, building on research in learning and cognition. Institutionally -embedded technology supports the flow of content and data, providing an integrated approach to teaching, learning and assessment and the learner is a ‘producer ‘ using networked technologies to model and make.</td>
</tr>
<tr>
<td>Stage 4 Extend</td>
<td>Network redesign &amp; embedding</td>
<td>Where ubiquitous, integrated, seamlessly connected technologies support learner choice and personalisation beyond the classroom. Teaching and learning are distributed, connected and organised around the learner, with learners taking control of learning using technology to manage their own learning.</td>
</tr>
<tr>
<td>Stage 5 Empower</td>
<td>Redefinition &amp; innovative use</td>
<td>Where technology supports new learning services that go beyond institutional boundaries, mobile and locative technologies support ‘agile’ teaching and learning and the learner is a ‘co-designer’ of the learning journey, supported by intelligent content and analytics.</td>
</tr>
</tbody>
</table>

| Table 3: Levels of innovation |

There is widespread agreement that access to technology cannot increase the degree of maturity by itself. Even the best equipped schools will fail to implement absolutely innovative scenarios unless teachers have the competences, vision, training, support and time required in order to harness ICT. Pupils are also unlikely to be motivated to learn if they are not engaged by the technology they are using. Moreover, there are important cultural and legal contexts influencing the adoption of a scenario - e.g. attitudes to risk, curriculum rigidity, and various national and even local policies and regulations that dictate how digital technological can be accessed and used in schools – not least health and safety regulations determining the circumstances in which technology use is acceptable, the restrictions placed on certain types of content, and the modalities in which teachers can interact with students through digital and networking technologies. For example, it is not uncommon for schools to explicitly advise teachers against using digital media to communicate with students outside of school hours (Vasager and Williams, 2012).

This implies that technology should only be one area of the model. The other two will relate to product and process, the latter divided into three areas: pedagogy, learner role
and the management of teaching and assessment. Moreover, unlike maturity models already in existence which focus on the stages of implementing and realising the benefits of technology, this one uses the stages of innovation itself as the core organising principle. The model is represented pictorially in Error! Reference source not found..

<table>
<thead>
<tr>
<th>Level 5</th>
<th>Empower</th>
<th>Redefinition &amp; innovative use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 4</td>
<td>Extend</td>
<td>Network redesign &amp; embedding</td>
</tr>
<tr>
<td>Level 3</td>
<td>Enhance</td>
<td>Process redesign</td>
</tr>
<tr>
<td>Level 2</td>
<td>Enrich</td>
<td>Internal Coordination</td>
</tr>
<tr>
<td>Level 1</td>
<td>Exchange</td>
<td>Localised use</td>
</tr>
</tbody>
</table>

Table 4: Overview of Innovation Maturity Model

It is important to remember that maturity models are constantly evolving. What was initially level 5 was expected be extended in the future as education and technology progress. They also need to be adapted according to circumstance. This may be merely changing the labels – feedback showed that the terms enrich and enhance are not distinct when translated – but it may also involve revising content as new ways of learners working together emerge. The maturity model used in iTEC can be found in Appendix A: Innovation Classroom Maturity Model (Found in Eduvista).

The maturity model has become a key part of the change management process described in the final Future Classroom Toolkit, where it has been developed into an interactive tool, to support benchmarking as well as the design and assessment of scenarios. In its final iteration at the end of the project it has been renamed the Future Classroom Maturity Model, in recognition of the fact that innovation is always possible, so the idea of reaching a level of maturity is not appropriate. Having said that, the highest level of maturity within the matrix is intended to be one where ongoing innovation is the norm.
3 The scenario planning toolkit: innovation in curriculum planning

From the previous section it is clear that scenarios lend themselves to identifying, assessing and carefully implementing innovation within the classroom. However, to support stakeholders create scenarios, a structure to guide users through the process is required. This is the topic of this section.

3.1 Why was a toolkit created?

The development of scenarios relies on much more than simply asking teachers, no matter how “innovative”, to recount their experiences or give opinions and views. The role of face-to-face discussions, based on prompts, facilitated activities and emerging interactions (sometimes critical and argumentative) is crucial to create a sense of purpose and relevance.

The Future Classroom Scenarios Toolkit structured the process of scenario creation. In all five cycles this was designed to be a collaborative approach to exploring how emerging trends in teaching and learning, technology and society can support institutional self-review and transformation. The Facilitator selects partners and other stakeholders to develop scenarios tailored to the needs of specific communities and organisations at a national, local or community level. Bringing together partners and stakeholders in this way is the first example of innovation; rather than merely being consulted on curriculum changes, partners and stakeholders take an active role in helping the school shape its priorities.

Next, a toolkit structure enables stakeholders to fully understand the end to end process and all key features within a scenario. In iTEC the toolkit is modular, with individual modules that can be used outside the iTEC project, for example, identifying stakeholders in the context of the school. This flexibility means that it can be adapted to local needs and contexts. For example, by a school looking to visualise the impact of a new library or by policy makers in central government looking at what would happen if the curriculum was amended. In turn this will support long term exploitation of the process.

3.2 How should the Future Classroom Scenarios toolkit be used?

The toolkit was designed to be used during the iTEC project but also afterwards hence trying to make it flexible and standalone. It is designed to have a Facilitator who coordinates and drives the activities. They can decide which is useful, who needs to be involved, the timescale, and where necessary collate and publish any input, for example, trends and challenges identified, the results of assessing current context using the maturity model. In its final version, the Future Classroom Toolkit has been produced with the same original aim.

The various resources within the toolkit can be used independently or used in turn. Again it is the Facilitator that decides what elements are required as well as time tabling the process.
3.3 The role of stakeholders

As discussed in the previous section there has been a shift from stakeholders taking a more passive role of reviewing the short scenarios and then being presented with learning activities to creators of their own bespoke scenarios. Why this shift?

From a theoretical perspective the involvement of stakeholders leads to a sense of ownership. The investment in the scenario means that not only is it more appropriate to the local context but because it has been designed by the person they are more willing to implement it. There is also a practical element as the stakeholders are the ones that know what is required.

Consequently the first part of the Future Classroom Scenarios Toolkit was dedicated to the Facilitator identifying stakeholders; a core group of staff, policy makers, technology experts etc; and a wider group of community stakeholders; eg students, other education practitioners, local employers, members of other institutions (e.g. the local university), representatives of associations (e.g. parents’ associations and faith groups). It then discusses how to keep the group momentum.

The small “core working group” of stakeholders selected by the facilitator influences the successful creation of scenarios. In Cycle 4 success was mainly down to the careful selection – or “self-selection” - of suitable participants, who were already motivated and familiar with the project. Moreover, Cycle 4 showed that face-to-face sessions were essential to the creation process as they ensured enthusiasm of participants. Another feature of Cycle 4 was the maintenance of clear and consistent communication and the flexibility of the shared area.

3.4 Trends within the toolkit

3.4.1 How are trends and challenges identified?

The identification of trends – which became the areas to be addressed when fed into the scenarios – was developed through a collaborative process with iTEC partners and wider groups of stakeholders over the course of the project. It is this reflection and identification of trends that ensure the resulting scenario is not ‘blue sky’ but applicable to the needs of the stakeholders.

As discussed in Section 2.3.2 the toolkit has a set of resources that describe the currently identified trends; the results from various questionnaires and focus groups; the results from the votes by students on important factors. Although these trends will continue to be valid for a few years they are not definitive – they will evolve as new technologies emerge and the curriculum changes. This led to links being included as well as the option to write in trends directly.

3.4.2 Selecting relevant trends and challenges

Many trends and challenges will impact the future classroom. However, it is important to focus on no more than three when building a scenario. This is a result of earlier cycles where it was found that incorporating more than three trends resulted in scenarios that were complex and less likely to be selected.
Stakeholders, be they teachers, pupils, parents, local industry, academics, or policy makers, will have differing views on what is important to them, as well as ideas around what factors will be influential that have not necessarily previously identified.

As in earlier cycles, where iTEC partners were asked to prioritise trends, the process of evaluating what will have greatest impact on the learning environment still needs to be performed and is thus included in the toolkit. Thus the process for gathering trends initially devised in Cycle 1 has been incorporated into the toolkit in the form of a questionnaire to be sent to stakeholders. The structured questions are designed to elicit views on what challenges face teachers, students, and what new technologies could have an impact on learning. The questionnaire is not the only approach though. Stakeholders are encouraged to have discussions and consider ranking of trends by importance by the individuals. Therefore the toolkit contains a template to be issued to partners asking for pedagogical or technological trends, along with examples of how these could influence education and learning and suggestions for further reading. It also asks if necessary whether they can suggest what evidence is needed to understand if the trend has been successfully incorporated.

![Figure 1: Likelihood and impact assessment of trends or challenges template](image)

### 3.5 Using the Innovation Maturity Model

The maturity model can be used at several stages within the toolkit. According to when it is used it can be:

- a tool to measure absolute level of innovation
- a tool to measure relative levels of innovation
- an 'innovation ladder', which can help schools and localities identify their current stages of innovation, identifying local context is necessary to determine if a scenario is innovative in that situation
- an organising framework for the scenarios, clearly identifying the stages of innovation where each scenario sits
- a stimulus to the production of more innovative scenarios.

Facilitators are encouraged to get stakeholders to discuss the ranking of the context or scenario on the model as feedback from Cycle 5 (Lewin and Nichols 2013) shows that the wording can be ambiguous and interpreted differently between participants.

### 3.6 Creating the scenarios

The output of the toolkit is the scenarios. The structure has been discussed in Section 2.2 but it should be remembered that the development process should reflect the collaborative approaches advocated in the maturity model. It demands a positive attitude towards change, innovation and risk-taking by stakeholders and a focus on the development of digital competencies.

### 3.7 Assessment of innovation in scenarios

The maturity model is one way of assessing innovation. Current practice can be assessed and compared to that occurring after the scenario has been implemented to measure relative innovation as well as looking at the scenario to define the absolute levels of innovation. However, between cycles 3 and 4 the process of reviewing projects against desirability and likelihood was revised to reflect the goals of those implementing the scenarios, namely:

- A: Match identified trends and challenges
- B: Feasibility of pedagogical implementation
- C: Feasibility of technological implementation
- D: Innovative/transformational character
- E: Prospects of impacting at scale, if validated successfully

From these five aims the following questions were devised and given to the reviewers:

- Is the scenario sufficiently innovative for the future classroom?
- Does the scenario have the potential to support teacher competency acquisition?
- Is the scenario innovative its potential use of technology?
- Does the scenario address recognized focus areas for educational reform?
- Is the scenario currently feasible and sufficiently scalability for potentially large scale impact?

To aid assessment each question was subdivided into three explicit criteria, for example, in the first dimension the reviewers must consider: if it meets the challenge specified, if the benefits of innovation are expressed and is there a novel assessment process. In addition to comments around how this area is fulfilled, or any concerns if not, it is then
scored out of three depending on how many of the criteria was met (0 – none, to 3 – all). This means that it is possible to compare scenarios as well as see how innovative they are through looking at the combined score as well as reviewing comments.

A further dimension was added if multiple scenarios had been created:

Do the scenarios represent a range of innovations?

This ensures a range innovations in pedagogy and technology are represented (for a complete description of the areas see Le Boniec et al. 2012, pp.29-38).

The advantage of considering these questions in addition to using the maturity model is that they force a broader consideration of the scenario. The maturity model cannot assess whether the proposed scenario actually addresses the trends or challenges initially identified. It cannot determine the feasibility with respect to the teacher, or match it to policy, or see if it is scalable. These questions force the stakeholders to consider if the scenario is actually fit for purpose as well as encourage reflection and possibly amendments to enhance the scenario.

These questions form the basis for the evaluation exercise within the Future Classroom Scenarios Toolkit.
4 Analysis of scenario content

In this section the selected scenarios developed over the course of the five cycles have been compared to identify similarities and differences in terms of pedagogy, technology and curriculum goals. This focus on product compliments the work by done by Cathy Lewin and Sarah Nichols at Manchester Metropolitan University who gathered feedback from teachers about the impact of the process and scenarios (2014).

4.1 Scenario development over the five cycles

Although scenarios were produced in each cycle, the process was iteratively refined over the five cycles. These changes in process impacted the structure and selection of the scenarios, as described in the next paragraphs. These changes mean that a like for like comparison of the five sets of scenarios cannot be performed; however, they can be used to look for broad themes and areas of concern.

In the initial plan scenarios were to be created by a project team with expertise in the areas of learning, technology and policy that were a preferable and appropriate response to challenges and trends identified by research, experts, and surveys of teachers across the EU. Initial drafts of scenarios were created in workshops using a template. The template took into account “who is learning; where they are learning; why they are learning; what they are learning and what resources, tools and services are being used”\(^9\). These were then to be reviewed by stakeholders (school leaders and teachers, policy advisors, partner organisations, and technology providers) across the EU. Approximately eight to ten deemed most desirable and most feasible, i.e., realistic practice within five years, would be extended and used in the next stage. The “top” scenarios selected from each cycle, 49 in total, can be found in Appendix B: Scenarios selected for further development.

Over the course of the project the workshop structure changed. In the first three, experts were invited to create scenarios from trends and challenges identified by partners, a literature review and surveys of teachers and students. In the third workshop the groups generating scenarios were given trends to explicitly focus upon. In the fourth the first draft of the scenarios were written by Futurelab with input from WP2 partners rather than other stakeholders. They were based on: an analysis of the previously identified trends, innovative practice collated from iTEC partners, and suggestions from groups of learners elicited in workshops held in four countries. Finally in the fifth the toolkit was used to create bespoke scenarios. In addition, experts created radically innovative scenarios that were used to create small scale pilots. The last two cycles also approached assessment differently; instead of looking at desirability and likelihood – which varied across the EU given the spread of technology and various curriculums – it asked specific questions about the innovation in each area of the scenario. This became the basis for the evaluation process within the toolkit (see Section 3.7 Assessment of innovation in scenarios).

\(^9\) See the original Description of Work, p12
It should also be noted that scenarios were designed to be adapted and therefore could be made more or less innovative. Thus an initial scenario could suggest that the students create a video explaining their findings – but the school infrastructure, kit and time available, and teacher experience may result in the findings being made into a presentation illustrated by pictures. This is clearly not as innovative but still has the same overall goal of peer teaching.

### 4.2 Analysis of selected trends and challenges

In this section the process and results of analysing the trends that form the basis of the scenarios are described. From Cycle 2 onwards trends and challenges were explicitly recorded on the template; with the ability to express them in the stakeholders own words rather than using the exact wording identified by researchers and partners.

#### 4.2.1 The analysis process

In the first cycle the trends were not explicitly recorded. However, what can be seen was that of those selected in the first cycle there was a focus on problem based learning and collaborative working indicating that trends were around 21st century skills.

In the remaining cycles the trends from each selected scenario were categorised into themes loosely relating to the maturity model matrix, for example, by subject area such as the need to improve maths, science, technology skills, or an outcome such as the development of 21st century skills. Note that in the trends analysis the narrative was not analysed to determine the subject area of the scenario. In educational processes there were pedagogical themes such as problem based learning, in the learner trends looking at desired behaviour, and the need for professional development within the management of teaching, learning and assessment area. With respect to underpinning technologies these were classified into broad areas, such as the need to incorporate mobile devices alongside the potential of virtual reality or cloud computing and the potential of Bring Your Own Devices or incorporating mobile technologies effectively.

Categorising trends is problematic given the freedom in definition. Collaboration can be listed as a trend in its own right, for example, but it can equally be seen as integral to 21st Century Skills and was classified as such alongside “21st century skills in practice”. Moreover it was often hard to separate stakeholder intention about whether a trend fell into a change in pedagogy or learner role. Learner roles often seemed to overlap pedagogy; if the trend is around extending peer tutoring obviously this changes the role of the learner as well as being a pedagogic technique. With respect to the maturity model the emphasis on how the learner becomes less passive and starts taking control of their learning journey does not assist the classification. There is only one trend that states they wish “to support learners to be more active and inquiring learners in class” [Cycle 5].

And often when analysing trends that stakeholders viewed as distinct, these were classified together. An illustration would be the scenario from Turkey in Cycle 5, **Using interdisciplinary school subjects and technology to enrich teaching and learning.** The following trends were both categorised as the need for professional development, yet clearly the stakeholders viewed them as different challenges as they listed them separately.
• In Turkey most of the teachers are unaware of positive use of technology and internet in the class and this situation causes them to fall behind the students and to lack in 21st century competences.
• Teachers are supposed to be connected through social media and be open to collaborative work and sharing and to developing their ICT and 2.0 Tools literacy communication problem solving skills.

Therefore any analysis can only be viewed as indicative of the stakeholders’ intention and understanding as it is impossible to truly understand how the trends were interpreted and implemented by participants from the scenario template.

4.2.2 Results and discussion
The only subject areas that occurred as a trend focused on fostering science, mathematics and technology skills. For example, scenarios were built around:

• “A growing MST (Mathematics, Science and Technology) skills gap” – [Cycle 2]
• “Growing awareness that disaffection and low attainment in relation to MST subjects (Mathematics, Science and Technology) and in general are related to inequalities and social background” – [Cycle 3]
• “The challenges of fostering MST and in particular connecting students to industry” – [Cycle 4]

In Cycle 2 there were two mentions in ten scenarios, in Cycle 3 four mentions in seven scenarios, and in Cycle 4 four mentions in ten scenarios. This can be explained by the focus in the workshops on SMT as it was a focus of iTEC. However, in Cycle 5 these subject areas were not mentioned as a trend in any selected scenario. This would suggest that teachers have a broad view of where they wish to see innovation, and not necessarily in the areas predicted as those that would benefit.

However, a desire for students to improve their 21st century skills was explicitly expressed in all five cycles. What is interesting to note is that many did not feel the need to elaborate what they meant by such skills whereas others provided detail, e.g. “21st century skills: communication skills, social, collaborative and critical thinking and creative ability of students and the use of ICTs as tools for working and learning” [Cycle 5]. This indicates not only is this viewed as important, but that in order to summarise stakeholders may have discussed what they mean by this phrase and what sort of behaviours they wish their students to develop.

The largest number of trends occurring in the educational process area was around pedagogy and the overlapping learner roles. This is best illustrated in Cycle 5 where stakeholders created their own trends; specifying problem and project based learning, peer-tutoring, group working and reflective learning. However, from Cycle 2 onwards at least one of the selected scenarios explicitly addressed motivating students or helping them to overcome their frustration with typical classroom activities.

The last two cycles show the emergence of underpinning technology as a trend that is explicitly listed as an area the scenario needs to address. This is not to say that earlier
scenarios do not use innovative technologies, as they clearly do, but that without the constraints of being given a list of trends and challenges to use or adapt, stakeholders are driven to create scenarios because of the potential of a technology. Thus in Cycle 5 stakeholders list specific technologies, such as cloud computing, augmented reality, 3D printers. They also start considering broad areas such as how they could incorporate students bringing in their own mobile devices to the classroom. In Cycle 4 stakeholders do not include specific technologies, but have listed the potential of a specific technology, for example, that GPS mobile devices allow the potential for play which will become more important in the future.

From this analysis it would seem that some trends are constantly the basis for scenarios. Given this, it would seem sensible to allow the stakeholders to search previous scenarios by trends they address.

4.3 Analysis of scenarios for similarities

The evolution of the Future Classroom Scenarios Toolkit not only shows that there are trends that are common but similar narratives emerge. For example, using a range of technologies to investigate the natural world were selected as scenarios to go forward in the first and final cycle.

<table>
<thead>
<tr>
<th>Cycle 1: A Breath of Fresh Air</th>
</tr>
</thead>
<tbody>
<tr>
<td>Learners go out into the school grounds to understand why the ladybird population has decreased in the last year. They gather data using a range of technologies to bring what they find back to the classroom. They create a short film to share and reflect on their findings.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Cycle 5: Pollution everywhere, collecting data</th>
</tr>
</thead>
<tbody>
<tr>
<td>In groups students will be asked to research and prepare an interactive presentation around pollution. They collect data out of school with their devices: e.g. digital cameras, mobiles, tablet. Teachers also ask students to collect different samples of surrounding water to be analysed later on using the microscope. Students collect water from the nearby lake, water from rain, and water from home. All samples are recorded and captured with the document camera and shared between all groups. Students use social media or blogs created also to share their experiences and teacher uses the school web or LMS to share the resources with the class.</td>
</tr>
</tbody>
</table>

Each group will record their final presentation using the document camera and the teacher will keep all this material for evaluation and for next year to use as a class resource that could be used to flip the classroom.

**Box 2: Scenarios that focus on technologies to investigate the outside world**

Similarly, different groups independently developed scenarios to learn about business – as shown in Box 3.

<table>
<thead>
<tr>
<th>Cycle 2: Developing collaborative approaches to learning about business</th>
</tr>
</thead>
<tbody>
<tr>
<td>As the fallout of the financial crisis is set to continue, many EU countries are facing massive debts and high spending cuts, which is affecting the job market and decreasing young people’s chances of employment. This activity will support students to develop collaborative approaches to business and to gain practical experience of setting up and developing a business idea.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Cycle 5: Applications for solutions</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>
To overcome a high level of unemployment a programme for entrepreneurs is set up. Activities include talks from banks explaining funding and business plans etc and marketing departments explaining some of their techniques. Then local families and businesses and the wider community can suggest ideas of products and services that they would like, or problems that they need solutions for. The students are then supported to investigate these suggestions which are presented back to the community to identify the most important or to indicate whether they would buy that solution. Once the list is ordered the students can then select a problem identified as important that interests them. Working in groups or individually they then propose a solution and where possible create it. To achieve this they interview those that raised the issue, contact experts in the area, create prototypes if appropriate and document how they reached this point – including producing formal product specifications etc.

**Box 3: Examples of scenarios that focus on business**

Alternatively, scenarios evolve through cycles. In the first cycle a scenario was created but not taken forward that suggested using technology to create networks for teachers enabling a sharing of resources and providing assistance. In the second workshop a similar idea emerged in two scenarios; the creation of communities to provide support, peer learning and resources between teachers. In this case both the scenarios were shortlisted by stakeholders across the EU. In the fourth cycle the first was selected for refinement using ideas from those in the second.

**Cycle 1: Supported through Change**

In this scenario, teachers are supported through the development of networks via which they can gain the expertise and benefits of working with other teachers. Technology allows for the networks to develop and teachers can share resources and ideas for developing teaching and learning within the same subject. Wider networks can also be developed which help teachers with assessing work, for instance, by drawing on the expertise of media teachers to assess multimedia work.

**Cycle 2: Mentoring Teachers to improve Digital Literacy**

Knowing how to use the web and digital technologies effectively and appropriately is a critical skill for students to learn and is one that is now being addressed within many schools. Teachers are therefore often expected to have high levels of digital literacy themselves. However, lack of confidence or competence in their own knowledge and skills is often a barrier to using technology in classrooms. Peer learning and support is one way teachers can gain the necessary skills and knowledge to develop their own – and their students’ – digital literacy.

**Cycle 2: Professional development in the global classroom**

Legislative and economic pressures mean that certain methods used to teach difficult science, mathematics or technology topics are no longer possible or practical. Teachers need inspiring ideas to cover these gaps. There are pockets of innovation in classrooms around the world. Social media and online collaboration tools can help teachers get connected with each other and share innovative teaching practice and resources between schools in the same community or across the globe.

**Cycle 4: Supported through Change**
This scenario aims to support professional development of teachers using a model that combines cognitive apprenticeship (coaching) and peer teaching enabled by telepresence technology. An online professional network provides the general framework. Teachers meet and identify shared challenges or developmental opportunities through the network. They then arrange lessons in which one teacher is in the classroom, while the other acts as a coach through a telepresence system running on the IWB. The main advantage of such a system is the ability to provide adaptive, real-time support as challenging or critical situations arise; this translates into more effective, “on the job” professional development and, at the same time, into a more powerful learning experience for the students.

Box 4: Example of an evolving scenario

In the fifth cycle the stakeholders had the option to adapt previous scenarios. However only one of the selected scenarios was an adaptation of an existing scenario; this was **Personalised learning paths** which was: “An adaptation of « Personal learning agent » scenario, with a touch of « Radical Flip »” – a Cycle 1 and Cycle 3 scenario which had been renamed **Homework and school work “flip”**.

In summary, as similar themes emerge without prompting there is merit to allowing stakeholders to access previous scenarios as a resource, or for inspiration. Thus the explicit recommendation to review and reflect on existing scenarios that focus on similar areas of concern would seem beneficial and should be included in the Future Classroom Scenarios Toolkit.
5 Are the scenarios innovative?

The rationale for scenarios, the toolkit and what is meant by innovation have been considered in earlier sections. In this section the scenarios are reviewed to see the type of innovation they display – are they absolutely innovative (that is, innovative in all contexts) or is there a tendency to relative innovation (where the practice described may be happening elsewhere but is innovative in this context)? Given that no information was collected around the current context within the classrooms participating, relative innovation can only be assumed if any of the three areas – Outcomes, Process (Pedagogy, Learner Role, or Management of Learning) are ranked at level 2 or above.

As discussed, there are two ways of reviewing scenarios suggested in the toolkit, namely review:

i. Against the Innovation Classroom Maturity Model to ensure that a progression has occurred in at least one of the categories\(^\text{10}\).

ii. Using the review questions developed to check for innovation.

5.1 Radar diagrams

Stakeholders can select various aspects of the Future Scenarios Classroom Toolkit to implement. One of these is the review process comparing the scenario against the maturity model; in the toolkit this is part of the iterative design, not only checking for innovation but enabling the stakeholders to identify and amend areas of weakness. Table 5 was generated by assigning the relevant level in each dimension for every scenario and then averaging. The full tables can be found in Appendix D: Radar diagram scores.

<table>
<thead>
<tr>
<th></th>
<th>Number of scenarios</th>
<th>Product outcomes/learning objectives</th>
<th>Pedagogy</th>
<th>Learner role</th>
<th>Management of teaching, learning and assessment</th>
<th>Underpinning Technology</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cycle 1</td>
<td>9</td>
<td>3.22</td>
<td>3.56</td>
<td>3.22</td>
<td>3.22</td>
<td>3.00</td>
<td>3.24</td>
</tr>
<tr>
<td>Cycle 2</td>
<td>10</td>
<td>3.20</td>
<td>3.30</td>
<td>2.90</td>
<td>3.50</td>
<td>3.20</td>
<td>3.22</td>
</tr>
<tr>
<td>Cycle 3</td>
<td>7</td>
<td>3.43</td>
<td>3.43</td>
<td>3.57</td>
<td>3.14</td>
<td>3.86</td>
<td>3.49</td>
</tr>
<tr>
<td>Cycle 4</td>
<td>10</td>
<td>3.50</td>
<td>3.00</td>
<td>2.70</td>
<td>3.30</td>
<td>2.70</td>
<td>3.04</td>
</tr>
<tr>
<td>Cycle 5</td>
<td>13</td>
<td>3.54</td>
<td>3.46</td>
<td>3.69</td>
<td>3.23</td>
<td>3.54</td>
<td>3.49</td>
</tr>
<tr>
<td>Expert panel - cycle 5</td>
<td>7</td>
<td>4.14</td>
<td>3.86</td>
<td>3.57</td>
<td>3.29</td>
<td>4.00</td>
<td>3.77</td>
</tr>
</tbody>
</table>

Table 5: Average scores of scenarios against the maturity model

\(^\text{10}\) Appendix C: Creating a radar diagram describes in depth how to categorise a scenario and create a radar diagram
At a superficial level Table 5 shows that the scenarios are similar in terms of innovation - although the Expert panel in Cycle 5 does have more scenarios with aspects that are classified as more innovative. It should be borne in mind that in Cycle 5 many scenarios were listed as being level 4 in terms of technology because a 3D printer was mentioned and this was classified as an innovation. Also that, if the model was used in the design process, it may be that the resulting scenarios use phrases from higher levels and therefore are classified as more innovative.

An alternative is to look at the individual radar diagrams for each cycle. A radar diagram is produced by plotting the levels of the scenario against the five categories of the Future Classroom Scenario Maturity Model. This gives a quick visual representation of where a scenario is felt to be innovative (for an example of how to generate radar diagrams see Appendix C: Creating a radar diagram). In this project each scenario was double marked by two experts and where a difference in evaluation was found a level was agreed.

![Radar Diagram](image)

**Figure 2: Evaluation of scenarios in Cycle 1**
Figure 3: Evaluation of scenarios in Cycle 2

Figure 4: Evaluation of scenarios in Cycle 3
Figure 5: Evaluation of scenarios in Cycle 4

Figure 6: Evaluation of scenarios in Cycle 5
The radar diagrams show that in every cycle there were some highly innovative scenarios that were shortlisted, although these may not have necessarily been implemented in that format. There is, however, no one area in which innovation appears particularly prevalent. All of them have at least one scenario with aspects that were at level 4 or above. Although, as discussed, scenarios are designed to inspire rather than be lesson plans. The learning activities generated may be adapted according to time, equipment, and curriculum.

Similarly, the radar diagrams show that in every cycle (even Cycle 5) scenarios were shortlisted that could be seen as not particularly innovative – although no scenario is constantly at level 1 – so there is the potential for all scenarios shortlisted to be relatively innovative in some aspects. For example, in Cycle 4 the inclusion of scenarios to introduce Interactive Whiteboards lowers the average level.

To conclude, radar diagrams are useful to give an overview of innovation, and clearly show whether a scenario is relatively or absolutely innovative. However, as no stakeholders plotted “before” radar diagrams to show the current context or “after” diagrams to represent the levels that occurred in practice, there is no data to determine how relatively innovative the scenarios, and their implementation, actually were.
5.2 An analysis against the review questions

In Cycles 4 and 5 experts from the iTEC partners worked in groups to assess the shortlisted scenarios against the review questions described in Section 3.7. The main goal was to explicitly give the strengths and weaknesses of each scenario in order to strengthen the scenario before it was used as the basis of the Learning Activities. However, as stated, to aid the review points could be allocated according to whether or not that criteria has been fully, mainly, partially or not met. This gives a score for each scenario – the higher the number the more it meets that criterion.

The scenarios shortlisted are not necessarily the most innovative according to the review. As shown in Appendix E: Voting for Cycle 5 scenarios the order of preference does not match the levels of innovation identified.

As discussed, this process is not designed as an evaluation tool; it is meant to be used in an iterative fashion to improve the scenario. The review is to determine the feasibility of the scenario at the classroom, local or national level. It allows the stakeholders to consider scalability and whether or not the trends and challenges it was designed to address have been met. However, using it for quantitative analysis reinforces the idea that scenarios that are relatively innovative may be more desirable than those that are absolutely innovative.

5.3 Summary

As stated, in earlier cycles the reviewers felt that scenarios did not display absolute innovation. However, reviewing by analysing against the maturity model or the reflection questions shows that all the scenarios have a degree of relative innovation and many could be viewed as having some aspects of absolute innovation. In earlier cycles the scenarios were selected and refined for implementation in a range of classrooms. This may have led to selecting those with fewer barriers to implementation giving the appearance of a lower than anticipated levels of innovation.

The focus on relative innovation is not an undesirable outcome. As discussed in the Innovation Maturity Model, an incremental move upwards in the model is more likely to be successfully implemented than a dramatic jump up multiple levels. Larger jumps require more preparation in terms of infrastructure, stakeholder training, and curriculum structure.
6 Reflections on the iTEC process

6.1 Key achievements

The key output from Work Package 2 within iTEC was the Future Classroom Scenarios Toolkit. It was developed with European Schoolnet and is based on the scenario development process of the first four of the five iTEC cycles. The final Future Classroom Toolkit has now been produced based on feedback in the final year, and use in Cycle 5. Initially there was to be no toolkit. The scenarios would be developed and trialled over the five cycles of the project after which they could be used as a resource by future teachers and policy makers. However, it became clear that scenarios needed to relate to context, and stakeholders therefore needed the ability to define their own – for inspiration or to create learning activities from. Thus Eduvista was born and trialled in Cycle 5.

Eduvista was created using a user-centric design process to help educators, policy makers, ICT suppliers and other stakeholders think beyond current practices. The development of scenarios relies on much more than simply asking teachers, no matter how “innovative”, to recount their experiences or give opinions and views. The role of face-to-face discussions, based on prompts, facilitated activities and emerging interactions (sometimes critical and argumentative) that form the toolkit is crucial to create a sense of purpose and relevance. The process has proved sufficiently evidence-based and disciplined to produce a suite of scenarios for the future classroom that have been developed and trialled across Europe.

The goal of iTEC was always to create scenarios that were meaningful to the stakeholders yet were innovative. This led to work around the nature of innovation when the scenarios, and the learning activities that arose from them, did not appear “cutting edge”. To achieve this, a maturity model was developed that classified the types of innovation that could be seen in the classroom. The Innovation Maturity Model and Future Classroom Maturity Model provide an ‘innovation matrix’ setting out these stages in a way that provides a ‘sense of direction’. It allows policy makers and practitioners to first benchmark their current level of innovation in a way that prompts more innovative thinking in the future. Secondly, it provides one method of assessing whether or not a scenario will result in innovative practice. And finally, it can act as an inspiration to help stakeholders identify where they wish to be in terms of process and outcome.

The shortlisted scenarios were relatively innovative, that is, they were more innovative in some areas than current practice, and some had elements of absolute innovation, so no matter the context they would be viewed as innovative. However, an analysis of scenarios selected showed that teachers were not necessarily looking for absolute innovation when they were selecting, or even creating, scenarios. They were looking for a narrative that addressed the trends and issues they faced that moved them on from current practice.

11 Eduvista can be found at http://eduvista.eun.org/ – (accessed Sept 2014)
To summarise, the creation of scenarios was found to be beneficial to stakeholders. The goal of allowing teachers, students, academics and industry to work together to create a shared understanding collaboratively was achieved. The role of facilitator is important and so is making clear the process of scenario creation, even if not all the tools are used.

6.2 Future developments

The Future Classroom Scenarios Toolkit has been integrated into European Schoolnet’s Future Classroom training programme, and further developed by them to provide the Future Classroom Toolkit (discussed in more detail in the Exploitation plan: D11.5.4). The training programme is offered online free of charge, and covers the toolkit and scenario creation. From the analysis of the trends and scenarios, feedback from WP5 (Lewin and Nichols 2014) and feedback from the last EU review, further refinements were incorporated to improve the usability of tools. For example, as a consequence of feedback from stakeholders in Cycle 5 (Lewin et al 2013) tools have been made more interactive rather than being printable PDFs. Similarly, instead of two separate processes to create scenarios – one from scratch and one from adapting an existing scenario – they are to be combined.

The original Eduvista home screen is shown in Figure 8. This shows it is set up into six distinct modules that can be used independently or in combination. In the remainder of this section five changes are identified, all of which have informed the final design of the Future Classroom Toolkit. These have been identified through the WP2 review process looking at scenarios created. Where appropriate they include mention of suggestions from the WP5 review (Lewin and Nichols 2014) and the last evaluation which corroborate them.
1. **Instructions and inclusion of examples**

In Eduvista explanations and instructions are given predominantly in text with few examples. The scenarios submitted by stakeholders in Cycle 5 often did not follow the template or there was confusion over what each section was to contain despite the facilitation. This confirms feedback from the National Co-ordinators (Lewin et al 2013, Lewin and Nichols 2014) and from the review that suggested a short introduction explaining the toolkit purpose to anyone not familiar with the process, and including instructional or demonstration videos would be beneficial. With respect to the content examples should be included that were practical and relate more closely to their own experiences, for instance covering different subjects and age ranges taught.

*Videos explaining the purpose of each activity and talking heads describing how they used the various tools and outcome are now being included.*

2. **Guidelines for facilitators**
As mentioned in the previous suggestion for improvement was the fact that facilitators did not ensure that the template was completed as designed. This failure is not surprising given the range of activities and tasks the facilitator must understand and lead. For effective use one stakeholder, the facilitator must manage the process, identifying stakeholders, organising input to the trends and challenges, collating this information, arranging workshops etc.

3. **Searchable resource bank of scenarios**

Although only one scenario that drew on existing scenarios was shortlisted in Cycle 5, there appears to be frequent similarities between scenarios created. Stakeholders therefore may find it easier to draw from existing scenarios rather than constantly starting from scratch. This option is currently available in Eduvista but the previously created scenarios are ordered by title rather than categorised. As the numbers grow they will need to be searchable. This implies scenarios need to be tagged as a minimum by:

- Trends and challenges
- Technology used
- Desired levels of innovation (by maturity model areas)
- Outputs/Subject areas
- Combinations of the tags

This would enable stakeholders to search for inspiration if the challenge is using the schools new digital editing suite creatively when teaching literacy; or if teachers need support in professional development in using technology as the school is currently considered as only using technology to enrich the lesson.

Consequently stakeholders will need the ability to tag their scenarios – from a given list or to choose their own - and record the levels against the current maturity model. Note that this means the associated maturity model will need to be linked as current innovative practice may become everyday so that scenarios that are radically innovative now may be standard in the future.

The scenarios will need to be easily accessed from the home page as they can be used as a resource – for example as inspiration for teachers – without being integrated into other activities.

4. **Sharing trends**

Eduvista lists locations where new trends can be identified as well as listing those used within the ITEC project. Once again, to avoid stakeholders repeating research, there should be the capability for new trends to be added to the repository by stakeholders, including the ability of policy makers to add future requirements.

The trends need to be accessed from the module focusing on identification; however, as stated they should be used as a means of searching for scenarios.

5. **Revisable maturity model**
The wording in the maturity model was designed to be at a high level so that it describes states without explicitly specifically defining what it could entail. This was to keep the model brief enough to be useful and accessible across the EU. However, it is not definitive, and over time the levels will evolve as practice, trends and challenges, technology available etc change. For example, currently 3D printers are given as an example of Level 5, Empower, as they have the potential to expand the type of activities open to students. However, in time more schools will have access and they may become as ubiquitous as the Interactive Whiteboard is in some countries – and the challenge will become to integrate newer technologies.

In addition to evolving definitions it is important that stakeholders can express and agree their understanding within the model itself – be it in English or a translation. Concepts are expressed in different ways across schools, let alone countries. After Cycle 5 it emerged that some stakeholders were confused by terms like *enrich* or *empower* which may confuse because of the context they are used in. Similarly, some stakeholders may not understand ‘agile teaching’ and the model should be amended so the idea is clear and shared for those stakeholders working together. Translations of the Maturity Model should capture the ‘spirit’ of each level, using the language and linguistic conventions that resonate with users rather than be a simple literal translation of the text.
7 References


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OECD (2006b). Universities Future project, OECD Publishing, Available at: http://www.oecd.org/document/18/0,3746,en_2649_35845581_31245522_1_1_1_1,00.html


## Appendix A: Innovation Classroom Maturity Model (Found in Eduvista)

<table>
<thead>
<tr>
<th>Stage</th>
<th>Educational Outcomes</th>
<th>Educational processes</th>
<th>Management of teaching, learning &amp; assessment</th>
<th>Educational resources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stage 5 Empower Redefinition &amp; innovative use</td>
<td>Activities address personalised learning objectives that are negotiated with students and are reviewed and revised throughout.</td>
<td>Ubiquitous, integrated, seamlessly connected technologies support learner choice and personalisation beyond the classroom.</td>
<td>Technology supports new learning services that go beyond institutional boundaries, allowing the school to broker services provided by others, such as learner communities of practice.</td>
<td>Mobile and locative technologies supporting ‘agile’ teaching and learning, that is, responding to situation</td>
</tr>
<tr>
<td>Stage 4 Extend Network redesign &amp; embedding</td>
<td>Activities address learning objectives that go beyond traditional subject competencies to include cross-cutting 21st Century Skills such as collaborative problem solving.</td>
<td>Teaching and learning distributed, connected and organised around the learner, bridging the gap between formal and informal learning, through extended, productive, inquiry based learning.</td>
<td>Institutionally-embedded technology supports the flow of activities, content and data, providing an integrated approach to teaching, learning and assessment giving the teacher and learner timely data on learners’ experiences and achievements.</td>
<td>Use of innovative technology, e.g. 3D printing, augmented reality. Using technology across boundaries, for example, integrating products made at home with those in school</td>
</tr>
<tr>
<td>Stage 3 Enhance Process redesign</td>
<td>Activities address learning objectives that include higher order thinking and key subject specific process skills such as inquiry skills in science or presentational skills in languages.</td>
<td>Teaching and learning redesigned to incorporate technology, building on research in learning and cognition. The teacher uses new pedagogies (such as the learner as teacher or concept mapping) to develop competences.</td>
<td>Technology is used to allocate learning tasks and to track learners’ progress through a task to assess process skills alongside knowledge and understanding.</td>
<td>Using software to programme, create websites, games, video clips, animations, 3D models etc. 1:1 computing</td>
</tr>
<tr>
<td>Stage 2 Enrich Internal Coordination</td>
<td>Activities address sequences of learning objectives addressing related areas of content within a subject domain.</td>
<td>Technology used interactively in support of familiar pedagogical approaches, with a variety of resources being matched to different learners’ needs.</td>
<td>Technology and systems support differentiated provision within the classroom by providing a variety of entry and exit points to tasks and offering alternative routes through the tasks. Assessment evidence is generated throughout.</td>
<td>Interacting with technology, for example, adding to blogs or wikis, using apps within a learning platform</td>
</tr>
<tr>
<td>Stage 1 Exchange Localised use</td>
<td>Activities address isolated learning objectives targeting specific pieces of subject content within the curriculum such as the life cycle of an insect, or prime factors.</td>
<td>Technology is used within current teaching approaches as a direct substitute for well established resources, such as using an IWB as a substitute for a chalkboard, or an e-Book as a substitute for a text book.</td>
<td>Learning is directed by the teacher and located within the classroom, with all learners following instruction in step. Technology is used to generate assessment evidence.</td>
<td>Standard technology, such as interactive whiteboards, linear courseware, and websites.</td>
</tr>
</tbody>
</table>
Appendix B: Scenarios selected for further development

In the first three cycles scenarios were selected by stakeholders across the project using the criteria of likelihood and desirability. In the fourth they were developed by WP2 with input from stakeholders rather than experts and assessed and selected using the set of questions discussed in Section 3.7. The same criteria was used in Cycle 5 but this was an exercise to look at innovation as the stakeholders were encouraged to use the scenarios they had created.

In this section the brief descriptions for the shortlisted scenarios are given.

**Cycle 1**

1. **A Breath of Fresh Air**: Learners go out into the school grounds to understand why the ladybird population has decreased in the last year. They gather data using a range of technologies to bring what they find back to the classroom. They create a short film to share and reflect on their findings.

2. **Biblio-High-Tech**: This is a ‘physical-digital’ library or hub for learning. Learners can use it individually whilst within the physical space, or virtually whilst in other classrooms or at home/other places. They can also use it in groups for class sessions. It is a flexible comfortable physical location with virtual reach to enable ‘anytime, anywhere’ learning.

3. **Insightful Instruction**: Learners choose an open project through which to develop their subject knowledge of a personal interest and their research and media production skills. In conjunction with subject specialists and experts, a programme of work is developed alongside criteria for assessment.

4. **Online Repositories Rock**: Learners develop their digital literacy competencies through a programme of work designed around quality online resources from museums, libraries and observatories. They compare these resources with those they find themselves online as a starting point to learning how to evaluate what is found and developing critical skills.

5. **Personal Learning Agent**: Teachers help learners to design a personal programme of work which fulfils the curriculum requirements and which builds on their prior knowledge, level of understanding of the subject and learning preferences.

6. **Out-Of-School Matters**: The aim of this scenario is to recognise learners' informal learning outside of school and formally accredit it. Learners are encouraged to upload any evidence of their increasing skills and knowledge in relation to personal hobbies and interests to an online portfolio where teachers can access this learning and accredit it where appropriate within the curriculum.

7. **Beam in the Expert**: Learners are asked to carry out projects in relation to environmental issues in order to make recommendations. They are required to
engage with wider learning communities through contact with one national and one international expert in their chosen area. There are also encouraged to use these contacts to support language learning. Teachers have been supported to map these cross curricular projects to the curriculum and to accredit this work.

8. **Repositories and Responses: Reactive Teaching**: Teachers use technologies such as student response systems to collect numerical votes/open text responses in order to gain a better understanding of learners’ knowledge and difficulties. From this, the teacher can better tailor teaching and learning to the students and provide them with opportunities for peer-mentoring. The teacher also draws on online resources held within an App Store to support learning.

9. **Supported through Change**: In this scenario, teachers are supported through the development of networks via which they can gain the expertise and benefits of working with other teachers. Technology allows for the networks to develop and teachers can share resources and ideas for developing teaching and learning within the same subject. Wider networks can also be developed which help teachers with assessing work, for instance, by drawing on the expertise of media teachers to assess multimedia work.
Cycle 2

1. **Combining formative and summative assessment:** Teachers use a classroom response system to assess students' understanding and knowledge of a topic. This information is represented within a class wiki. Students are organised into teams to carry out research to address gaps in knowledge. Support for students comes from teachers, other students and experts via the "people bank".

2. **Developing collaborative approaches to learning about business:** Students design a business idea mapped to the school curriculum. They support development of their entrepreneurial skills and knowledge through real-life, authentic tasks. The student and teacher set up a virtual "hatchery" to hatch or develop ideas supported by parents, local businesses and schools as well as the "people bank".

3. **Embedding exam preparation in learning activities:** The scenario provides both teachers and students with useful and innovative ways of using technology to build a bank of resources that can be used for ongoing learning and revision. This enables the teacher to introduce transferable skills and cross-curricular activities whilst still addressing the certification needs of the students.

4. **Mathematics in a multicultural setting:** This scenario uses the language of mathematics to improve participation and communication in a multicultural setting. Using simple and authentic questions and challenges, activities will be informed by research carried out by additional language students and worked through in multiple languages.

5. **Mentoring teachers to improve digital literacy:** This scenario supports action-based teacher collaboration and professional development through the fostering of students' and teachers' digital literacy. Through peer and network learning, as well as drawing on the expertise of students, teachers' digital literacy skills are developed.

6. **Our school, our environment:** Using technology to raise environmental awareness. This scenario raises students' awareness of climate change and how to manage energy use. It involves working with the wider community and active monitoring devices and other measures to estimate the school's carbon footprint.

7. **Professional development in the global classroom:** This scenario encourages teachers to become networked in order to support trying out and co-development of new innovative practices. Teachers give each other support across different countries and students have the opportunity to share their work in these alternative settings.

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The "people bank" is a database of experts being set up by European Schoolnet. It will be populated with people who are easily contactable by schools and willing and able to support learners. It will be a resource through which teachers are able to straightforwardly 'bring in an outside expert'.
8. **Researching online social behaviour:** Students research online behaviour to share experiences with peers and develop an understanding and guidance for managing their online identity and activities. Students present their findings in the format of their choice, for instance video, podcast, poster, presentation.

9. **Students creating science learning resources:** Students support one another to learn difficult concepts in science. They create their own "virtual science museum exhibit" alongside sample problems to teach a concept from the curriculum.

10. **Using multiple resources and technology to research a common topic:** This scenario develops students' skills to recognise what resources are appropriate and valid and when they should be used. It aims to challenge some students' overdependence on the internet.
**Cycle 3**

1. **Designing maths games:** This scenario introduces students to the skills of computer programming and develops their mathematical skills through the creation of interactive games using simple, intuitive online programming software such as Scratch.

2. **Designing with multi-touch technologies:** The scenario supports student collaboration and comprehension of difficult concepts in design and technology through the use of multi-touch technology. The multi-touch applications students work on are networked to the main classroom interactive whiteboard so that each group's progress can be demonstrated throughout the lessons.

3. **Digitally mapping local biodiversity:** This scenario develops students' knowledge of local ecosystems and digital mapping skills through outdoor learning. It engages them in scientific understanding of the local area and in species identification via online repositories and interaction with experts. It supports them to use digital media effectively to communicate their knowledge and opinions to others.

4. **Home-school communications:** This scenario uses social media to encourage three-way communication about learning between teachers, students and parents/carers in order to begin to bridge the gap between home and school.

5. **Homework and school work “flip”:** This scenario enables a radical transformation of activities, relationships and expectations by "flipping" the core element of the educational experience: school time and homework time.

6. **Schoolville:** This scenario uses the tools and principles from video game design and social networking to foster cross-curricular learning with an emphasis on citizenship.

7. **Virtual engines:** The scenario deploys simulation software to create virtual prototypes that behave realistically according to the laws of physics. This enables the possibility of recreating authentic conditions in which learners can experiment with decision making, problem solving and where learners can experiment with far reaching ideas in a safe environment.
**Cycle 4**

4. **GPS Enabled Learning Games:** Using GPS devices to arrange geo-located treasure-hunts on school grounds, the search will lead to a location where puzzles and problems need to be solved.

5. **Supported through Change:** To support professional development of teachers using a model that combines cognitive apprenticeship (coaching) and peer teaching enabled by telepresence technology between connected IWBs.

6. **Hackspace:** To draw on the informal learning opportunities provided by HACKSPACE to increase creativity with an entrepreneurial spirit in the classroom.

7. **Audio/video Feedback:** Using audio-recording equipment to record feedback given to a piece of student work. The recordings are uploaded to the VLE. Students are given extra-credits if they access the recordings and if they can demonstrate that they acted on the recommendations. The recordings give clues and direct students to additional resources (books, web-based, etc.).

8. **Create a Model:** Using models and visualisations to support an argument or to solve a problem.

9. **Digital producers:** Using digital media to create “broadcasts” of curricular work: presentations, classroom discussions and other school activities are captured and recorded through various means, they are then edited and uploaded to the web or to the VLE.

10. **Mindmapping the soil:** To use mind-maps and related approaches as a powerful tool for learning, in particular to promote deep understanding while at the same time encouraging a cross-curricular approach.

11. **Digital tools for effective, engaging science:** Using digital resources to undertake tasks in STEM subjects which would be difficult or impossible to do in most classrooms or schools.

12. **IWB Journey:** To promote classroom level integration of IWBs.

13. **ICT Journey:** To promote school level ICT integration.
**Cycle 5: Shortlisted scenarios**

14. **Quadcopter with 3D printed parts:** In this project, already piloted in Austria, students must build a flight-capable drone (remotely controlled multicopter/quadrotor e.g. at [http://quadcopters.co.uk](http://quadcopters.co.uk)) as part of their STEM lessons. When one or two model kits have been assembled, students design and construct a model using a 3D printer to create the parts.

15. As students are motivated to make their model fly, they find out a lot about the required know-how through self-study. The combination of design, prototyping and practical implementation provides many opportunities for new teaching scenarios.

16. **Personalised learning paths:** The main purpose of the scenario is to improve student’s learning experience, and ultimately students’ knowledge and skills, by adapting learning paths to students’ needs. There are different levels of adaptation. First, teachers work with students to assess initial knowledge and define personal learning goals. Second, interactive and adaptive software is used to adapt exercises to students’ comprehension level and respond to emotional states during learning. Third, there is a global level adaptation where different groups of students will work on different subjects according to their interests to foster motivation and engagement. All over this process, students are encouraged to reflect on their learning and to create links between what they learn at school and the outside. Teachers guide students on their project and help them assess their learning over the school year.

17. **Message in a bottle:** The main participants are members of a class and their teacher – although others, e.g. parents, experts, the local community can participate. The scenario also encourages collaboration between student groups on an international level. Groups of pupils create puzzles (messages in a bottle) to other groups and hide them with the help of geolocation technology in the area. Teachers are mainly coordinators while students create, collaborate, evaluate and self-assess during the mini projects.

18. **Coding to learn:** In this scenario there is a collaboration between teachers and initiatives developed by organizations and private individuals in the IT sector, such as Let’s Teach the Kids to Code in Norway ([http://www.kidsakoder.no/](http://www.kidsakoder.no/)), or Computer Clubs for Girls ([http://www.cc4g.net/](http://www.cc4g.net/)) and its aim is to arouse interest in coding among children and adolescents. The reason is that there is a huge need for knowledge of coding and programming in the labour market, but this is not reflected in school subjects and curricula. In Norway the Let´s Teach the Kids to Code is in the process of establishing a collaboration with the local after-school programme, where students at the lower secondary level teach those at the primary level how to program games with the aid of visual programming languages such as KODU and Scratch.

19. **Restructured school:** The school day and curriculum has been adapted in this scenario. Older learners (those 13 and over) no longer need to be at school from 8:00 and leave at 15:00. Instead they have a specific two hour
slot in which they have to attend. For the rest of the school day they work on projects or in a flipped classroom. Learners also collaborate during the week with other students that are working on the same project, or working to prepare for lessons after flipping. Furthermore students can decide where they need to go in order to fulfil their assignments, e.g. to the city, park, forest or library. Learners can borrow instruments and tools when required from the school.

20. The rationale for this is so that learners can cope with the big amount of information there is around, and how to use it in their projects. It allows learners to explore and create things and to collaborate and be taught or teach their peers.

21. **Online tutors:** This scenario describes an instant digital tutoring project using smart phones. A teacher is available online for each subject throughout the day. Students open the instant tutoring application on their mobile device and choose the subject they need help with. They then post their questions to a forum and the teacher answers. Because the answers are saved all the other students can see the questions and answers and learn from them.

22. **Flipping the teacher: A teacher/student tech club:** In this scenario teachers and students learn 21st century skills together rather than teachers learning as personal development. Those students with technical skills publicise them within the TechTutors skills bank. These TechTutors can be assigned to either a younger student group or a teacher or class that wants to develop that skill set. The TechTutors are also encouraged to work with the teachers at the lesson planning stage suggesting how they might harness technology to assist in the delivery or assessment of the lessons.

23. Advanced and willing students are encouraged and provided specialist training in IT and networking areas using curriculum developed by CISCO, Intel and others. They are given time to shadow visiting technicians, who are actively encouraged to share their skills with students. They also identify and organise appropriate personal training for teachers and interested students in relevant technology that they deliver in an after school club type environment. Ideally the school would work with a local IT training company to provide student TechTutors with a basic IT competence qualification.

24. **Students designing demonstrations:** In this scenario an Assessment Design workshop is held as part of a major curriculum review. Students are actively involved from the start as stakeholders and seen as valuable co-contributors of ideas. Working in small teams comprised of teachers and student representatives during a "learning development day", they develop new example assessments for various types of learning activities that allow students to show their understanding of concepts and ideas. There is no presentation of ideal assessments or traditional models. Groups are instead presented with a simple question.... "How could you best show your deep and wide understanding of this topic to others?"
25. **The food challenge**: Teachers collaborate to design a game fulfilling multiple curriculum requirements in this scenario. Each teacher creates a couple of challenges. Students use their own devices to find the QR code and access the task. Then as a group they have a week to solve the mystery – with the option of involving external experts – to score points. At the end there is a final challenge to prepare a presentation, animation, video, etc. ... that should teach students in primary or lower grades, about healthy eating using the material they’ve learned.

26. **Pollution everywhere, collecting data**: In groups students will be asked to research and prepare an interactive presentation around pollution. They collect data out of school with their devices: e.g. digital cameras, mobiles, tablet. Teachers also ask students to collect different samples of surrounding water to be analysed later on using the microscope. Students collect water from the nearby lake, water from rain, and water from home. All samples are recorded and captured with the document camera and shared between all groups. Students use social media or blogs created also to share their experiences and teacher uses the school web or LMS to share the resources with the class.

27. Each group will record their final presentation using the document camera and the teacher will keep all this material for evaluation and for next year to use as a class resource that could be used to flip the classroom.

28. **History in my community**: The scenario is set both in and out of the classroom, and in both the physical and virtual world. It uses ICT tools to facilitate collaborative work and will evaluate students’ attitudes, processes, skills and results. In teams students identify their own subject knowledge around history using predefined topic areas. Then each group elaborates on one topic, sharing their findings in an appropriate format. These are then used to create a virtual model of the town. Finally this is linked to the real locations using augmented reality via QR codes.

29.
30. **Cycle 5: Scenarios Created in Expert Workshop**

31. **Applications for solutions**: Students work in groups or individually to tackle real problems – often going beyond traditional subject competencies and institutional boundaries - identified by those in the local community with teachers and local businesses acting as mentors and facilitators. Students are expected to work closely with the wider community who provide feedback on their solutions and identify areas of importance to work on (this is an adaptation of the crowd sourcing model). It requires application development software, 3D printers and other prototyping equipment to generate solutions. But a key feature is the assessment process in which the products are presented physically in an exhibition structure as well as online, allowing constant review by all interested parties and as a resource to future students as well as a public portfolio for students.

32. **Developing for developers**: This scenario goes beyond the school boundary and aims to make the learner (working in groups or individually) a designer of their own learning journey. Local software companies act as mentors and provide a “real” working environment with teachers working alongside them. While they tackle an identified problem using business techniques the schools become a resource for students. Students are expected to integrate multiple subjects to develop solutions, and then prototype these – for example by using a 3d printer to produce something solid if required, or by producing wire frame models or mock ups of functionality. They constantly document progress which is reviewed by the local community, peers and teachers and at the end formally present and explain their solutions to interested parties.

33. **Robot helpers**: Robots and screen devices to support the flow of activities, content and data, which gives the teacher and learner timely data on learners’ experiences and achievements. The focus in this scenario is on using such technology to assist in the teaching of modern foreign languages. A key feature is the agile learning as the system responds directly to feedback from the students.

34. **Community video challenge**: The students are responsible for addressing a real task, for example the organisation of their school fair; they have autonomy but the opportunity to work with teachers and the community as mentors to complete their task. They have to work effectively together and structure their time appropriately. To document the best practice and explain their choices students must choose the technology (video cameras and editing software, blogs, web development software, video clips, animation software). After the event they review it and incorporate feedback into their presentations. These are then tagged and published.

35. **Productive project work**: This scenario is dependent on ubiquitous and shared computing and the ability to access external resources as well as student portfolios linked to analytics. The students select their own projects and learning objectives across subjects with teachers acting as facilitators rather than as lecturers. In the projects there is a high degree of peer
learning and feedback, with teaching and learning distributed – being organised around the learner who is expected to work in and out of the school environment.

Appendix C: Creating a radar diagram
In order to aid visualisation, matrix profiles may be represented as radar diagrams. Take, for example, the scenario Flipping the teacher devised in workshops run by Promethean in Cycle 5 given below in full.

Flipping the teacher: A teacher/student tech club

<table>
<thead>
<tr>
<th>Trends</th>
</tr>
</thead>
<tbody>
<tr>
<td>• 1:1 learning paradigm</td>
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<tr>
<td>• 21st century skills in practice</td>
</tr>
<tr>
<td>• Teachers become less central as direct instructors, and more involved in helping students learn autonomously at their own pace (personalisation)</td>
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<td>• Students would like more freedom and control over learning activities and to be more active and inquiring learners in class.</td>
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<tr>
<td>• Young people are always connected and make heavy use of digital media, this is posing challenges to teachers and education systems</td>
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</table>

<table>
<thead>
<tr>
<th>Who is involved in the existing scenarios? What are their roles?</th>
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</thead>
<tbody>
<tr>
<td>• Students – as teachers, mentors and facilitators to other students and teachers</td>
</tr>
<tr>
<td>• Teachers – as co-designers of courses with students</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Why have those involved in the existing scenario decided to change their practice? What is the core purpose of the scenario?</th>
</tr>
</thead>
<tbody>
<tr>
<td>• To provide an integrated and collaborative set of educational tools and services that glue together the class environment of people, interactions, content, activities and technologies to improve the productivity of learning for students and the productivity of instruction for teachers.</td>
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<td>• This includes methods to enable the management and assessment of personalized and collaborative learning.</td>
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<tr>
<td>• The proposition covers whole class, group and individual learning through automation, integration and orchestration within all classroom environments, collecting and reporting real-time data collection/feedback at the Point of Learning together with anywhere anytime learning beyond the classroom.</td>
</tr>
<tr>
<td>• Providing the platform for software and services that support personalized learning in the context of the classroom building up to system-wide management of devices; content and assessment data.</td>
</tr>
<tr>
<td>• Developing the tools, services and interfaces adding education value to the individual user and community experience.</td>
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</tbody>
</table>
**Where** does the existing scenario take place? Describe the environment.

- School – in lessons and in after school training sessions

**When** does the existing scenario take place?

- Ongoing

**What** happens in the existing scenario? What activities are the people in the scenario doing? What sorts of interactions are there between the people in the scenario?

- Students become TechTutors and work with teachers and other students to integrate technology more effectively into the school
- Teachers and students share personal development time

**Technologies**

Promethean EOS with Windows 8 platform allows for the following learning modalities in the classroom;

- ActivTable for collaboration;
- Engage 2 for real-time assessment;
- Microsoft Surface tablet for personalisation;
- Management and Assessment of personalised and collaborative learning
- Whole class, group and individual learning
- Integration and orchestration within the classroom environment
- Learning beyond the classroom, anytime, anywhere with the Microsoft cloud

**Other resources/background information**

- There are an increasing number of applications for tablets becoming available. Most have guidance on how to use them with an emphasis on the activity however understanding how the application will improve learning is much harder and less explored and documented.
- Applications categorised through stages of Knowledge Transfer, Knowledge Sharing, Knowledge Communities. The following 28 categories have been proposed in by [http://mgleeson.edublogs.org](http://mgleeson.edublogs.org) based on the pedagogy wheel: Presentation tool, Collaboration tool, Writing tool, Reading tool, Brainstorming, Mapping tool, Information collection, Information organising, Note taker, Research tool, Data collection tool, Role playing tool, Class management tool, Assessment tool, Video creation, Audio Recording, Book creation, Publishing, Digital Storytelling, Debating tool, Experimenting tool, Calculating tool, Demonstrating tool, Communication tool, Artistic tool, Designing tool

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**Scenario narrative**
The schools realised that teachers and students shared many common needs when it came to skills development with 21\textsuperscript{st} century tools. Rather than the teachers dealing with their personal development (PD) needs separately and in isolation from the students, the school brought teachers and students together to learn under an umbrella of whole school development.

Students who believe they can offer leadership or insight in a useful technical area are encouraged to publicise their skills with a poster about themselves on a “skills bank” and become “TechTutors” who are then available to be assigned to either a younger student group or a teacher or class that wants to develop that skill set. The TechTutors are also encouraged to work with the teachers at the lesson planning stage suggesting how they might harness technology to assist in the delivery or assessment of the lessons.

Some teachers find the student “skills bank” a really useful tool as they can go to it to ask the students for assistance at any time when they have new ideas they want to explore. They find that this is a lot more positive than admitting they need help to colleagues or management. Advanced and willing students are encouraged and provided specialist training in IT and networking areas using curriculum developed by CISCO, Intel and others. The intention of the school is that they are far more self-sufficient for general IT support and development. Visiting technicians are actively encouraged to share their skills with students and TechTutors are given time to “shadow” workers coming into the school to observe their skills and ask questions.

As the school runs a staggered school day, TechTutor students are also available on a rota in break times to work directly in the other classes they support on one or two occasions each week.

Every other weekly staff meeting is devoted to the development of the “learning family”. Older students act as coordinators working with the head teacher or department leaders to identify and organise appropriate PD for teachers that they deliver in an after school club type environment. Students from each class are encouraged to join in the evening staff PD sessions with their teachers to encourage more TechTutors. The school also works with a local IT training company who provides student TechTutors with a basic IT competence qualification.

The scenario should then be compared with the maturity model to identify the levels of each aspect. This is shown in

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Scenario</th>
<th>Criteria</th>
<th>Layer</th>
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</thead>
<tbody>
<tr>
<td>Product/Outcomes</td>
<td>umbrella of whole school development ... harness technology to assist in the delivery or assessment of [any] lessons... provided specialist training in IT and networking areas</td>
<td>Outcome goes beyond traditional subject competencies – cross curricular, 21\textsuperscript{st} century skills such as collaboration</td>
<td>4 - Extend</td>
</tr>
<tr>
<td>Learning Objectives</td>
<td>Students become TechTutors and work with teachers and other students to integrate technology more effectively into the school...Visiting technicians are actively encouraged to share their skills with students and TechTutors are given time to “shadow” workers coming into</td>
<td>Teacher uses innovative pedagogies and develops competences. Teaching and learning ‘redesigned’ to incorporate technology, building on research in learning and cognition.</td>
<td>3 - Enhance</td>
</tr>
<tr>
<td>Table 6: Using the maturity model to identify levels of innovation</td>
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</table>

Plotting the five layer numbers gives a radar diagram, which quickly gives an overview of the type of innovation within the scenario. Thus it can be seen that the learner – asking students to train teachers, students, contributing to the design and content of lessons, is the most innovative aspect, with pedagogy the least – although still reasonably innovative.
**Figure 9: Radar diagram for the scenario Flipping the teacher: A teacher/student tech club**

36.

**Appendix D: Radar diagram scores**

The scenarios were assessed by at least two experts to identify the levels of the scenario in the areas of innovation. Differences were discussed in order to reach a shared opinion of level. These results are used in Section 5.1 Radar diagrams.

<table>
<thead>
<tr>
<th>Cycle 1</th>
<th>Product outcomes/learning objectives</th>
<th>Pedagogy</th>
<th>Learner role</th>
<th>Management of teaching, learning and assessment</th>
<th>Underpinning Technology</th>
<th>Average</th>
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<td>A Breath of Fresh Air</td>
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<th>Management of teaching, learning and assessment</th>
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<td>Combining formative and summative assessment</td>
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<td>Developing collaborative approaches to learning about business</td>
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Appendix E: Voting for Cycle 5 scenarios

The scenarios shortlisted by stakeholders were reviewed by colleagues across the consortium using the six dimensions. A scenario was scored as:

- 0 = does not match any of the criteria
- 1 or 2 = matches some or most of the criteria
- 3 = adequately matches the criteria
- 4 = matches all criteria to a high degree

The scores in the table are the average of the reviewers for that dimension. The strengths and weaknesses – arguably the more important part of the review, are not shown. This shows that each scenario has different strengths, and again that the order of desirability and likelihood does not match that of innovation.

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<th>Dim 2: Responding to trends and barriers to innovation</th>
<th>Dim 3: Opportunities for teacher high level competencies</th>
<th>Dim 4: Opportunities for 21st century skills</th>
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