Chapter 2
Development of the Future Classroom Toolkit

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Abstract Key to iTEC was the need to empower teachers to facilitate positive and sustainable innovative classroom practices enhanced by digital technologies. Initially it was envisaged that experts would create challenging yet feasible scenarios that would be refined by stakeholders. From these scenarios, Learning Activities would be developed that would lead to innovation either pedagogically or technologically. Nevertheless, the complexity of defining innovation and the challenge of innovating within different contexts had been somewhat underestimated. As the nature of the project work became better understood, it became clear that stakeholders—particularly teachers—needed to be responsible for scenario creation in order to be able to assimilate innovative approaches into current practice. This chapter explains the evolution of this process from the creation of scenarios to the development of the Future Classroom Toolkit. Within this, it focuses on the role of maturity models to enable stakeholders to assess their current context and practice in terms of the level of innovation. In addition, it shows how the Future Classroom Toolkit can support and encourage stakeholders to take ownership of and augment their own innovative practices using digital technologies for the benefit of learners.

Keywords Scenarios • Digital technologies • ICT • Innovation • Future classroom toolkit

Introduction

This chapter focuses on the challenges of innovation; specifically how the Future Classroom Toolkit was designed to encourage innovation through the development of educational scenarios and, in turn, within classrooms. To achieve this, it considers the evolution of the three key outputs from Work Package 2: scenarios, the Maturity Model and the Future Classroom Toolkit.

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The Challenge to Innovate

The concept of innovation is difficult to define and this provided a key challenge throughout the iTEC project. Innovation is a matter of perception, not an absolute (Rogers 1995). It is dependent on subjectivity and context. As Somekh (2007) points out, 'the difficulty in understanding the process of innovation is that we see it necessarily from our own standpoint'. Concepts like 'new' and 'better' are based on subjective assessments of the value of an innovation (Moyle 2010); and as (Kozma 2003) found in the international Second Information Technology in Education Study (SITES), 'innovation often depends on the cultural… context within which it is observed'. Therefore, recognising and accounting for the context where the innovation is introduced is critical.

Educational innovation must be a change that creates positive value, not simply something new. OECD/CERI (2010) define innovation as '… any dynamic change intended to add value to the educational process and resulting in measurable outcomes, be that in terms of stakeholder satisfaction or educational performance' (p. 14). Innovation is typically considered to be deliberate, designed to be of benefit, about change, dynamic and potentially unpredictable and 'occurs in a specific political, sociocultural, economic, technological, and organisational context that influences its development, diffusion, and use' (Kampylis et al. 2012, p. 6).

The level of innovation can also be defined in various ways. Kampylis and colleagues (2012) refer to incremental (progressive change involving a few new elements); and radical (involving a number of new elements) and disruptive innovation 'a profound and comprehensive change' (p. 9). However, Christensen et al. (2008) define two different trajectories: 'sustaining': building on and improving existing thinking, products, processes, organisations or social systems; or 'disruptive': which changes the core of what already exists.

A further challenge exists in the need to scale and sustain innovative and effective projects (Brecko et al. 2014; Bocconi et al. 2013; Kozma 2003). Dede (2010) argues that scaling up demands adaptable innovations, irrespective of context and particular circumstance. Others argue that it is essential to identify mechanisms to support system wide change (Brecko et al. 2014). Kampylis et al. contend that there is no single approach to scaling up innovation but instead there is a need for scaling up strategies to support 'multiple pathways and ecological diversity in innovation' (Kampylis et al. 2013, p. 133). Rogers' (1995) 'diffusion' model of innovation demonstrates how individual, small-scale (incremental) changes can support and lead to a broader set of local innovations. Moreover, Kampylis et al. note that 'more disruptive innovations are more difficult to scale up' (Kampylis et al. 2013, pp. 131–132). Therefore, innovation is best seen as a process of incremental steps, the most common approach in educational contexts (Kampylis et al. 2013).

In the context of the challenges outlined previously in relation to defining, scaling and sustaining innovation, iTEC's aim was to drive innovation by developing and trialling new approaches to teaching and learning enabled by technology. Specifically, iTEC's activities were intended to help teachers respond to the

day-to-day and systemic challenges they face by providing them with pedagogical and technological solutions. The project also took account of research showing that innovations led and managed by teachers are more effective than initiatives from external forces (Von Hippe 2005; Sutch et al. 2008).

The issue of how innovative the interventions were remained an enduring challenge throughout the project and required partners to develop a clearer idea of how innovation should be evaluated within the project. It was agreed that innovation in iTEC could be either technological or pedagogical, or both. Nevertheless, this has its complexities. Technological innovation refers to widespread use of an invention or a technology regardless of its use or possible innovative practices with it (Béchard 2001). For example, it is possible that interactive whiteboards, a technology that is no longer new, could be used to either reinforce traditional teacher-centred practices or facilitate innovative learning approaches. The SITES project for instance found that many of the 174 case studies of innovative practice it gathered used 'ordinary technology' to do innovative things (Kozma 2003).

Pedagogical innovation exists only when approaches in teaching and learning are modified; this could be the introduction of a totally new approach or a novel combination of existing approaches. Consequently this could require a major change in educational values and organisation (both pedagogical and administrative—structures, functions, roles, communication). Given these conditions, it can be difficult therefore to pinpoint specific pedagogical practices and to recognise these as innovative. Such changes can be qualitative (e.g., depth) or quantitative (e.g., frequency, duration). The same analysis can be made of relationships between teacher and student (teacher or student locus, peer learning, etc.). In all cases, it is important to document qualitative and measure quantitative aspects, with and without the technology, and the wider effects (e.g., motivation, confidence in working with others). Gathering such evidence is also needed to scale up a pedagogical innovation but that is not possible through the development of a simple formula or step-by-step guide applicable in any context. What really makes an innovation scalable is that it can be adapted to any new environment (recombining, adjusting, etc.)—while retaining its essence (Tobin 2005)—in order for other teachers and learners truly to own it.

Furthermore, the iTEC project was firmly focused on delivering sustainable mechanisms for wide scale adoption of innovation that had deep and lasting impact. This aim was underpinned by belief that incremental change (Kampylis et al. 2012) is as important as disruptive innovation. And this is supported by Rogers' (1995) 'diffusion' model of innovation which demonstrates how individual, small-scale changes can support and lead to a broader set of local innovations by other 'end-users'. Similarly, Fierro-Evan's research (OECD 2008) identified: 'While micro-level innovations might seem to have "limited relevance", paradoxically, they are usually the most permanent and make the deepest impact on practice' (p. 19).

From this, in the iTEC project, an innovation in education is defined as a change that brings about a positive result in teaching and learning but which is context specific. This is because an innovation in one country or school is not necessarily considered innovative in another. Moreover, innovations are often found to be most

effective when they bring about incremental change building on existing practice as these can be easily scaled and lead to local innovations by others.

Keeping this in mind, the next section will define scenarios, one of the key drivers of innovation and outputs of the iTEC project, and the rationale for their use. Specifically it will look at how scenarios sought to stimulate innovation and how the evolution of the development process refined the understanding of innovation within the project.

Overview of Scenarios, and Scenario Development and Monitoring Process

Scenarios have been used in multiple projects as a tool to consider the possible future of education. They have been recognised for stimulating 'new, visionary thinking' and helping to motivate educators to get 'unstuck' (Ogilvy 2006). The Future Classroom Scenarios were defined as narrative descriptions of teaching and learning that provided a vision for innovation and advanced pedagogical practice, making effective use of ICT. Scenarios were key to the success of iTEC in enabling stakeholders (including school leaders and teachers, advisers at a regional or national level, and technology providers) to recognise the needs of students, *and* inspire teachers to change their own practices. 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 on 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.

Future Classroom Scenarios were structured around specific trends and challenges that affect and are affected by education. These could be economic, social or technological factors that were either recognised as important and/or could influence the context. The trends identified during the project were viewed as having long-term impact. For example, the introduction of twenty-first century skills such as problem solving, collaboration and negotiation, vertical teaching or mixed-age classes, or that assessment would become more personalised. Trends could take account of technology developments outside the education environment. They included physical devices such as 3D printers, an increased use of web 2.0 collaborative tools to enable peer-learning; technology which could automatically adapt to the ability of users—already a feature of many electronic games; the inclusion of repositories on the web where contents were well-organised, and checked for quality and reliability.

Future Classroom Scenarios were designed to have five elements which were considered to be key:

- 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);
- Resources (what is required to support the scenario).

Future Classroom Scenarios are **not** lesson plans; they are designed to be inspirational and flexible in order to be adapted by teachers according to the local context.

The Theoretical Basis for the iTEC Scenario Development Method

The iTEC scenario development process was adapted from a range of scenario development techniques and consensus building tools such as the Delphi method (Rowe and Wright 1999; Scheele 1975). It also drew on methods developed to support futures-facing prototype development such as the Beyond Current Horizons programme (www.beyondcurrenthorizons.org.uk).

The resulting Future Classroom Scenarios provided a means of thinking about the needs of future students and provided inspiration for teachers. The scenarios were intended to be grounded in current realities as opposed to more 'blue sky' visions of the future where schools have been set aside (e.g., the IPTS project described by Ducatel et al. 2001).

Future Classroom Scenarios were based on trends and challenges considered to be important by the scenario designers *within their context* rather than setting a scenario in a broad futuristic environment. The theoretical principle behind this 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. These alternatives constitute the 'evidence' as they refer to events and developments that can be observed empirically as they unfold in the present. This approach has been explored by a number of authors and thinkers (e.g., Bussey and Inayatullah 2008; Bell 2003; Slaughter 2002).

The generic trends and challenges were identified from a range of sources. Desk research identified factors from other projects that looked at education in the future.[1] In addition, 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

[1] 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 and Wright 2010); The Horizon Reports (New Media Consortium NMC 2009, 2010).

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

These trends were presented to teachers and other stakeholders across the EU in focus groups and through online surveys to obtain feedback on content and to identify those that they believed to be particularly important.

As the project evolved, participants were encouraged to identify for themselves the types of changes that would impact education in their context from relevant organisations (e.g., OECD, Pew Research, Eurydice) or by their stakeholders. They were also encouraged to consider how technology, again in their own context, would impact on learning. For instance, at the time of the project, a growing trend was the increasing number of student-owned mobile devices being brought into schools.

The Evolution of the Scenario Development Process

The scenario development method consisted of five cycles of development and monitoring which are summarised next. In this cyclical, iterative approach, both the process of development and the content of scenarios themselves were fine-tuned during the process to incorporate feedback and reflection from completed cycles. This practice improved the development process, helped strengthen the rationale for and use of scenarios, and importantly, increased the involvement of teachers and learners.

In all five iTEC cycles, the process 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.

Cycles 1 and 2

The first and second cycles had a similar structure. Initially in both there was a 2-day workshop attended by experts representing technology, pedagogy and industry. Participants were briefed on the trends as identified through the method detailed previously and provided with summary presentations of the results of a specially commissioned European teacher survey, focus groups, and the students' views.

A template setting out the elements of the scenario was provided for workshop participants to generate up to 20 mini-scenarios. The template was designed to encourage participants to brainstorm what were considered to be the key aspects

needed for the scenario: activities and tasks; environments; roles; interactions and resources (as outlined above).

The activities to create scenarios were undertaken in groups, mixing pedagogical and technical partners.

After the initial workshop, in both cycles, the scenarios were then published online and iTEC partners, invited experts in technology and education, and other stakeholders assessed and ranked the mini-scenarios using the online survey tool Survey Monkey. In both cycles respondents were asked to assess desirability (how much they liked the scenario) and probability/timescale (how long it would take for the content of the mini scenario to become common practice in schools without the influence of the iTEC intervention). Once the feedback had been collated, the top eight scenarios were further developed in a second workshop attended by members of the project team.

Similar activities were carried out to those in the first workshops, that is, summary presentations were given of the trends, findings from the teachers' survey and Power League. Again, a template was provided to ensure standardisation of the content of the scenario.

Refinements in the second cycle added criticality and addressed lessons learned in Cycle 1. For instance, many of the first cycle scenarios were seen to be rather too similar in their focus on collaboration, peer teaching and problem-based learning. Steps taken to address this included presentation of feedback about the Cycle 1 scenarios, evaluation criteria and prompts designed to interrogate and challenge each scenario. Partners with a stronger pedagogical background were given prompts to challenge and criticise each scenario from a pedagogical perspective and partners with a stronger technological background were given prompts to challenge and criticise the technological content of the scenario.

Also, to ensure the inclusion of teacher and learner opinions, each group in Cycle 2 were given a list of headlines from the teacher survey and learners to incorporate.

Cycle 3

In this third cycle the need to include more learners, teachers, subject and pedagogical experts in the scenario development process was addressed and the number of invites expanded.

In relation to young people's input, half-day workshops for learners that gathered their ideas and suggestions for scenarios were organised. Five workshops were held in four countries (Portugal, Italy, Norway and UK), and all materials were translated and then locally adapted to suit the situation and requirements of the participating students. Workshop activities began with exploratory activities that asked students to imagine and discuss what schools could be like or should be like. In groups, the youngsters then outlined what they would like learning and education to be like. They responded to this question in relation to four categories (People, Space, Activities, and Technology and Resources) that aligned with the iTEC taxonomy of

teaching and learning used in the scenario development workshops with professionals.

The method for scenario development was also modified in Cycle 3 in order to try to increase innovation further. Project partners were asked to research and submit ideas that they considered to be innovative before the workshop. Workshops with teachers and pedagogical experts from Finland, France, Spain and the UK were then held to evaluate and develop these ideas rather than to co-author them from scratch. The intention was that preparation and research beforehand could lead to more innovative scenarios and also allow people to contribute who were not able to attend the workshops. Again, at the workshops activities were designed to facilitate this process, which included a synopsis of 'Pedagogical Approaches' and results from the young people's workshop.

At the workshop, participants were asked to challenge and suggest improvements to the scenario in relationship to the following criteria:

- How inspiring is this scenario?
- How well are young people's views represented or included in this scenario?
- How innovative is this scenario?
- How pedagogically feasible is this scenario?

Participants were asked to carefully capture their discussions on a template so that enhancements and recommendations could be incorporated for each mini-scenario before they were put online for feedback from iTEC partners.

The workshop participants then ordered the scenarios in terms of preference and innovation according to the criteria previously outlined. After the scenarios had been ranked in the workshop they were published and again Survey Monkey was used to elicit feedback on the positions as ranked at the workshop. The request was distributed to all iTEC partners who were asked to indicate whether they agreed or disagreed with the scoring; and to add comments if they wished.

Cycle 4

By Cycle 4 it was clear that scenarios created by teachers were most popular with other teachers: which was important for ownership and localisation. Thus a one day workshop with 46 teachers took place which produced six draft scenarios that reflected their particular interests and challenges.

There was also a shift to integrate scenarios and research from existing EU projects and a separate 1-day workshop with iTEC academic and industry partners was held that focused on ensuring that the technical vision and capabilities provided by industry were used to enhance the Cycle 4 scenarios. After the face-to-face session the teachers were invited to continue collaborating online in a purpose built community.

Unlike the previous cycles, the scenarios were reviewed against fixed assessment criteria which were developed by project partners to ensure that a range of innovations in pedagogy and technology were represented (for a complete description of the areas see Le Boniec et al. 2012, pp. 29–38).

The reflection questions alongside the areas of focus are given below:

- Is the scenario sufficiently innovative for the future classroom? (Match identified trends and challenges.)
- Does the scenario have the potential to support teacher competency acquisition? (Feasibility of pedagogical implementation.)
- Is the scenario innovative in its potential use of technology? (Feasibility of technological implementation.)
- Does the scenario address recognized focus areas for educational reform? (Innovative/transformational character.)
- Is the scenario currently feasible and sufficiently scalability for potentially large scale impact? (Prospects of impacting at scale, if validated successfully.)

The feedback against these indicators was incorporated into the scenarios before they were taken forward.

Throughout the scenario development process, it was clear that a major challenge was to ensure that the scenarios were innovative. For this purpose, both paper-based or electronic materials were used to develop scenarios. For example, Fig. 2.1 shows a Futurelab facilitator using an interactive whiteboard displaying a scenario template to capture and develop ideas generated by iTEC partners at a workshop in Paris. The process for the creation of innovative scenarios led to the development of

Fig. 2.1 A Futurelab facilitator capturing ideas on a whiteboard at a scenario creation workshop in Paris

the Future Classroom Maturity Model discussed in the next section. This allowed stakeholders to assess not only the overall innovation but also the relative levels of innovation in each of the key areas of the scenario.

Cycle 5

This cycle departed from all previous cycles as teachers took on the role of creating scenarios using a toolkit developed to create bespoke scenarios for their own contexts. The toolkit is further discussed in section "The Future Classroom Toolkit" but in brief, it allowed teachers to identify and consider factors that would impact on their classroom, to create meaningful scenarios for their students.

The scenarios were then reviewed as in Cycle 4, that is, the same reflection questions and feedback questions were used, and again the Maturity Model was used to assess the levels of innovation.

The Future Classroom Maturity Model was key to Cycle 5 in stimulating scenario production. Teachers were encouraged to assess the current level of innovation in their own situations and then to assess their proposed scenario in order to develop or adapt it to be more innovative. In this case, the maturity model enabled stakeholders to identify whether or not a scenario was innovative in a given context. And whether this innovation was incremental—that is, used tools or pedagogies in a new way building on previous behaviour, or radically innovative—a cutting edge scenario (even if not straight forward to implement).

The Future Classroom Toolkit

The Future Classroom Maturity Model and Future Classroom Toolkit encapsulate the final development process; and, in line with the scenarios, were aimed at encouraging innovation. Firstly, the process and not just the output will be considered in terms of innovation.

The Maturity Model

An analysis of the scenarios selected for further development by stakeholders showed a discrepancy in what experts viewed as innovation—either in process or product—and what was innovative to teachers and other stakeholders. Thus scenarios which included the introduction of interactive whiteboards, the validity of online data and using maths as a language to integrate students who have the native tongue as a second language, were not viewed as innovative by all stakeholders because of local differences. For instance, in some European classrooms, these scenarios had already occurred.

To tackle this challenge the working definition of innovation was further refined to enable the application of two characteristics.

- '**Relatively innovative**' was ascribed to scenarios considered by some to be new and more advanced in terms of outcome, process or by its use of technology in a specific context. This is regardless of the fact it may be common practice in other contexts.
- '**Absolutely innovative**' was ascribed to scenarios that result in an outcome that all stakeholders believed to be new, or used a process or technology that all considered cutting edge.

There was also a need to discern sustainable more incremental change and disruptive more radical innovation. For example, was there an incremental change in the use of technology or was the script being totally rewritten? This led to the introduction of maturity model theory in the project.

Maturity models have been 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'.

Following this line of thought, it could be argued that maturity—or "e-maturity" in the context of ICTs for education—depends on a similar combination of factors: the presence of 'dominant designs', which are yet to emerge in educational technology. As noted by Zemsky and Massy (2004), these include the presence of an adequate infrastructure (e.g., bandwidth, connectivity, support and even technical training), positive attitudes and adequate levels of technical knowledge within the teacher community.

'E-maturity' has been used in the past to describe the conditions that might support the uptake of ICTs in education—most notably by the former agency for ICT in the UK, Becta (Bradbrook et al. 2008)—and this made it particularly suited to iTEC. According to Becta, e-maturity refers to the capacity to make strategic and effective use of technology to improve educational outcomes, and is understood to be an additional stage of development beyond 'e-confidence'. The latter embodies high levels of ICT knowledge and skills, and a readiness to apply these to existing situations and new challenges. E-maturity can be observed when professionals apply ICT in strategic and discriminating ways.

The model could be used:

1. As an assessment tool for relative innovation if the prior and current state were ranked;
2. As 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);
3. As a design tool to highlight factors that the scenario should contain to ensure that innovation occurred.

The potential of Future Classroom Scenarios to drive technology-based innovation in European education systems is influenced by the degree to which such conditions of maturity are present in different countries.

At the same time, there is widespread agreement that access to technology cannot increase the degree of maturity by itself. Even the best-equipped schools will fail to become 'e-Mature' unless teachers have the competences, vision, training, support and time required in order to harness ICT to support innovative teaching and learning. 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. These include: attitudes to risk; curriculum rigidity; various national and even local policies and regulations that dictate how digital technologies 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 the underpinning technology should only be one dimension of the model; in the model it is called 'Tools and resources'. From section "The Challenge to Innovate", pedagogy also needs to be considered, but this is pedagogy in context—which can be subdivided into: Learner's role, Teacher's role, and Learning objectives and assessment. Finally, there is the overall context, which is the category: School capacity to support innovation in the classroom.

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 in Table 2.1 with level 5 being more aligned to the notion of disruptive innovation.

It is important to remember that maturity models are constantly evolving. What is currently empowering (at level 5) may be extended in the future as technology progresses. 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.

Rationale for the Development of the Future Classroom Toolkit

The Future Classroom Toolkit was not part of the original project proposal. It was developed in response to the need to provide an innovative approach to the scenario development process that could be carried out by schools autonomously. This would sustain the process developed within iTEC of creating contextually appropriate innovative scenarios. This need was identified earlier in the project when the original scenarios were trialled across schools throughout the EU.

Table 2.1 Overview of the future classroom maturity model

	Learner's role	Teacher's role	Learning objective and assessment	School capacity to support innovation in the classroom	Tools and resources
5—Empower The capacity to extend teaching and learning through ongoing whole school innovation, with teachers and learners empowered to adapt and adopt new approaches and tools					
4—Extend Connected technology and progress data extends learning and allows learners greater control on how, what and where they learn					
3—Enhance The learner is able to learn more independently and be creative, supported by technology providing new ways to learn through collaboration					
2—Enrich The learner becomes the user of digital technology, which improves teaching and learning practices					
1—Exchange Isolation of teaching and learning, with technology used as a substitute for traditional methods					

At the level of individual schools, school leaders need a framework for developing curriculum delivery, 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. Looking at the regional and national level there was also 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 needed to be consistent—and this can be in the form of a shared scenario generated through the toolkit.

The second reason was that teachers had been selecting Learning Activities, concrete descriptions of discrete actions (derived from the scenarios), which were easy to understand and fitted in with their curriculum. Learning Stories present a package of Learning Activities and exemplify how they might work together (see Chap. 3 on Learning Design). By devolving scenario development to stakeholders, supported by the toolkit, the scenarios would be more relevant to their context and curriculum. The resulting Learning Activities derived would therefore also be more diverse and provide appropriate innovation for the future needs of the school or region.

Finally, the Future Classroom Toolkit encourages those creating scenarios to work with wider groups of stakeholders, for example, teachers, suppliers, experts, policy makers, those in the local community or TEL researchers, to develop scenarios that address trends and issues that impact their schools at a local or national level. To achieve this the toolkit contains tools to suggest, identify and record possible relevant stakeholders and methods for collaboration. These tools are generic and can be used across the various EU member states.

Future Classroom Toolkit

The Future Classroom Toolkit enables participants to create scenarios from scratch by identifying stakeholders and trends, the current context—locally or nationally through maturity modelling, and then creating or adapting a scenario structured by completion of a template. It then goes on to briefly explain about designing innovative learning activities and concludes with methods to evaluate the innovation.

Training courses incorporating this toolkit have been developed to ensure that stakeholders outside the project can replicate the iTEC scenario development process at national, local and community levels. In addition, the toolkit resources are available on the web[2] so that teachers and other stakeholders can create scenarios independently.

The toolkit encourages whole school use of ICT by:

- Creating an educational vision that is ambitious but achievable;
- Involving all key stakeholders involved in designing a schools' curriculum;
- Focusing on advanced pedagogical practices and change management.

The Future Classroom Toolkit Development Method

The Future Classroom Toolkit provides a structure for the process of scenario creation. The toolkit was designed to be used during the iTEC project but also afterwards hence the need to make it flexible and standalone. It was designed to have a

[2] See the website: http://fcl.eun.org/toolkit

facilitator who co-ordinates and drives the activities. As the toolkit is modular facilitators can decide which tools are useful, who needs to be involved, the timescale, and where necessary collate and publish any input, for example, trends and challenges identified, or the results of assessing the current context using the Maturity Model.

To deploy the Future Classroom Toolkit, 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, the toolkit structure enables stakeholders to fully understand the end-to-end process and all key features within a scenario. This flexibility means that it can be adapted to local needs and contexts. For example, a school may seek to visualise the impact of a new library or policy makers in central government may explore what would happen if the curriculum was modified. In turn, this will support long term exploitation of the process.

Many of the activities within the toolkit are adaptations of the process facilitated prior to and within earlier cycles, for example, the initial identification of trends, a review of emerging technologies, the Future Classroom Maturity Model, the completion of a template to ensure relevant areas are considered, etc. However, the toolkit contains new activities to support stakeholders to structure their trends and review the existing and identified descriptors and prioritise them against a number of factors (including timescale, concerns and aims of education).

Innovation with Respect to the Toolkit Process

As discussed in section "The Challenge to Innovate", innovation within a scenario is not merely dependent on the technology employed but is a combination of technology and pedagogy. For example, the result of implementing 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 have an innovative outcome, but if in previous years the same information appeared on a paper map, the process is not innovative. However, there is more to iTEC than the production of innovative scenarios, importantly there is also the process of creating scenarios.

The act of measuring technological innovation can be found in the 'Oslo Manual' (OECD 1997). This makes a helpful distinction between technological product and technological process innovations that can be transferred to the context of education. The product is the desired learning outcome as expressed as a teaching objective,

Table 2.2 Process and output innovation summary

	Process innovation	Product (scenario content) innovation
Planning	Curriculum planning based on future needs and opportunities identified within trends and challenges	Scenarios for future teaching and learning
Teaching and learning	Greater personalisation through considering how to seamlessly integrate new technologies and approaches	Learners developing new knowledge and capabilities, including twenty-first century skills

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 2.2 for a summary of how it was developed by iTEC to apply to the Future Classroom Maturity Model.

To summarise, the toolkit does not only lead to innovative scenarios, but the act of creation is in itself innovative.

Overcoming the Barriers to Innovation Within iTEC

As set out above, the scenario development process is in itself innovative. Nevertheless, there were other stages which occurred during the project where barriers to innovation were identified and the process was refined to overcome these. This section discusses examples of this. For example, it was known that there were different levels of innovation and e-maturity across European schools, where great variation could be found between and within countries, regions, districts, *and* even between and within individual schools. See, for example the findings of the schools ICT in Education survey (European Schoolnet 2013). In response to this challenge, it was decided to develop scenarios which allowed for openness in interpretation and could therefore be adapted to different conditions, including variations in technological access, differences in skills and knowledge, different attitudes and perceptions and so forth.

The scenarios were also designed to be non-prescriptive so that they could be implemented according to the individual teacher's ability, creativity and willingness to make the most of the scenario's potential in any of the cycles. The aim was to allow teachers to adapt the scenarios so they could be used by the mainstream while still being innovative. For example, several of the scenarios developed included the collection and analysis of real-world data. The scenarios make suggestions as to how such analyses could be carried out, but they never "lock" teachers into one solution or another. So, for instance, it is entirely possible that the same scenario might be based, in one classroom, on basic uses of the spreadsheet application Excel to analyse certain forms of environmental data; in another classroom, a teacher might decide to use different educational modelling software to develop visualisations. This idea of flexibility according to context also fits in with the underlying principles of maturity models.

There were other issues encountered during the earlier cycles of iTEC which required a rethink and subsequent re-design to overcome. For example, in the initial plan, scenarios were to be created by a project team with expertise in the areas of learning, technology and policy to create preferable and appropriate responses to challenges and trends identified by research, experts, and surveys of teachers across the EU. These were then to be reviewed by stakeholders (school leaders and teachers, policy advisors, partner organisations, and technology providers) across the EU to ensure consensus in which scenarios should be taken forwards. Approximately 8–10 scenarios were to be deemed most desirable **and** most feasible to be extended and used in the next stage. Unfortunately, this method led to less innovative scenarios being selected as teachers and other stakeholders selected those which could realistically be incorporated to support current curricula. Also, it 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 were easy to understand, fitted in with their curriculum and could be the easiest to implement (see Chap. 3 on Learning Design). It was important therefore 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 individual context to be feasible and to provide greater choice.

Alongside this concern from project partners, external reviewers emphasised the need to develop and therefore investigate the potential to introduce 'radical scenarios', to test the assertion made in some quarters that the limits of reform in the system may have been reached (OECD 2010). Therefore, indicators were developed by iTEC partners to further define the characteristics of more 'radically' innovative scenarios.

- There is no or very little evidence of the scenario currently in use in European Schools, other than in specific research projects.
- There are clear barriers to up-scaling resulting in very low probability of mainstreaming in the near future e.g., policy barriers (e.g., preventing the use of personal technologies in educational contexts), technical barriers such as limited technical infrastructure and current pedagogical constraints of curriculum and assessment.
- Technologies rarely seen in schools are used (e.g., very new technology, expensive technology, or technology not perceived to have a place in education).
- The innovation concerns a theme of current TEL research (e.g., cloud computing; mobile learning; 3D printing; augmented reality; serious games and gamification; personalised learning; and virtual laboratories or remote labs).

Scenarios that are only relatively innovative are not ignored as the degree of innovation is context dependent. For example, in one of the cycles, scenarios building on the introduction of interactive whiteboards were shortlisted by stakeholders. However, as they were already regularly used in some classrooms they were not considered to be a radical innovation but rather relative, reflecting the differing contexts across the 17 countries and over 2500 classrooms involved in the project.

Whilst the piloting of radical scenarios involving emerging technologies may provide evidence for their future potential if, and once, such tools become established within educational contexts, project partners decided that, in terms of facilitating up-scaling and mainstreaming, the promotion of radical scenarios could be counterproductive. Rather, scenarios that support incremental innovation are much more likely to lead to pedagogical change and wide-scale uptake as discussed in section "The Challenge to Innovate".

Teachers participating in iTEC pilots have reported changes in technology-supported pedagogy (see Chap. 9 on Evaluation). The nature of these changes varied from individual to individual. The filtering processes adopted at European, national, regional and local levels in relation to the selection, presentation and uptake of Learning Activities have led to the majority of teachers making incremental rather than radical changes. This is not surprising given the nature of education and the risks and challenges involved in relation to radical change. It also reflects the ethos adopted throughout iTEC: that the resources provided should be a source of inspiration for teachers, introducing them to new pedagogical approaches and new technologies, and not a prescriptive lesson plan.

A Reflection on the Scenario Development Process

This chapter has described the evolution of the scenario development process within iTEC. It has discussed what is meant by scenarios, the challenges and trends upon which they are based, the Future Classroom Maturity Model that defines how innovation can be assessed—for the current context as well as the proposed scenario. It has also described the toolkit itself—used by stakeholders to design a narrative for innovating practice, supported by information on the who, what, when, where and how, that addresses the concerns specific to that classroom, school, or national context. In addition, it discussed the activities within the five cycles that led to the creation of the toolkit and the reflective process that ensured that scenarios addressed concerns and minimized any risks or issues. As explained in this chapter, innovation within iTEC is more than the actual production process for creation of scenarios; the process for scenario creation is itself an innovation, providing as it does a structured way of thinking about the future.

In this final section the outputs from this work package are considered in the wider context of the iTEC project. It reflects on the various goals of iTEC discussed in Chap. 1 and the tangible and intangible benefits to stakeholders from using the scenario design process.

Scenario Development in the Context of iTEC Goals

Scenarios underpin the impetus for changes in the classroom; they are the basis for the Learning Activities implemented in classes across Europe and from which the descriptions for the technical products evolved. As a consequence, scenarios

underpin the goal of iTEC to improve the uptake of ICT in schools. For example, they address the mainstreaming gap, by which we mean the discrepancy between rapidly changing technology and the slower pace of change in some classrooms. The scenarios can be adapted according to the technology available. Furthermore, the systematic review process is designed to address risks, issues and barriers in advance so that each scenario is less likely to fail when implemented.

Another goal is to connect with the concerns and current practice of learners, teachers, head-teachers and policy makers. This is achieved by emphasising that *all* stakeholders need to be involved in the scenario development process. 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 a change management process, it includes an effective methodology to ensure that key stakeholders are consulted and their support secured. As part of this, stakeholders (not just the head and teachers but advisers at a regional or national level, and technology providers) have to recognise the needs of students in this environment of tomorrow. Furthermore, the analysis needs to inspire all teachers to change their own practices appropriately. 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 which can be at a classroom, regional or national level.

The scenarios build on the engaging potential of emerging technologies; scenarios can incorporate the potential distractions that multimedia and the digitally driven world of today offer. ICT provides the capacity to link the physical spaces where learning takes place (school, home, library, museums, community, etc.)—and scenarios incorporate these. The Maturity Model makes explicit the importance of incorporating emerging technologies without necessarily defining them.

Finally, and most importantly, the scenario design process was designed to lead to systemic change—that is, rather than focus on incorporating a new technology which may be obsolete in a few years, it is the process of reflecting on current trends and challenges and once a need has been identified, generating a scenario to address it. The scenario design process encourages reflection on incorporating new technologies—and this is supported by the toolkit which can be used by all to innovate as set out earlier.

The Tangible and Intangible Benefits of the Scenario Development Process

As well as addressing the wider goals of iTEC, the scenario development process that was created can be seen to have tangible and intangible benefits for the various stakeholders that use it. As discussed in previous sections, key outputs in relation to the development process are:

- **Future Classroom Scenarios**—narrative descriptions of teaching and learning that provide a vision for innovation and advanced pedagogical practice, making effective use of ICT.
- The **Future Classroom Maturity Model**—a tool to assess current and desired practice based on the idea of innovation, in particular relative and absolute innovation.
- The **Future Classroom Toolkit**—a modular collection of tools and processes to support the scenario-led design process including the identification of trends, the development of scenarios, and the development of Learning Activities and Learning Stories.

These three outputs are clearly tangible benefits. Scenarios can be used or adapted by any of the stakeholders. They provide a 'realistic' inspiration for teachers. From scenarios, specific Learning Activities can be derived which leads to a change in practice (see Chap. 3 on Learning Design). Moreover, by having a narrative that relates to desired practice it is easy for all stakeholders to comprehend the scenario and analyse and refine it collaboratively. At a national level the scenarios can relate to educational policy in the real world and allow for an exchange and comparison of approaches.

The Future Classroom Maturity Model is also of tangible benefit. It enables stakeholders to reflect in a structured manner on the current levels of innovation within schools, local and national contexts. This is important because shared understanding allows stakeholders to identify what needs to be done to actually innovate practice. It also leads to discussion around terminology allowing stakeholders to define what is required and analyse the current situation. Thus stakeholders can be explicit about current status and develop a shared vocabulary.

Similarly the Future Classroom Toolkit itself is of tangible benefit. It provides a structure for the creation of scenarios, and a way of thinking about practice embodied in the modules. The process enables the stakeholders to reflect on who are required to input to the scenario, what issues need to be addressed, what technology will be used, etc. The toolkit is a forum for the exchange of ideas—stakeholders will have differing views on what is important to them, as well as ideas around what factors will be influential that have not necessarily been identified previously.

In addition to the tangible products there are generic intangible benefits for stakeholders: the first being an appreciation for individuals of the potential of scenarios and their role in changing education. Also, there is a growing understanding that innovation is relative to the context and that it is equally important that practice advances incrementally rather than just aiming at radical innovation. The Maturity Model approach highlights that it is often better to move up one level at a time rather than introducing new technologies and practices for teachers and students without the experience and knowledge to use them effectively. The model also acknowledges that many factors lead to innovative practices, and technology is only one aspect.

A second intangible benefit is the creation of a relationship between the stakeholders. Through the process of scenario creation, stakeholders learn to share their viewpoints and engage in strategic dialogue around the direction of policy and practice.

The process allows them to form relationships and appreciate the differing perspectives which come from their varying roles.

Conclusion

The feedback towards the scenarios and their development process was positive. Stakeholders felt that the process of evaluating their own current levels of innovation and designing scenarios that increased the level of innovation in at least one dimension was a useful exercise. The maturity model framework allowed them to establish a shared vocabulary and a means of analysing their own understanding and expectations. The process gives the opportunity to be creative, and to think laterally about how technology can be used. Furthermore, the introduction of the idea of trends, an abstract concept, made stakeholders more aware of context. Having scenarios allowed a way of sharing best practice.

Some participants recommended that the toolkit be incorporated into teacher training in order that stakeholders would become familiar with reflecting on context and practice in this structured way. It could also be integrated within national professional development structures. Facilitators and trainers mediating the process would benefit from targeted support on the use of the toolkit and should be supported to use the toolkit in their own practice.

In relation to lessons learned, the scenarios which were selected show the importance of ownership. A greater range of scenarios are implemented if the stakeholders—particularly teachers—are responsible for their creation. The process also shows how stakeholders need support to recognise and integrate trends and challenges into their practice but that these need not be abstract and can address issues affecting them not only at a national level but also in the classroom. The resulting scenarios must not be rigid either. They are intended to be inspirational and must allow flexibility in implementation according to the context and the resources available.

Finally, there are implications for policy and practice; the toolkit has been designed to be used at national, regional and school levels—pulling in all relevant stakeholders in a structured manner. The methodology allows relationships to be established with industry, research and policy makers. As discussed by those who used the toolkit in Cycle 5 the Future Classroom Toolkit would be especially applicable in countries where the toolkit clearly supports current policy directions.

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