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D2.1.1

Report on good practice of innovative applications of learning theories in TEL v1

SEVENTH FRAMEWORK PROGRAMME

HoTEL Holistic Approach to Technology Enhanced Learning

Innovators – Opinions – Perspectives

WP2| D 2.2.1

Report on good practice of innovative applications of learning theories in TEL v1

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Executive Summary

The HoTEL Support Action aims to contribute to more effective, holistic and faster innovation cycles in European Technology Enhanced Learning (TEL), focusing on the design, testing and validation of a new innovation working method.

This document sets out the learning theories which influence innovators, identifies the new learning practices supported by TEL in higher education, professional learning and informal learning, and offers a multiple stakeholder analysis for TEL innovations in learning & education.

Educational innovators should benefit from this document as a guide to effective analysis, decision-making and implementation.

1 Introduction and Background

Learning theory has been a contested scientific field for most of its history, with conflicting contributions from many scientific disciplines, practice and policy positions. With the continuing and disruptive influence of technology on information, knowledge and practice in all sectors of society it is no wonder that innovators, drawn to the interactive potential that computers bring to learning, are challenged by the theoretical basis for their innovations.

1.1 Multiple societal purposes of learning

Formal education is also a high stakes, culturally & institutionally conservative activity, which serves more than one societal purpose, including:

- learner development and fulfilment;
- child care;
- preparation for citizenship, parenthood and retirement;
- preparation for work;
- selection for jobs.

1.2 Complexity of learning outcomes

Even in the higher, informal and professional sectors of education, complexity of education is matched by complexity of learning outcomes which may include:

- skills development;
- knowledge acquisition;
- improvement in strategic, analytic and creative capacities;
- attainment of competence;
- establishment of attitudes and values.

Each of these societal purposes and these learning outcomes demand different approaches and understandings for the theorist and may develop at varying rates or found to be diverse in relation to context, location and culture.

This review begins by providing an overview of known learning theories and presents these in the form of a hyperlinked concept map. For each theory, author, concept or paradigm identified, there is a short summary and links to articles on InfEd and Wikipedia.

In addition, learning paradigms that are currently informing innovation with technology enhanced learning are listed and described.

Finally, this review introduces some analytical frameworks to make sense of this complexity and to use as check-lists against proposed innovations to consider their

nature. In many cases, such analysis is intended to lead to improvement in design or in the change-management of its adoption. In other cases they may help identify the assumptions made of existing practices that can be combined with the innovation to ensure its viability.

Within HoTEL, this report is a review of Learning Theories and their relationship with TEL – examples of good practices will be presented in the second version, D.2.2.2 which will be a revision based on WP4 activities so that the Exploratorium pilots feedback is represented. The revised version will contain a set of pedagogical scenarios and accompanying heuristics that guide their selection for different levels of education, domains and age groups.

2 Learning Theories

2.1 Learning, Education & Pedagogy

Learning theories have been discussed since the time of Socrates, although most development is usually associated with the last two centuries. Apart from the social and cultural complexities mentioned in the introduction, there is further terminological confusion between learning theory, educational theory and pedagogy. For the purpose of this document, learning theory concerns itself with explaining the way in which individuals advance in skills, knowledge, capacities, competence, attitudes and values. Educational theory explains the nature of the organisation of learning to fulfil societal need, whether formal or informal. Pedagogic theory is primarily about the teacher and their acts to facilitate learning within an educational context. This exposition of learning theory does not attempt to fully disentangle this confusion, but warns the reader to consider it.

2.2 Scientific Disciplines

Learning theories have their roots in a number of scientific disciplines, which range from the 'pure', individualistic psychology to the 'mixed' or multi-disciplinary fields of organisations or education. Some of the contestation mentioned in the introduction arises from value judgements made about the basis for scientific conclusion and the nature of evidence and proof, including a debate about quantitative and qualitative methods for researching learning.

2.3 Tacit Theories and the Grip of Instructivism

Importantly, all humans experience learning and arguably are themselves theorists. Politicians often formulate policy on the basis of their own, valid and experienced, theories of effective learning. When ordinary people perform as teachers, formally or informally, they fall into the 'instructivist' mode, assuming that they must

communicate ideas and that these are absorbed by the listening learner. Surprisingly, even trained teachers can be observed following this atheoretic process, partly because it seems to work! But this simple instructivism underestimates the complex behaviours and process that well-informed teachers adopt to maximise learning, constantly re-working their methods through practice and developing powerful tacit theory of 'what works' in teaching and learning. Nor does it recognise the way learners can subvert the apparent learning method, create their own understandings and achieve success.
Much continuing professional development for teachers engages them in reflective practice to understand their 'theories in use' and contrast them with 'espoused theories' and thereby achieving greater understanding of areas to improve.

2.4 Learning Theory Concept Map

The following interactive diagram [Millwood 2013] attempts to capture an overview of the learning theories which have been proposed by theorists in recent times. Each theorist is linked to their main scientific discipline and to the main concepts or paradigms they have been credited for. A more detailed analysis of the review on learning theories is provided in Annex 1. This concept map is intended to act as a quick reference and overview. In its interactive form, the icon under each box links to a Wikipedia, InfEd or other article to expand and provide further references.

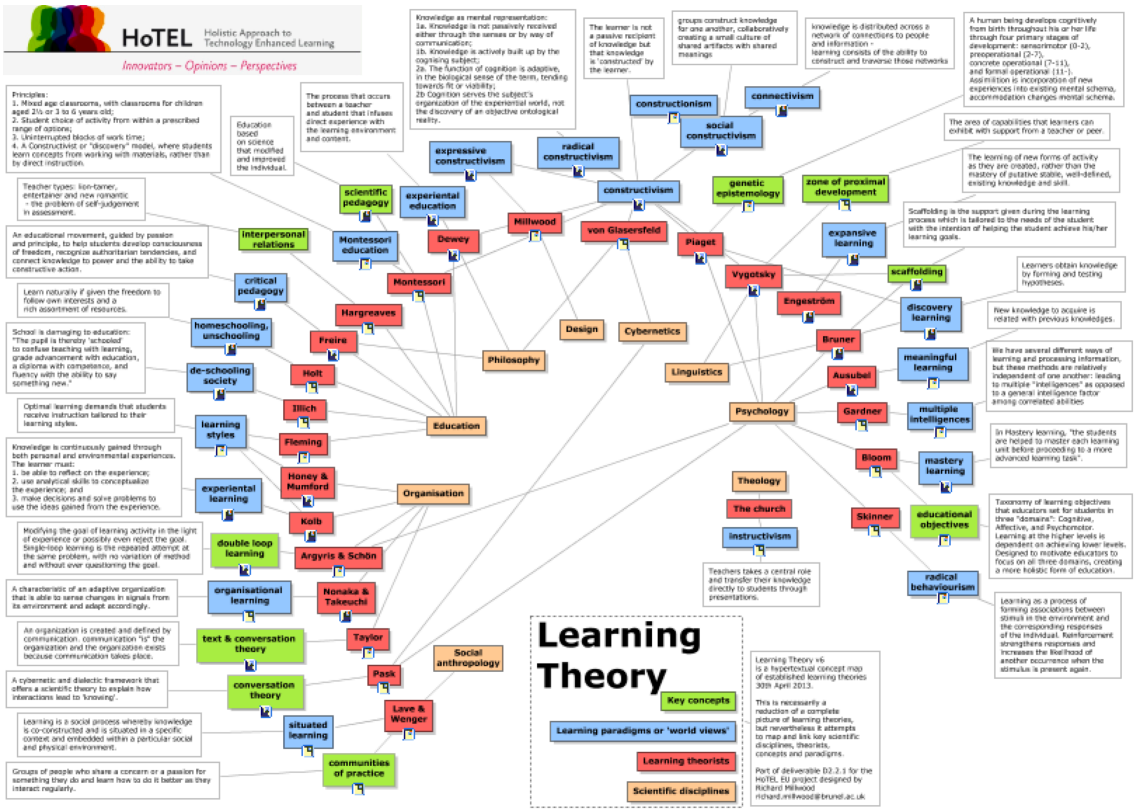

Figure 1: Learning Theory - what are the established learning theories? [Millwood 2013a]

There is much work represented in this concept map that focuses on young people and schooling, a natural result of society's focus on formal education, and less on the higher education, informal and professional areas, but it can be argued that many of the theoretical ideas continue to have application as we become adults. This does not imply no change in pedagogy - indeed Knowles (not included on this map) developed a theory of adult education employing another term, andragogy, to characterise the teaching approaches for adult learners, but even he concedes that this is a continuum rather than a hard distinction, and that many of the characteristics he defined for adult learners apply to younger learners too. On the other hand, adult learners may bring maturity and clarity of purpose to bear on the learning process - motivation and concentration may thus be enhanced. This review argues that this may operate in reverse too, in that many of the theories founded in school learning may well have application to adult contexts and thus are included here.

Finally, there are very many more theorists that have contributed to these concepts who are not included, and neither is the contestation of these theories clearly represented. Dominant are the major thinkers of the Western world, but there are other perspectives, analytical frames and criticisms that could be made to enrich this map, but would make it unwieldy.

3 Learning practices

At the time of writing the following learning practices are being proposed as offering interesting perspectives on learning enhanced by technology. These involve paradigms, or world-views, of the tools, infrastructures, organisation and pedagogy of learning and do not offer new theoretic insight into the learning process itself. Paradigms are informed by values, philosophies and analyses, but not necessarily by scientific evidence - nevertheless, they are based on the learning theories described above. The choices made here are current in 2013 and are not categorical - they overlap and support each other giving us a complex web of potential learning, but all of these may benefit from or are made possible by technology and thus may be considered TEL paradigms.

3.1 Microlearning

Microlearning is characterised by relatively small learning units and short-term learning activities, simple ideas and learning tasks. In turn these relate to micro-content and structures such as blogs, and social bookmarks. The most common denominator of microlearning studies seems to the use of mobile devices, promoting learning through interaction with micro-content. Julie Clow, manager of learning and organizational development at Google Inc., describes Microlearning as "discrete chunks of information or skill-based knowledge that can be delivered in

short bursts of time". However, Microlearning is often presented as pedagogically unspecific – multiple choice exercises fit the bill just as well as self-directed knowledge quests based on blog posts, images, events, URLs or videos.

Lindner lists a number of innovative features that make microlearning successful:

- '**seamless integration**': learning is part of everyday work and live practices, so that micro-content is not perceived as disjoint or incomplete;
- '**peripherical consumption**' : rather than demanding learners full attention, microlearning acknowledges that many tasks actually consist of multiple, partially overlapping tasks which include searching, filtering and evaluating information as well as producing and disseminating self-authored information;
- '**emergent motivation**': learning situations are less predictable – even at a relatively high level – so that few points of reference exist to generate 'built-in motivation', the most likely fix-point remains to be the user interface. [Lindner 2007]

Microlearning leans on Skinner's radical behaviourism, often derided despite its value in the rote learning of facts that underpin more sophisticated knowledge. It may be usefully critiqued in terms of Experiential Learning (Kolb) and needs to respond to Bloom's expectations expressed in Mastery Learning, but also has the potential to exploit learning style preferences (Fleming, Honey & Mumford, Kolb) if learning units are made to adapt and learners are able to choose.

3.2 Seamless Learning

Seamless Learning may relate to:

- the seamless **integration** of **technology** in the classroom;
- connecting **formal** and **informal** learning;
- combining **individual** and **social** learning.

Seamless Learning can further be described as 'learning wherever, whenever and whatever' learning [Chan et al 2006]. However, common to most definitions is the aim to support continuous, fluid learning experiences – mainly driven by the learner's desire to inquire or to investigate. The concept of seamless learning is to make the transitions between different learning situations and contexts as smooth as possible. [Looi et al 2010].

Mobile devices play an important role in the context of seamless learning. They provide access to the learning environment and facilitate the whatever, wherever and whenever principle. In recent times, many students have a mobile device like a mobile phone or a tablet computer. The technological evolution continues so that nowadays many mobile phones have smartphones features, comprising a range of internet services (Dropbox, Twitter etc). They are simply small portable computers.

Hence, seamless learning also means that the learning environment moves from the desktop to the portable device [Chan et al 2006].

3.3 Open Educational Resources

Open Educational Resources (OERs) refer to the potential for large-scale participation and open access over the internet due to the publication on web-sites of material for learning (e.g. open courseware, Udacity University, P2P University, Massive Open Online Courses - MOOCs, etc.) MOOCs represent the organisation of such OERs In a critical review of MOOCs, Sir John Daniel remarked that "the real revolution is that universities with scarcity at the heart of their business models are embracing openness". However, the way this is happening follows two different innovation models: there are c-MOOCs, closely linked with connectivism (following George Siemens and Stephen Downes), and there are x-MOOCs, bringing existing courses to an extended audience. Whereas the former is aiming for innovative pedagogy, the latter is driving technological and economical innovation on the basis of more instructivist paradigms.

3.4 Gamified Learning

The idea of Gamified Learning is to use game mechanics and elements of game design in non-game contexts in order to motivate a desired learning behaviour [Deterding et al 2011]. Gamification is not limited to a specific thematic field. Elements like timing, accuracy and scoring can be applied to any task, process or context. Other game mechanics are levels, challenges, virtual goods, leader boards and gifting & charity [Muntean, 2012].

One example of gamification in everyday life is the staircase modified to act as a giant piano. The stairs were turned into black and white piano keys, producing a sound when stepping on them. By turning the stair into a piano, more people used the stairs, i.e. usage increased by 66 per cent [Kapp, 2012], which it was believed would bring health benefits. Another example is the use of 'loyalty' cards in restaurants, where you get the tenth meal for free, aiming to increase follow-on business. Common to both examples is the fact that gamification is used to modify behaviour. The reason why people are engaged by game mechanics is because they overlap with basic human desires like reward, status, achievement, self-expression, competition and altruism.

Theories which would support this practice include Gardner with Multiple Intelligences, Bloom with his concept of Mastery and Hargreave's notion of the teacher as entertainer to enhance motivation.

3.5 Flipped classroom

In an ordinary classroom situation students listen to the teacher and do some exercises at home. In a flipped classroom this process is inverted. Various synonyms exist like inverted classroom, classroom flip, flip teaching, reverse teaching, reverse instruction and many more. The lecture part is moved from school to home and the exercise part takes place at school. Online videos and podcasts substitute the lectures and are now homework. Time in the classroom can be used more interactively, group projects, discovery activities, experiments, and class presentations. The teacher can use the time to support the students. The teacher's role changes from "sage of the stage" to "guide on the side". Students become active learners rather than receptacles of information. [Strayer 2011]

Flipped Classroom is not a synonym for online videos. And it's not about replacing teachers with videos. It's the combination of watching videos at home and applying what has been learned during face-to-face time, hence it can be seen as a form of blended learning [Bergmann et al 2011].

Broadly constructivist in its thinking, this practice is clearly supported by Vygotsky's Zone of Proximal Development and Bruner's Scaffolding.

3.6 Connectivism

Connectivism asserts that recall of knowledge is supplemented or even supplanted by knowing where knowledge can be found. The internet has empowered us to find distributed knowledge effectively, and it is now more important for students to increase their capability to find the knowledge they require, than it is for them to internalise it.

George Siemens defines the following principles of connectivism:

- Learning and knowledge rests in diversity of opinions.
- Learning is a process of connecting specialized nodes or information sources.
- Learning may reside in non-human appliances.
- Capacity to know more is more critical than what is currently known
- Nurturing and maintaining connections is needed to facilitate continual learning.
- Ability to see connections between fields, ideas, and concepts is a core skill.
- Currency (accurate, up-to-date knowledge) is the intent of all connectivist learning activities.
- Decision-making is itself a learning process. Choosing what to learn and the meaning of incoming information is seen through the lens of a shifting reality. While there is a right answer now, it may be wrong tomorrow due to alterations in the information climate affecting the decision.

Rhizomatic learning, arising from the metaphor of a plant which multiplies through horizontal root systems, describes theory and research that allows for multiple, non-hierarchical entry and exit points in data representation and interpretation - in this analysis we align rhizomatic learning with connectivism. Many other learning theories contribute to the ideas in Connectivism, particularly those associated with Vygotsky in social constructivism and Illich's idea of the 'tools for conviviality'.

3.7 Inquiry-based learning

Inquiry-based Learning involves the investigation of questions, scenarios or problems (and thus included here is Problem-Based Learning). It promotes a learning environment where higher order cognitive abilities may be developed frequently in the context of a critical community of learners, where both reflection and discourse facilitate the construction of personally meaningful and socially valid knowledge and guides decision and action. Blumenfeld et al says that, "Project-based learning is a comprehensive perspective focused on teaching by engaging students in investigation. Within this framework, students pursue solutions to nontrivial problems by asking and refining questions, debating ideas, making predictions, designing plans and/or experiments, collecting and analyzing data, drawing conclusions, communicating their ideas and findings to others, asking new questions, and creating artifacts." [Blumenfeld et al 1991].

As a learning practice, there are variants in which teachers define the inquiry and plan for the learners' to discover knowledge. Alternatively, and often with more mature learners, the inquiry is defined by the learners themselves to follow their interest, curiosity or desire to improve - thus linking closely with 3.11 Action Research below. In each case the learning model is derived from the constructivist thinking of Piaget, Bruner and many others. Where teachers intervene or mentors are involved, Vygotsky's concept of zone of proximal development (ZPD) is relevant as learners achieve with help what they would find difficult if working alone.

3.8 Work-focussed learning

In Work-focussed learning, the content of learning arises from the work or project in the real world. Authority of knowledge is found amongst colleagues, from professional institutions and from the evidence gathered in the working practice of the learner as well as from traditional and academic sources. This is distinguished from but is related to work-based learning, which the EU defines as "Acquisition of knowledge and skills through carrying out – and reflecting on – tasks in a vocational context, either at the workplace (such as alterance training) or in a VET (vocational education and training) institution." [Tissot 2011]. A key distinction concerns who defines the learning need and plans the learning path - the employer, an external organisation or the worker?

This practice leans heavily on Kolb's 'experiental learning', Argyris and Schön's Double Loop Learning and Reflective Practice and can be explained through Nonaka & Takeuchi's SECI analysis of organisational learning.

3.9 Personal Learning Environment

This learning practice employs systems that help learners take control of and manage their own learning. This includes providing support for learners to: set their own learning goals manage their learning, both content and process communicate with others in the process of learning manage their personal learning network. Characteristic of Personal Learning Environments is the concept of a dashboard - an overview of the relevant tasks, status and connections in front of the learner, often implemented in a web page with embedded widgets which are selected and arranged by the learner to suit their preference. Each widget represents an external resource which provides information, connection or opportunity for dialogue, and these resources, often included under the title 'WEB 2.0' are where learning activity takes place. Clearly the learner is at the centre of this web and is expected to be active and self-regulating to a high degree. In that respect, learning content is not as important as identifying and creating the connection to where or who to find it. [Wheeler 2013]

This learning practice is arguably inspired by Illich's concepts of 'deschooling' and 'learning webs' and relies in part on the practices described in 3.6 Connectivism.

3.10 Instructivism

Traditional educational environments which offer linear structured content through teacher-led delivery, based on objectivism-positivism as a philosophical standpoint. The stereotype of learning is passive listening with note-taking and subsequent practice - the teacher is in 'lion-tamer' mode (Hargreaves). Learning content is defined authoritatively by the teacher who may take Ausubel's advice that: "The most important single factor influencing learning is what the learner already knows. Ascertain this and teach him accordingly". The best practitioners will have a clear knowledge of progression through a curriculum designed to build on concepts introduced earlier.

Much content available through TEL is designed in this way, providing a narrative for learning that is 'ideal' with respect to increasing complexity or difficulty and responsive to ideas of preparedness derived from Piaget's thinking. Further improvements are attempted with multimedia and hypertextual content to address diversity in modalities (reading, listening, seeing, acting), learning outcomes, levels and learning styles amongst learners (see Kolb, Fleming, Honey & Mumford, Bloom and Gardner).

Critics argue that instuctivism offers little of self-discovery, reflection, edification and intellectual expansion, instead anticipating that learners may be able to recite and write the material presented in examination with little idea of real-world application.

3.11 Action Research

In many professional, working and higher education learning contexts such as education, social work and health, Action Research has become a useful approach for continuing professional development i.e. learning for professionals. Derived from the social sciences research community, but applied to professional learning, it refers to ideas of justice, based on not only enabling access to action for all in society, but also sharing the benefits. It promotes transformative learning by way of emancipatory education that fosters the human rights and equity that are seen in the everyday lives of people, from every level of society. It provides a learning environment that facilitates development of higher order cognitive abilities and it promotes a critical community of learners, where both reflection and discourse facilitate the construction of personally meaningful and socially valid knowledge and guides further decision and action.

Action Research can vary in its details - for example, Critical Emancipatory Action Research is not intended to add facts to an existing body of knowledge, but rather to contribute to the transformation of theory and practice with emancipatory goals. It constitutes a process of empowerment for the participants. It impels them to take action based on critical reflection. As Grundy reports, when "understanding", that is derived from critical reflection on critical social theorems and on the direct social context, is linked to social actions directed towards changing the illiberal and unequal relationships that exist in the social group, then what is applied, is a critical emancipatory form of action research [Grundy 1987:146-155]. Other important variants include Participatory Action Research, where the researcher is fully embedded in the real-world context being researched.

This learning practice derived from Action Research emphasises a shift from teacher-centred to a learner-centred approach. Indeed it can be seen to be based on the paradigm of Critical Pedagogy (Friere) which is an "educational movement, guided by passion and principle, to help students develop consciousness of freedom, recognize authoritarian tendencies, and connect knowledge to power and the ability to take constructive action."

Important to the learning practice is single and double loop learning (Argyris and Schön) as interpreted in the following diagram:

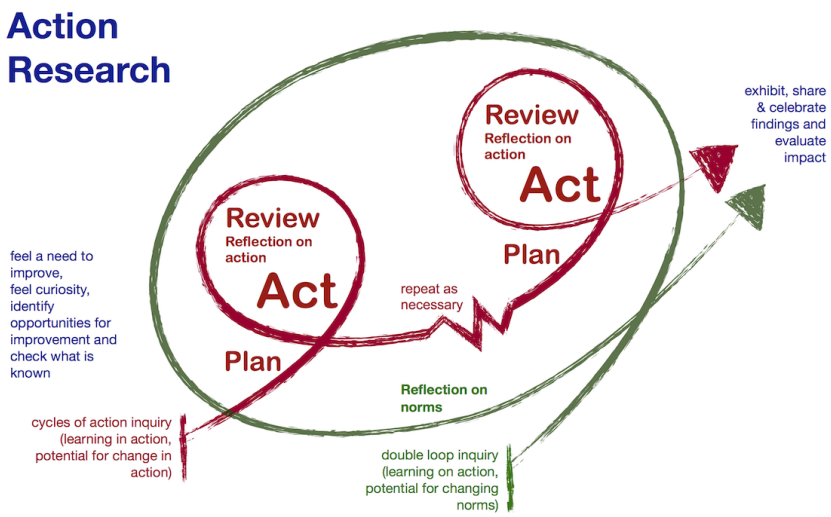

Figure 2: Action Research [Millwood 2013b]

This learning practice benefits from a cooperative environment in the framework of a Learning Community connected via shared aims and activities. While for one person learning is a matter of participation and contribution to the practices of a community, learning, for the entire community, is a matter of improving its practices and of securing new members. This is described by Lave & Wenger as a Community of Practice. These are ripe for implementation through technology as vehicles for supporting Action Research.

3.12 Expansive learning

This description of Expansive Learning, based on Activity Theory, is drawn from Weibell's dissertation 'Principles of Learning':
"Expansive learning theory [...] is concerned with the learning of new forms of activity as they are created, rather than the mastery of putative stable, well-defined, existing knowledge and skill.

Standard theories of learning are focused on processes where a subject (traditionally an individual, more recently possibly an organization) acquires some identifiable knowledge or skills in such a way that a corresponding, relatively lasting change in the behavior of the subject may be observed. It is a self-evident presupposition that the knowledge or skill to be acquired is itself stable and reasonably well defined. There is a competent 'teacher' who knows what is to be learned.

The problem is that much of the most intriguing kinds of learning in work organizations violates this presupposition. People and organizations are all the time

learning something that is not stable, not even defined or understood ahead of time. In important transformations of our personal lives and organizational practices, we must learn new forms of activity which are not yet there. They are literally learned as they are being created. There is no competent teacher. Standard learning theories have little to offer if one wants to understand these processes. (Engestrom, 2001, pp. 137-138)" [Weibell 2011]

Expansive learning is related to social production of knowledge via negotiation and peer-review. Examples include the learning that authors of Wikipedia or programmers in open source development projects gain as they develop such collaborative materials.

As a learning practice it clearly demands the kinds of community of practice described by Lave & Wenger and is clearly related to the principles described in organisational learning by Nonaka & Takeuchi.

4 Analytical frameworks

In order to make sense of proposed innovations in the light of learning practices and theories, some frameworks for analysis are proposed. These are simply lists of questions, each list from a different stakeholder point of view. They attempt to cover the key issues that an innovation in any educational setting should be able to enhance. They are presented as diagrams first as an overview, but also listed at the end of this section in the form of a table with further explanation.

A. Technology-centred

This framework relates to the way technology has the potential to enhance learning. It is based on an Expressive Constructivism analysis by Millwood, which is a simplified constructivist model of learning based on theories of Kolb, von Glaserfeld and others and arises in the design and development of innovation in technology for learning. It argues that learning is characterised by a cyclical process of learner's active expression and evaluation of ideas, leading to re-expression until satisfaction is achieved. Expression may be through internal thought (including the thoughts evoked as an audience to traditional lectures, or the apparent passivity of watching a video), external informal language (speaking, acting or doing, often with others) and formal language (writing, coding or use of computer applications). Evaluation may be through internal reflection, external feedback or computational response.

Figure 3: A simplified model of the learning process - Expressive Constructivism [Millwood 2012a]

The first seven of these factors, in red, are enhancements that technology can make to the learner's expressive creativity. The final three, in blue, are enhancements technology can make to the learner's evaluative power:

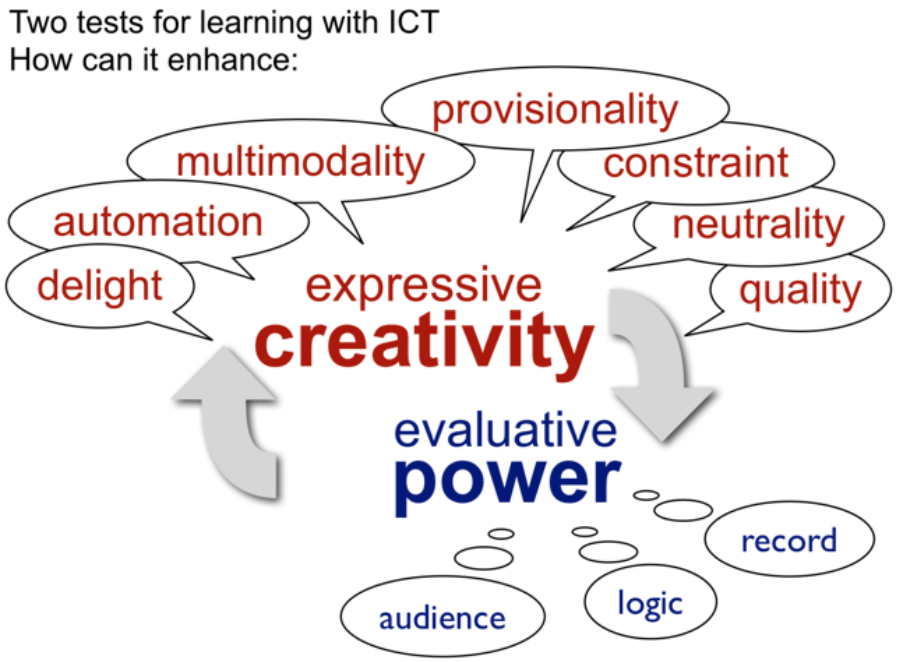

Figure 4: How does technology enhance learning [Millwood 2012b]

B. Learner-centered

Regardless of technology, a focus on the learner's situation in the context of education demands that the following questions can be answered by the learner. In this context, the question is how these aspects of education can be enhanced by a technology innovation.

Figure 5: The learner at the centre [Millwood 2009]

In addition to these questions, the learner must clarify what responsibility do they carry themselves to find answers at each decision-point in their life-long learning, and which do they have a right to answers from other sources (peers, teachers, parents employers, government).

C. Teacher-centred

Here the teacher represents not just the school teacher, but any person who takes responsibility for the education of others, including peers, parents and employers. The professional will take these questions seriously, but they are no less important to the informal facilitator of learning, who may be unconscious of their response.

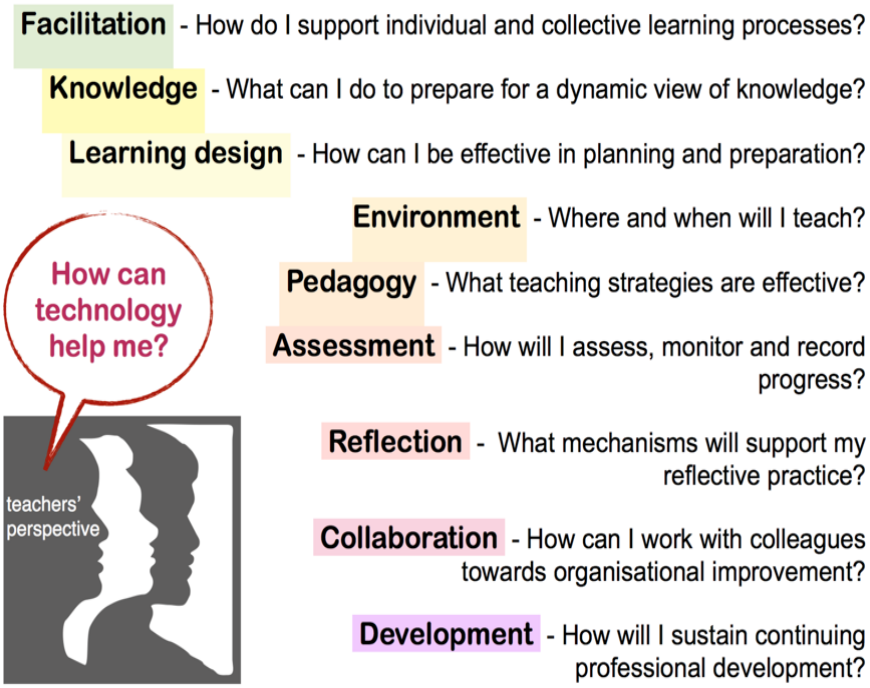

Figure 6: The teacher's perspective - How can technology help me? [Millwood 2013c]

D. Institution-centred

These are the questions that institutional leaders may ask to establish how technology can influence their institution:

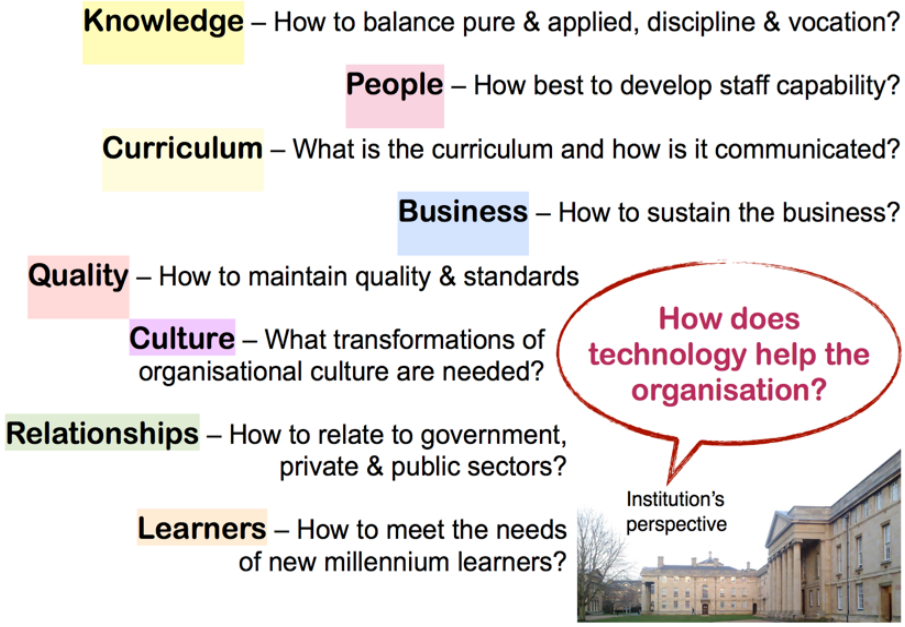

Figure 7: The institution's perspective- How does technology help the organisation? [Millwood 2013d]

5 Analytical Tool for Innovation Proposals

This analysis uses the checklists of questions below to identify where each innovation has strengths and also identify how it might need to be improved or augmented in order to offer a complete solution. This should help the three HoTEL Learning Exploratorium Labs, for Higher Education, Workplace Learning and Informal Learning, to assess innovations within the proposed Plan / Act / Assess / Review cycle. Each innovation tested may be checked against each item in each perspective to provoke creative inspiration rather than exclusion.

Question about the innovation's enhancement to learning	Discussion
A. Technology-centred	
A1. Delight - how is this activated?	The computer frequently pleases, aesthetically and affectively, in a way that delights the learner. This positive mood is clearly valuable to creativity, as a means of sustaining motivation at the very least.
A2. Automation - how does the technology help activities to be repeated economically?	A powerful spur to more complex expressions of ideas is the ability to re-express cheaply and repetitively. The potato print transforms a simple shape into a rich pattern, the 'automation' provided by this simple tool allows a variety of re-arrangements of the shape to be explored at low cost and with reliable quality. Computers provide this kind of automation and much more, through copy and paste in almost every program, through formulae and 'Fill down' in a spreadsheet and, most important of all, through programming languages.
A3. Multimodality - what sensory modes of input and output are supported?	The capacity for learners to use multiple media through ICT increases the opportunity to work in alternate modalities to the predominant text. ICT simplifies the production of visual & aural media as well as helping to make viewing & listening a more delightful engagement with material. Of even greater consequence is the potential for (re)construction in film, hypermedia (networks of information) and linear presentations. Such integrations of multiple media are perhaps the most demanding of expressions, not only anticipating audience viewing but also audience choice of sequence.
A4. Provisionality - how easy is it to re-draft ideas?	For many learners, starting is difficult because making mistakes has such a disastrous effect on continuation. Many young people in schools use correction fluid to eradicate 'errors', or resort to ripping pages out of books in order to achieve a 'perfect' copy. Provisionality arises when one can begin developing ideas and, at little labour cost, perfect and re-draft those ideas with no evidence of the false starts. This means that creativity is promoted, one can start recording ideas out of order, in draft form and incomplete. Confidence then unlocks ideas, which might otherwise be considered not worth expressing.

A5. Constraint - are there supports to improve accuracy or limit variety?	ICT tools can promote the development of ideas, paradoxically, by constraining the universe of possible expressions. In many of the arts, the choice of constraint can lead to greater fertility by focussing on specific aspects of ideas – this kind of limit can offer similar gains in ICT. In graphic programs, limits on the position of the cursor to a grid can lead to the rapid development of diagrams. In geometry programs, constraints can help learners see important connections and propose new interpretations.
A6. Neutrality - how is it made clear that judgment is not being made on the person?	After some acquaintance with computers over a period of time, young people see through any pretence of intelligence or life in a computer and thus begin to see it as a neutral tool which although it may offer canned feedback, is clearly incapable of judgement. Computers allow students to 'say things out loud', but without judging those things in an interpersonal manner. The computer is a silent helper in this sense and can be trusted with half-formed ideas and ideas which follow the students creative impulse.
A7. Quality - how does the technology empower perfection?	ICT media are unique in that little imprint of the creator's weakness in production are seen – perfect fonts, geometric accuracy and colour faithfulness permit the weakest of learners to produce material which compares, on the level of media quality, with that of the most experienced professional. This means that learners' self-esteem, which is so heavily knocked by poor handwriting, inaccurate drawing or inadequate oral skills, can be raised. This in turn encourages risk-taking and attention to the content of ideas – continuing engagement which can promote attention to higher-order issues.
A8. Record - does the technology help with recording for later reflection or refinement?	Most work on a computer can be saved for later perusal or at intervals to record drafts. This can help learners see how their ideas have developed, or peers & teachers to understand and judge their originality & value. In the long term, work that has been compiled provides the basis for a portfolio of work, which can be used to represent the learner's capability. It also may be efficiently mined for new starting points, new connections can be made between past work and present concerns. Often surprising insights can be obtained, because ICT has recorded the work and allowed searching and indexing to take place.
A9. Logic - are expressions made by learners computed or transformed?	Computers offer a powerful tool for certain ideas, which are developed in symbolic, formal languages. These include diagrams, spreadsheet formulae, programming languages and database design. If these formal systems are used to develop ideas, then it is possible for the computer to 'execute' them or analyse them and display their consequences. Often, in order to judge the success of an idea, this output can be compared to that anticipated, and evaluation independent of a peer or teacher can take place. The programming language Logo has provided a powerful example of this effect, in some cases leading learners into extraordinary intellectual and creative endeavour.

A10. Audience - how does the technology enhance sense of audience?	Using projectors or large screens in a classroom context, learners share a knowledge context and background, debate together, seek each other's views and respect diversity but also work towards consensus. The projected computer screen is a focus for representing the current state of the ideas being developed by the class and for judging quality and accuracy of expression. A wider, but identified audience can be found by publishing material on web pages so that the globe can take part in the evaluation of ideas and work. The power of potential audience to support both expression and evaluation is very real in the mind of the learner and can provide powerful motivational force and raise ambition.
B. Learner-centred	
B1. Motivation - Why do I want to know and share?	fulfilment delight relevance curiosity economics expectation
B2. Importance - What is there to be known?	culture tradition discipline ethnicity society literacy
B3. Process - How do I come to know?	skills creativity inquiry pedagogy technology tools mental-models facts memory intelligences bio-technology
B4. Community - Who can help me, and I them?	teachers parents peers stakeholders costs & finance
B5. Environment - Where and when?	buildings & equipment internet mobility timetable lifelong access

B6. Source - Which resources can help?	authority multimodality user-generated intellectual property universality global-local language & culture
B7. Assessment - What have I achieved and what next?	communication judgement planning progression continuity testing specialisation
B8. Recognition - How do I convince others?	reward accreditation standards qualification portfolio employment portability
C. Teacher-centred	
C1. Facilitation - How do I support individual and collective learning processes?	Online communications can provide powerful and effective means to facilitate learning. Monitoring of the learner's activities and results can inform the nature of teacher's interventions, help balance their distribution amongst a group and identify issues for special treatment.
C2. Knowledge - What can I do to prepare for a dynamic view of knowledge?	Maintaining personal awareness in developments in a discipline and new methods is made more effective through online information, but also personal experience of new ways to acquire knowledge can be modelled for learners.
C3. Learning design - How can I be effective in planning and preparation?	Learning design tools may be successful if they readily match the workflow and flexibility of the teacher. Simply storing, re-using and exchanging plans and materials can be made more efficient and enhance quality.
C4. Environment - Where and when will I teach?	The organisation of learning to suit educational institutions is driven by face-to-face convenience and limits. The place and time of learning is made more flexible, but this requires new decisions against new criteria to agree the 'learning contract' between institution, teacher and learner.
C5. Pedagogy - What teaching strategies are effective?	A greater range of learning activities with new tools to support expression and new opportunity for collaboration mean new strategies, outside the experience of many teachers, must be found.
C6. Assessment - How will I assess, monitor and record progress?	There are new opportunities to observe, record, analyse and feedback on learner's work, both individually and collectively.

C7. Reflection - What mechanisms will support my reflective practice?	As with assessment of learners, self-assessment may be driven by a different kind of evidence, more frequently collected and available for analysis.
C8. Collaboration - How can I work with colleagues towards organisational improvement?	Organisational learning can be supported by bringing evidence from all stakeholders to collective reflection. Improvement plans can be shared and discussed more widely.
C9. Development - How will I sustain continuing professional development?	The new forms of continuing professional development through microlearning, personal learning networks, teachmeets present a higher quality and focussed approach to be taken.
D. Institution-centred	
D1. Knowledge - Balancing pure & applied, discipline & vocation	As boundaries between education and work are dissolved, a new relationship between theory and practice and authority of knowledge must be created.
D2. People - Developing the staff	Who sets the agenda for staff development? How are the opportunities for more personalised learning to be aligned with institutional need?
D3. Curriculum - Defining the curriculum	As knowledge expands and becomes increasingly dynamic, how are we to decide what is taught and what is learnt?
D4. Business - sustaining the business	How is the institution to be funded in a world of open and accessible knowledge? What are the new models of the enterprise and financing?
D5. Quality - Maintaining quality & standards	If the curriculum is more personalised and learning negotiated, how is quality to be assured?
D6. Culture - Transforming organisational culture	With staff who have valued traditions and experience, how are new methods and working practices to be adopted and a more dynamic development of these sustained in the light of future change?
D7. Relationships - Relating to government, private & public sectors	As online and work-based / work-focussed learning permit the range of the institution to spread, how are relationships with key stakeholders made and how are the boundaries drawn? What remains at the 'centre'?
D8. Learners - Meeting the needs of new millennium learners	As learners arrive to embark on learning, how are their new practices, attitudes and expectations to be met?

Annex 1 - Educational Theories & ICT

This section is contributed by Maria Fragkaki and translated by Georgios Xydopoulos

The pedagogical use of IT and ICT

The way of use of ICT in the teaching learning process depends heavily on the personal point of view of the educator on teaching and learning applications, from the philosophical context, the scientific theory that supports teaching and the methodology for its implementation. It is argued that the educational, social, political and cultural context in which learning takes place and the teaching process seems to have a stronger influence on it, even stronger than the influence of ever increasing ICT potentials [Politis & Komis, 2001].

Any kind of educational process is based on certain assumptions about what knowledge is important for the learner, why it is better to acquire this knowledge and which best method and the best educational environment to acquire this knowledge. These elements compose the main objectives, the content and the teaching and learning process of educational practice.

Every teacher, explicitly or implicitly, apply in his teaching practice the principles of a learning theory or follows a synthetic teaching model in which selectively uses principles of learning theories. This is the case because the teacher with the knowledge of a scientific theory acquires a common conceptual, linguistic and instrumental basis necessary for the understanding, the communication and the negotiation of ideas [Raptis & Raptis 2006]. Each teaching approach represents and belongs ideologically in general philosophical, epistemological thought patterns.
In the following sections is presented the classification of the educational applications of ICT, based on the theoretical design approach, the learning theories that support the pedagogical use of IT and ICT in the educational process and the philosophical / epistemological approach of each theory.

Categorizing educational applications based on the theoretical approach design
The design of educational applications using ICT (explicitly or implicitly) is based on learning theories, which provide a suitable theoretical framework to formulate the basic standards that govern those theories [Komis & Avouris, 2004]. An attempt is made to categorize the educational software and in general the educational applications of ICT based on their design choices, which "favour" certain type of teaching approaches. A proposal for classification of educational software into three main categories is as follows:

1. Systems driven discovery. These are generally training and practice (drill and practice) systems and guidance or problem solving systems (tutorials).

2. Learning environments through guided discovery and investigation (discovery and exploratory learning); normally open type systems.
3. Environments of expression and information search, communication and collaboration in general-purpose software and Internet applications

The software of the first category is designed based on the principles of the behavioral and sometimes of the cognitive approaches. They are considered by many unsuitable because they limit the thinking of children, emphasizing memorization, providing little opportunity for interaction and limit exploration. On the other hand, they can be exploited by the teacher in relation to the learning objectives that refer to specific skills or in specific cases (e.g. young children, children with special learning needs). Determinant factor of whether software is used effectively is the teacher and the orientation activities that he will use to engage his students.
Unlike the software on the second and third category, that usually are arising from policies adopted by constructive and sociocultural approaches, are considered more educationally appropriate because they "favour" teaching-learning processes that are not linear or predetermined and therefore are referred to as open-systems (open-ended), while they are also enabling the creative expression and interaction of the students.

The Behavioral Theoretical Approach of ICT in education

The behaviorists and psychologists (Pavlov, Watson, Thorndike, Gurthie, Skinner, etc.) support the behavioral pedagogical approach which is based on the epistemological assumptions of positivism and objectivism. The world is a well-organized system, with a clear causal structure, which exists objectively, regardless of the capabilities of perceiving and understanding the ways of man (experienced analysts example). The ultimate goal is to intervene in the learning environment in order to maximize the effectiveness of educational practices [Raptis & Raptisi 2006].

The general philosophical conception of ICT focuses on a mechanistic approach, which considers the student as an "object." The technology, according to this view, but does not support replacing the social dimension of learning. Based on this framework, the technocentric and instrumentalist view of ICT in education and practice has the dominant role [Kostoula-Makraki & Makrakis 2006]. The educational practices separate the technological dimension of pedagogy, focusing on the first.

Learning through the use of ICT, based on the behavioral approach, is achieved when the desired behavior of the students is strengthened while unwanted student behavior is weakened. This strengthening is linked to the concept of feedback. The main stimulus that enhances the learning of a specific reaction follows the desired

response, and this method is called active learning conducive. The content of knowledge is specific and strictly structured with stages of progress leading to the intended learning outcomes. The courses offered are very well organized from specific designers of computer systems and applications, is provided with a strictly orderly manner and evaluated by predefined criteria, based on a grading scale.

In this context, teaching with the use of ICT is teacher centered. Guidance and Teaching systems are used, where through the use of Software Practice and Practice, students carry out activities whose designers have preset the only "right" answer. The computer is used in the behavioural approach simply as a technical tool, as a well-programmed machine, full of knowledge, which is provided to students linearly and sequentially. Learning that takes place through the technology, enhances the desired behaviour through exclamations, applause and cheerful sounds via the software or by deleting it through disapproval or failure to provide prizes.

The teacher, as an "authority" of the knowledge imparts knowledge and encourages students to solve the exercises of "closed" software, monitors their progress, control the amount of knowledge and effectiveness. The students are "empty vessels" that are filled with the knowledge of the teacher or "blank slate" that are written with the "pen" of. Complement the range of software activities, which may contain questions "true-false" assignments, supplements, etc. Any creative, exploratory activity of teaching is absent because he cannot control. The reinforcing of the desired response from the "machine" encourages the students to continue their effort.

Computational Learning Environments based on behavioural theories

Guidance systems and teaching

- Software training & practice (drill & practice)
- Software mentoring or teaching
- Educational Games
- Software multimedia presentation of knowledge
- Experience teaching systems
- Neural Networks

Constructivist and Sociocultural Theoretical Approach of ICT in education

The constructivism of Bruner, Piaget and Vygotsky, may have differences, but they adopt the basic epistemological assumption that the nature of human perceptual, learning and communication process is not objective or transported intact from a transmitter to a receiver because of the relativity of personal experience, interpretation and knowledge (history illustrative examples).

There are no dividing lines

There are no dividing lines between theories. No sealing between teaching approaches. Each teacher takes explicitly or implicitly some philosophical assumptions, but it's an option to exclude it and exploit others. For example, several elements of a behavioral approach can be used in children with disabilities, or an educational theory that supports constructive approaches depending on the educational needs of students.

Based on this framework, teachers and students who utilize ICTs have a more active and interactive role with technology in society and learning. The active role in the creation of knowledge is important, rather than its passive acquisition. The main point of the teaching process is the "understanding" of the meaning of a situation.

These considerations have emerged as alternatives to the traditional individualistic example of cognitive psychology. They emphasize the important role played by the social and the cultural context in the building or the appropriation of knowledge by students, and argue that learning is not solely a function of individual cognition, but a socio-cultural process that takes place through communication and interaction with other people. These approaches are incompatible with the positivist tradition for which the scientific method is the only way to drive someone to the discovery of an objective reality. They argue that the meaning is constructed by learners through their participation in various dialogs [Gee 1999] and practice [Lave & Wenger 1991] involved.

Discovery learning

Discovery learning, as a learning theory was proposed by the American psychologist Bruner in 1966. The basic principle is that learning is facilitated through the 'discovery' of scientific principles and structures of a learning subject. In relation to the pedagogical use of ICT is that the students discover principles or develop skills through Interactive Computer Learning Environments, Experimentation and Practice. Students build practical and symbolic representations (practical, figurative, symbolic) via corresponding software to understand the information, and develop their cognitive abilities. Moreover, the emphasis is on the cultural and social context that affects every cognitive process that involves the use of computers.

Furthermore it must be mentioned that Bruner in 1980 endorsed the principle of the learning process as storytelling (learning as narrative, Bruner 1986) and approached the positions of sociocultural approaches. Bruner believes that whatever is taught in a school, more so if it concerns young students, should be characterized by continuity, coherence and interconnections, is a "story" with an important meaning.

Cognitive & Social Constructionism

The Social constructivism, completing the Cognitive constructivism of Piaget (1969), who argues that cognitive development and the development of mental functions and structures of thinking, progressively evolve through the interaction of children with the natural world on the basis of pre-existing ideas or even the Radical constructivism (Glasersfeld 1990) which has as a basic principle the fact that knowledge is not passively received but actively built by the subject, points out that knowledge is built on a social level through social interaction (Vygotsky 1978). The Vygotsky, proposed a concept that is very important to the educational process, the "zone of proximal development» (zone of proximal development)."An essential feature of learning is that it creates the zone of proximal development, that is, learning awakens a variety of internal developmental processes that can operate only when the child interacts with people in the environment and in cooperation with peers' (Vygotsky, 1993, p 290). Based on this perspective, the interaction of the individual with the social and cultural environment has an important influence on the formation of language, thought, and finally of his personality.
The principles of socio-structural approaches led to the development of computational learning through discovery, investigation and construction of knowledge.

Within the borders of the social edification of knowledge, a more open teaching is promoted - learning process in the use and exploitation of ICTs. This implies another concept for teaching that emphasizes the transmission but not the direction of a society based exploration of meanings in a rich environment. Within this model, the computer becomes a tool of expression and investigation in the hands and control of students. It is important that social edification environments supported by the computer comprises not only knowledge but rather than that are ready to create situations and to provide tools that are motivating students to make maximum use of their own abilities and skills. So if we want ICT to support learning in an effective manner then it should only be used as sources of information, but rather as tools and facilitators of thinking and knowledge building of students.

Theories supporting Collaborative Online Learning Environments

Activity Theory, Situated Learning and Distributed Cognition, which are considered among the sociocultural approaches, support theoretical Online Collaborative

Learning Environments, such as digital learning communities, wikis, blogs (blogs), etc.

According to Activity Theory [Engestrom 1987] to achieve the goals mediated by the tools and influenced by the community to whom the students belong, the work required to be performed by each individual and the rules followed in the sociocultural context. According to the established Learning Theory [Lave and Wenger 1988, 1990], learning is a process evolved by the activities, content and cultural context from which it comes through. In other words, it is associated, dependent and influenced by the environment in which it evolves. According to the Hollan, Hutchins and Kirsh [2000] basic assumption of the Theory of Distributed Knowledge, is that human knowledge or else the cognitive resources can be shared among those participating in society.

The teaching based on these principles is an act of collaboration between teachers and students (collaborative research). Students are seeking information using search systems and Cultural Tools, they are spreading the information or even they are sharing it with their peers from other schools, networks and network services (supported by the computer learning, CSCL) tele-cooperation procedures, using synchronous and asynchronous communication. But there is knowledge in the form of interpretive understanding of the world, which is built especially during the teaching process through activities that create meanings, with the help of a system of inquiry, discovery, through the use of experiential experiences. The experiential knowledge is related to the personal experiences, knowledge, beliefs, interests, and generally the way in which students and teachers interpret and understand the world. The "knowledge is built better, established in laboratories through" cognitive apprenticeship "to solve authentic problems by using educational software, interactive whiteboards and Internet technology. The teaching is the "support frame» (scaffolding), a kind of scaffolding provided by the teacher, using the technology in such a way in order to move students to the next level at a time of growth (zone of proximal development).

The role of the teacher is guiding, mediating and facilitative. Exploits the potential of ICT to plan, organize, process and analyze the data of the matter with his students in an active learning process and teamwork. The aim is to understand the situation under evaluation. The teacher-student communication does not serve the 'transfer' of knowledge through technology by the teacher to the student, but allows the cognitive processing capabilities through the technology itself that provides the analysis and construction of new concepts.

Transformational theoretical approach to ICT in education

Constructivism Critical Reviews – Critical Reflection

The Critical Constructivism and Reflection are two theories on the basis of which the major problems of the individual and society, the socio-political function of knowledge, the cultural tools of learning, the official discourse and institutions of the dominant ideology are explained.

Linking technology and content learning in the real social world is the social aspect of teaching and learning (peer-dialectical example). It is no longer sufficient only to "understand" a situation, but its critical "reformation" (Taylor 1996), based on ethical criteria. The Critical Constructivism extends the historical and social context in which knowledge is constructed through ICTs. This is an effort to create a teaching and learning environment ,which aims beyond self-actualization, to overthrow incumbent situations in education and in society at large [Cummins 2003]. The Critical Reflection as a framework philosophy that supports students and teachers acquire knowledge and ideas, which help in their choices for action and reflection, are starting with the aim of restructuring and reorganization of experience. Great emphasis is given on the moral, political and social dimensions of pedagogical mediation [Gore & Zeicher 1995, Mezirow 1991, Adler 1991].

On the basis of these reviews and theoretical approaches concerning reflective pedagogical use of ICT, the Critical teaching is supported, which within a context of active participation of students, develops through such educational tools, applications and software, collection and processing of data that mobilizes the higher cognitive functions of students.

When the processing and analysis of data occurs within the broader socio-historical, political and cultural context, then we talk about thinker Review Teaching [Lovat & Smith 2003, Gore & Zeichner 1995, Zeichner & Liston 1987]. Open and exploratory software and web applications are utilised and the theory is examined in relation to the practice through relevant activities [Grundy 2003]. Itsbasic element is the ability that allows a person to be aware of "how thinking" and "why they think a certain way," to analyze the motives and evaluate the system and determine the result of the actions of a third neutral evaluator.

The afore-mentioned theories support Emancipatory Learning for a Sustainable Future education. The learning environments utilizing computer systems ICT should address genuine problems that fall within the field of experiential learners [Bigge 1990], who employ themselves and their social context, a meaningful investigation. The learning is performed through teamwork solving methods, linking learning

content to individual and collective experience as well as the broader social issues. By connecting the learning process and the learning content with real-world social treatment it acquires political significance, is an act of socialization and morals and sense when a person meditates and acts [Makrakis 1998, 1998v].
Teachers should be aware of the problems associated with society, to connect them with their educational practice and social action. They should strive to connect learning with society, knowledge with action. The Transformational, mental role (transformative intellectual) [Adorno & Giroux 1985] offers students methods, criteria and tools that will allow them to stand any form of critical knowledge to form opinions, to predict and explain the effects of decisions and their actions. Students have more control of their learning process, so wrought with tools, knowledge and skills, to reflect on over in their own learning and action. Students and teachers are counted as contemplating and active teachers / students / citizens [Kostoula Makraki & Makrakis 2006].

Computer-based Learning Environments and constructive support and criticism

- Expression system, Search & Contact Information
- Internet Applications (chat, forums, video conference)
- Internet tools for collaboration and communication systems (cooperative learning)
- Educational web portals
- Multimedia Systems Application Development and Web
- Systems for expression & creativity
- Symbolic expression Systems
- Communication Systems
- Generic software

Learning Environments and Systems through Invention Inquiry and Construction

- Hypermedia Applications
- Virtual Reality Applications
- Visualizers
- Systems concept mapping
- Simulation Applications
- Modeling Applications
- based computer Workshops
- Microcosm in specific subjects
- Digital encyclopedias and software
- Digital libraries
- Internet search engine

These Computational Learning Environments, more or less, and always with the appropriate teaching practice, can meet the desired aim for the teaching learning process in ICT, such as:

- The environment is desirable to promote students' existing experiences and offer multiple perspectives of the learning situation and assessment tools.

- The environment is desirable to provide new and authentic experiences to students about the process of building knowledge.
- The environment is desirable to support the integration of learning in realistic environments, which are directly related (or similar) with the real world.
- The environment is desirable to encourage the expression of opinions, beliefs, ideas and mental models of the students in the learning process.
- The environment is desirable to promote the consolidation of learning through experience and social interaction.
- The environment is desirable to offer and encourage the use of multiple and simultaneous forms of representation of reality (but intuitive and symbolic or formalistic type).
- The environment is desired to promote the encouraging personal awareness in the construction of knowledge, to promote cognitive and metacognitive reflective procedures.

(training material for the training of teachers B Level Training Support Centres (Issue 2: sectors PE60/70, 2008))

Pedagogical Use of ICT Teaching Approaches

Problem-Need

The International Commission on Education for the 21st Century proposes four pillars of education and knowledge, the person should learn:

- to learn
- to act
- to live and work with others and
- to exist.

The application of these pillars in education for a sustainable future requires collaborative exploratory teaching approaches, which derive from social and constructive reviews theoretical perspectives and their respective authorities (see section 3 a summarizing). The sociocultural theories have influenced and changed the orientation of the position of ICT in the educational process. Analysis modules are no longer exclusively the computer and educational software that came with it and added new analysis modules, such as computer network with the variety of applications available and the many activities that can be supported.

On the basis of modern theoretical and pedagogical approaches developed socio-structural and socio-cultural processes of teaching and learning through the use of ICT. Some of these are listed below.

Supported H / Y Collaborative Teaching & Learning

The socio-structural and socio-cultural approaches to support collaborative exploratory teaching in the classroom, but also the cooperation of different classes or schools for learning, the use and exploitation of ICTs. Striving for collaborative inquiry learning is effective when explore students' knowledge and ensure cooperation and constructive interaction within and session class and student groups. In a collaborative investigative environment students need to be aware that they are responsible not only for their own but also for the learning of other group members. To configure such an environment, students are asked to help each other and support each other while providing mutual feedback for individual and team performance.

Some micro-teaching strategies that can be used by the teacher in his quest to form a collaborative exploratory learning environment are:

- Promote dialogue and provides opportunities for students to talk in class ICT:
- Encourages the formulation of queries on the part of students,
- Spends time in formulating opinions and conclusions pupils and groups
- Promote dialogue and argumentation,
- Encourages the participation of all students and all groups,
- Raises appropriate questions (usually open)
- Do not monopolize the initiative,
- Possess the necessary time.
- It gives paramount importance in empirical-experiential views of pupils.
- It creates bridges between colloquial language and terminology-ICT.
- Actively involve students in activities and groups.
- Promotes authentic exploration in extent permissible.

At the same time, in our time as internet applications and wireless communications are changing the landscape of human interaction and create new areas of cooperation and communication between people. The increasing number of teachers and students friendly internet applications boosts Computers Supported Collaborative Learning (Computer Supported Collaborative Learning-CSCL). Through this practically eliminated distances and time constraints to human communication and collaboration. There is the possibility of creating learning communities that are supported by the potential of ICT (Electronic Learning Communities), many different learning-learning environments based on trust, interaction, collaboration and learning [Earl & Avouris 2003, Avouris, Karagiannidis & Komis 2007].

"The H / PC via functions and applications that promote, other than discipline, supervisory tool, communication tool, and cognitive development tool, can be used in educational practice as an emancipatory tool for managing problematic situations authentic society, providing alternative ways of looking, interpreting and solving them, exploiting the web and hypermedia technology, intra-group and inter-group collaborative framework with the constructive use of technological tools "(Fragkaki 2008:2).

Polymorphic Distance Education Methodology

Distance education (DE) as a methodology and as an educational practice is designed for distance learning (distance learning) using distance learning techniques. Primary Education can be used in cooperation of teachers and students from various schools. But what gives the pedagogical dimension of this method, the cell distance learning is the cognitive and value of teaching content, teaching and learning process, the teaching context in which takes place the means used [Lionarakis & Fragkaki 2010]. Since these data are covered by distance learning encompasses not only the means but also the beginning of a constructive learning and teaching, it is differentiated, called Polymorphic Education and receives under these circumstances, a special value that indicates the quality education operating principles of learning and teaching in a remote environment [Lionarakis 1998].

Computer networks, systems and hypermedia learning systems make up the new environment of Advanced Learning Technologies (PMT). We can distinguish two main forms of distance education that harness the potential of ICTs: Contemporary six years, taking place at the same time and on the face of distance education and asynchronous, as they themselves choose the learner space, time and the rate at which it will participate in a "heuristic self-learning course" [Lionarakis 2001]. Many teachers prefer a combination of teachers of synchronous and asynchronous transmission - Blended Learning - which can be enhanced by the combination of face-to-face teaching with a learning environment Web-Hybrid Learning [Anastasiadis 2006].

Work Plans Method (project method)

The method of work plans (project method) can be used in the context of constructive, of discovery and emancipatory learning. Howard Gardner [1983], studying brain functions, their structure and how they are coordinated and withdrawn, talked about the multiplicity and diversity of human intelligence and different learning styles that correspond to each of these forms. Method Project,

through multilateral, cooperative and flexible curricular activities utilizing educational applications, software and ICT tools, enables a multimodal approach a theme, with the simultaneous use of several brain functions [Fragkaki, Reynolds, Vanbuel, 2009].

Students, through interaction with their peers, with their teacher but also with their environment involved in managing complex projects, are developing their critical thinking and collaborative skills through experiential, collaborative and multi-sensory approach knowledge [Chrisafidis, 1994]. The method of project can follow the steps below [Fragkaki 2010, Matsagouras, 2000]. Of course, the teaching and learning process are not watertight. This is determined according to the educational needs of students and teachers' choices.

Step A: Exploring previous experience and knowledge of student-configuration issue
Students reflect in many ways their interest in a topic. Assess what is known and what children really of interest. The teacher continues to formulate open questions, to lead discussions and activities, to explore experiences, knowledge and interests of children. The issue emerged as the subject of investigation and then the children express and record their knowledge on the subject in many ways (text editor, tables, conceptual maps, paint programs, etc.). Record all the questions that arise and which cause curiosity and urge to answer their children in activities that will take the next step. Below is a working draft / action in order to answer the questions. Inform parents by letter or in a merger and sought their support (when it comes to long-term action plan). In Phase A is intended to raise awareness of the community.

Step B: Find and collect material from sources - sharing activities, assignment of roles
Splitting into researchgroups: Children are form groups which areunder the guidance of the teacher. Each team member takes a role. The children discuss their experiences, share and manage information, share answers. Each group proposed a final plan, with the agreement of all its members that the final design will incorporate the findings of all groups.
And collection of material: Children explore all relevant sources from the internet or other own (libraries, research centers, interviews with experts). Often the need for more information leads children to explore new possible sources. New questions and new interests emerge, leading to new programming activities that were not anticipated.

Step C: Implementation of planned activities - information, feedback-presentation of the themes of the groups
The activities may be free speech, constructions, games, communication with experts, group, interactive, versatile, flexible. The children draw, write, count,

manufacture, store data, dramatize, experiment and utilize the tools of the computer depending on the capabilities and facilities of each program. Particular attention should be given to the use of methods that allow students to think critically and to think on knowledge. In the end, the groups present their preliminary to the other teams; some of them revise and improve. All teams end up with a plan and submit it.

Step D: group and between group presentation and evaluation of the project and the procedures
[Matsagouras, 200]
In group - Intergroup Presentation: The final draft which has reached every group presented the rest.
Review - Submit final project: the project is evaluated and the processes in which they were submitted and a final project, which includes findings of all groups.

Problem solving method

The method of solving problem fits with the theoretical approaches of constructivism and critical reflection. May assist Critical Thinker-critical teaching and support emancipatory Learning for a Sustainable Future. This methodology refers to authentic issues covering a wide range of social and cultural environment. These emerge from the particular interests of students, the needs and problems of everyday life. A proposal to study steps with our students a social or environmental issue problem with the method of collaborative problem solving and the use and exploitation of ICT is as follows:

Step A: Identification and formulation of the issue / problem
The identification and formulation / description of the problem arises when students analyze what they already know and what they identify at the outset of their research. Originally starting out usually by asking students to create a directory in which record their ideas and everything you know about the issue / problem. In one or two sentences expressing / describing what the problem is we are trying to solve or explore. The wording / description of the problem can probably need some revision as research progresses with our students.

Step B: Analysis of the problem
After identifying the issue / problem we go in his analysis. The analysis may include two stages:

- What are the causes of the problem?
  Identified and listed the cause of creating or contributing to this problem. For example, the global problem of air pollution contribute significantly large industries and transportation.
- What impact does it have? Identified and recorded the effects of the issue / problem. For example, the global problem of air pollution, pollution from

industries and cars has resulted in the formation of clouds dangerous to the health of living organisms.

Step C: Analysis / search / evaluation solutions
The next step after the analysis is the search for and evaluation of all possible solutions of the question / problem. To explore the best and most feasible solutions in each case is very important process and it is good to have a leading position in the activities of the students. For example in case of closure movement of vehicles to reduce pollution, there should be restrictions on the movement of private cars or public transportation what are the possible solutions?

Also must occur and evaluate solutions based on criteria such as:

- How feasible is this solution?
- How long are the effects?
- How many and who benefits from it?
- Hierarchy of the proposals.

Step D: Select the most feasible solutions
This stage concerns the development of criteria for the selection of possible / realistic solution (or solutions). And then selecting the appropriate solution (or solutions) according to specific criteria, in the case of environmental education for example based on the principles of sustainability.

Step E: Configuring an Action Plan - Implementation of action
The recording and evaluation of best and most feasible solutions leads us to finalizing an action plan that can be individual or group, or a combination of them, may be associated with the class, school or local community.

Step F: Notification of results / findings of the process and study of the problem
Students make the results / findings of the process and study of the problem. Create a blog, prepare a presentation of their work with their predictions, their findings and the most important of the proposals relating to resolve the problem in accordance with the data and information they have identified, studied, prepared, evaluated. Support their presentation with text, pictures, sounds, recordings and snapshots general any material that documents their work. In essence, this step is a final evaluation of the whole process, as has also stoked character.

An example of software that has been developed by teachers and act based on the method of collaborative problem solving using ICT is the software "Young researchers in action to protect the planet", which was developed under the action Nereids.

WebQuest

A teaching strategy based on the use of the internet has grown in recent years is the webquest. The is to exercises (WebQuests) modules are scripts problems or issues in which a key role is pumping and processing information from the internet and are organized in a web form [WebQuest 2008, Dodge 2001].

The internet is a webquest the average organization of the material of the course while the learning environment, which is the largest part of the exploration information [Dodge 1995, Lymbouridis & Sevastidou 2007]. Eventually, of course, have transformed relevant scenarios directed investigation, which use resources from the web, but also a variety of ICT tools and an authentic task to motivate students to explore open questions, communicate their personal experiences and engage in group activities.

As part of this process, the teaching is organized around a problem / issue, as issues of health education and environmental problems, where the teacher sets the parameters initially and then guide the teaching and learning process to investigate and resolve. The webquest learning as teaching strategy enable teachers to design appropriate learning activities by defining the elements and structure. Also define the activity of students or student groups to focus on the use and exploitation of information rather than simple quest. In this way, a well-designed scenario webquests is desirable to involve students in a research process based on the identification and use of information published on the Internet and focuses primarily on the use, development and review of available information processing and data of any nature and not exclusively on finding and searching techniques.

The description of a scenario webquests includes the following components [WebQuest 2008, LymbouridisSevastidou& 2007]:

Introduction: the central idea of the script with a novel way and the general issue of webquests. Normally made and the key question around which turns the whole scenario webquests.

Work or Mission or Purpose: Describe the role of students in the script and set the job to start. In this manner disclosed students the final product which should produce the complete webquests.

Procedure: The procedure includes step by step all the activities required to implement the students to complete their investigation.

Evaluation: Describe clearly how to assess students based on specific criteria.

Conclusion: This section includes a summary of the learning experience, allows reflection on the process used, are open questions for new investigations.

Instructor page: Addressed to teachers and contains instructions for handling the learning process. Includes topics, advice and guidance for implementation of this scenario, correlation with curriculum and assessment objectives pursued. The page for the teacher may include sub-sections: Introduction,

curriculum-Objectives, Organization learning environment, Resources, Evaluation Reports.

The Lymbouridis and Sevastidou [2007] report that is to exercise can contribute in various ways to achieve goals in primary education, such as collaborative learning, skills training and raising critical information processing, the interdisciplinary, conceptual understanding and application of knowledge, education for the citizen, the epistemological development of competence and of course informatics literacy.

Examples of webquests:
"Why throw it away?" An webquest for scrap for classes D, E and F, Ministry of Education and Culture
"Planning and preparation Historical - Cultural map of Chalkidiki" (author: B. Missailidis)
"The earth is a sphere in space. Groups explorer searches for the sphericity of the Earth "Authors: Irene Spyratou Goumenakis John
"The fresh water on our planet" (authors: Stamoulis Ef., Louvers A., P. Piliouras)
"A webquest for spring. Jobs for students in the first class "(author: Tselepi S.)
Information is published on the Internet and focuses primarily on the use, development and review of available information processing and data of any kind, not only to find and search techniques.

Student research

Another instructive approach is that individual phases of the student survey which finds application in the course of ICT in learning and in particular, the use and exploitation of software related to the organization, classification and data processing. The student survey can take the following five steps:

A. Formulation of the problem and set of questions to explore
B. Data Collection
C. Development Database
D. Data Processing
E. Presentation of research results

A representative example in which the approach adopted in this research is the student teaching scenario entitled "Taller-Faster?" (Author: M. Argyris, involved knowledge areas: Computer Science, Mathematics, Language Classes Q and sixth grade) who Training Material contained in B 'Level, Volume 2: Branches PE60-70, (2008, 2010, pp. 380-395).

Annex 2 Commentary from Teacher Educators

The Learning Theory concept map was presented to a group of UK teacher educators at a TeachMeet organised by the Higher Education Academy on the 16th April. Many of the participants approved of the presentation and its aims, and there were a sequence of positive Twitter responses to the resource - presented here in reverse order:

Lena Pedersen @lenatp4h
#skolechat har du nogensinde haft brug for et godt overblik over læringsteorier, så er her et bud http://ow.ly/kBeS2 af @richardmillwood
Expand
(Have you ever been in need of a good overview of learning theories, so here is one)

flea palmer @fleapalmer24 Apr
Really useful! Concept Map of Learning Theories http://cmapspublic3.ihmc.us/rid=1LGVGJY66-CCD5CZ-12G3/Learning%20Theory.cmap ... by @richardmillwood via @catherinecronin @ProfDcotton

Laura Pasquini @laurapasquini23 Apr
+1 RT @catherinecronin: Impressed with this concept map of learning theories http://bit.ly/13YpofD by @richardmillwood via @oliverquinlan

June Girvin @JuneinHE23 Apr
@ProfDcotton @catherinecronin @richardmillwood Thanks for sharing. Useful.

Debby Cotton @ProfDcotton23 Apr
This is interesting >MT @catherinecronin: Impressed with this concept map of learning theories http://ow.ly/klJai by @richardmillwood

Rebecca Radics @RebeccaRadics23 Apr
RT @catherinecronin Impressed w/ this concept map of learning theories http://ow.ly/klJai by @richardmillwood (via @oliverquinlan)

Catherine Cronin @catherinecronin23 Apr
@oliverquinlan @IaninSheffield @richardmillwood Terrific resource -- individual research project?

Oliver Quinlan @oliverquinlan23 Apr
@IaninSheffield @catherinecronin @richardmillwood really interesting project. :)

STEM PedR @STEMPedR23 Apr
Great stuff! @catherinecronin: Impressed with this concept map of learning theories http://ow.ly/klJai by @richardmillwood #STEMPedR

Ian Guest @IaninSheffield23 Apr
RT @catherinecronin Impressed w/ this concept map of learning theories http://ow.ly/klJai by @richardmillwood (via @oliverquinlan) <Me2

louisedrumm @louisedrumm23 Apr
RT @catherinecronin: Impressed with this concept map of learning theories http://ow.ly/klJai by @richardmillwood (via @oliverquinlan)

Valerie Lopes @valerielopes23 Apr
RT: "@catherinecronin: Impressed with this concept map of learning theories http://ow.ly/klJai by @richardmillwood (via @oliverquinlan)"

Mary Loftus @marloft23 Apr
RT @catherinecronin: Impressed with this concept map of learning theories http://ow.ly/klJai by @richardmillwood (via @oliverquinlan)

Catherine Cronin @catherinecronin23 Apr
Impressed with this concept map of learning theories http://ow.ly/klJai by @richardmillwood (via @oliverquinlan)

Peter Yeomans @ethinking18 Apr
"@richardmillwood has put together a great mind map in progress of the landscape of #learningtheory http://cmapspublic3.ihmc.us/rid=1LGVGJY66-CCD5CZ-12G3/Learning%20Theory.cmap ... @ethinking"

Oliver Quinlan and **Sarah Horrocks** retweeted you
16 Apr:
#heateachmeet work in progress - learning theories http://cmapspublic3.ihmc.us/rid=1LGVGJY66-CCD5CZ-12G3/Learning%20Theory.cmap ...
18 Apr

Val Adam favorited your Tweet
16 Apr:
#heateachmeet work in progress - learning theories http://cmapspublic3.ihmc.us/rid=1LGVGJY66-CCD5CZ-12G3/Learning%20Theory.cmap ...

Oliver Quinlan @oliverquinlan18 Apr
. @richardmillwood has put together a great mind map in progress of the landscape of learning theory http://cmapspublic3.ihmc.us/rid=1LGVGJY66-CCD5CZ-12G3/Learning%20Theory.cmap ... @ethinking

Oliver Quinlan @oliverquinlan18 Apr
@richardmillwood Thanks for sharing this, and great to catch up with you the other night =).

HEA Education @HEAEducation17 Apr
@richardmillwood Thanks for sharing your work so far! #HEATM

Carina Girvan @cgirvan16 Apr
@richardmillwood super interesting - can you tell us more?

Helpfully, Dr Mike Blamires from Canterbury Christchurch University, who came to the TeachMeet, offered this series of Tweets with further ideas, some of which have been accommodated, but which may provide a basis for revision in future:

Pretty good account of Instructionism from the German Johann Friedrich Herbart http://webpages.leeu.edu/bestes/methods-resources/the-white-paper-on-lesson-planning/ ...

From Austria there is Alfred Adler & his concept of encouragement in education http://www.leeds.ac.uk/educol/documents/157654.htm ...

Chinese heritage classrooms still very influenced by CONFUCIUS (K'UNG TZU) (551-479 BC) eg zhong, ti

re Gardner's multiple intelligences see John White's Myth of.. http://eprints.ioe.ac.uk/1263/1/WhiteJ2005HowardGardner1.pdf ...

I would be wary of learning styles see Coffield et al http://www.ttrb3.org.uk/modality-matching-and-other-myths-learning-styles-and-pedagogy-in-post-16-learning/ ...

To add to the list of cultural/social theorists there is the work of Basil Bernstein

Herbert Spencer and his advocacy of learning through meaningful activity rather than rote rules

The Gestalt Psycologists eg Kohler of Germany gave us Cloze procedure & perhaps Developing Tray sw

From an arabic perspective there is Isma'il Al-Qabbani influenced by Dewey- an Arabic Pragmatist ?

from France we have CÉLESTIN FREINET (1896-1966) who pioneered the use of media much copied in ILEA

in a Islamic tradition there is al-Farabi of Turkistan who controversially promoted 'demonstration'

from a Socialist perspective one should not omit the work of Robert Owen. much respected by Karl Marx

from a European perspective one should not omit Juan Amos Comenius 'creator of Pedagogical Science'

Do not forget the Cuban contribution of Jose Marti which predates and predicts Paulo Friere by 100yrs

Do not forget the Russian contribution of Soviet Pedagogy via Anton Semionovich Makarenko

Do not forget the Russian and Finnish contribution of activity Theory eg Leontev & Engestrom

The key instructivist could well be Thorndyke then Skinner : in Scotland Bell and in England Lancaster

References

Adler, S (1991) The reflective practioner and the curriculum of teacher education. Journal of Education for Teaching, 17(2):139-150.

Aronowitz and Giroux (1985) Postmodern Education: Politics,Culture, And Social Criticsm. Minneapolis: University of Minnesota.

Avouris, N et al (2007) In Komis, B. (Ed.) "Collaborative Technology", Prentice Hall, Athens.

Avouris, N, Komis, V (2003) "Modern distance collaboration: issues of communication and interaction", Lionarakis, A. (Eds.). The 2nd National Conference on "Open and Distance Education ', Greek Open University, Patras, March 2003

Anastasiadis, P. (2005). New Technologies and Distance Learning at the service of Lifelong Learning: Towards a New 'Social Agreement' to remedy the consequences of 'Digital Dualism'. In Lionarakis, A. (Eds.). 'Pedagogical and Technological Applications, Proceedings of the 3rd International Conference on Open and Distance Education, Open University Greek Greek Network of Open and Distance Learning, Patra, 11-13 November.

Bergmann, J et al, (2011) "The Flipped Class: Myths Vs. Reality.", Web published http://www.thedailyriff.com/articles/the-flipped-class-conversation-689.php.

Bigge, M (1990) "Θεωρίες μάθησης" Αθήνα: Πατάκης.

Blumenfeld, P et al, (1991) "Motivating Project-Based Learning: Sustaining the Doing, Supporting the Learning", Educational Psychologist, 26(3&4), 369-398, Lawrence Erlbaum

Bransford T.D., Brown A.L. & Cocking R.R., (1999), How People Learn: Brain, Mind, Experience and School, National Academy Press.

Bruner, J (1986). "Actual minds, possible words", Cambridge, Massachusetts: Harvard University Press.

Chan, T et al (2006) "One-to-One Technology-Enhanced Learning: An Opportunity for Global Research Collaboration". Research and Practice in Technology Enhanced Learning 01 (01) (March): 3–29. http://www.cl.ncu.edu.tw/papers/ChanTW/ONE-TO-ONE%20TECHNOLOGY-ENHANCED%20LEARNING.pdf

Chrisafidis, K (1994/2000) "Communicative-Experiential Teaching", Athens: Gutenberg.

Claxton & Lucas (2012) "How to teach vocational education: A theory of vocational pedagogy", Web published http://www.skillsdevelopment.org/pdf/How-to-teach-vocational-pedagogy-summary-leaflet.pdf

Cognition and Technology Group at Vanderbilt (1993). "Designing learning environments that support thinking: The Jasper series as a case study", In T. Duffy, J. Lowyck, & D. Jonassen (Eds.), "Designing environments for constructive learning" (pp 9-36), New York: Springer-Verlag.

Dede, C., ed. (1998). "Learning with Technology", Alexandria, VA: Association for Supervision and Curriculum Development.

Deterding, S et al (2011) "Gamification - using game-design elements in non-gaming contexts", in: Proceedings of the 2011 Annual Conference Extended Abstracts on Human Factors in Computing Systems. ACM, New York, NY, USA, pp. 2425–2428.

Dimitrakopoulos, A (2004) "Ongoing and new trends in the applications of Information Technology and Communications for the teaching of Science", in KEKKI J. (eds) (2004). "New Technologies in Education, Planning and Implementation Issues: Philosophical-Social implications", Athens.

Dodge, B J (1995) "WebQuests: A technique for Internet based learning", Distance Educator, Vol.1, No.2, pp.10-13.

Earl B (2005) "Introduction to Teaching Informatics", Athens: Published by Prentice Hall.

Earl, B. 2004, Introduction to educational applications of Information Technologies and Communications. Athens: New Technologies.

Elliot, J ed. (1993) "Reconstructing Teacher Education": Teacher Development. London: The Falmer Press.

Engestrom Y (1987) "Learning by expanding: An activity theoretical approach to developmental research", Helsinki, Finland: Orienta-Konsultit Oy.

Engestrom Y (2008) "The Future of Activity Theory: A Rough Draft", Keynote lecture presented at the ISCAR Conference in San Diego, Sept. 8-13, 2008

Engeström, Y et al (2003) "The discursive construction of collaborative care" Applied Linguistics, 24, 286-315.

Fragkaki M et al (2009) "A Pedagogical Framework for the Effective Use of Video in Class/ Exemplary Video Based Educational Scenarios.", Deliverable WP6 Pedagogical Framework-Pilot Implementation/D.6.1 Pedagogical Framework, "EduTubePlus -A European Curriculum Related Video Library and Hybrid e-services for the Pedagogical Exploitation of Video in Class", Research Academic Computer Technology Institute.

Fragkaki, M (2008) "Create e-learning community for the pedagogical use of Information and Communication in educational practice: Study of a polymorphic model with emancipatory cognitive interest" Doctoral Thesis. National and Kapodistrian University of Athens.

Fragkaki, M (2010) "ICT integration in Education: A Right to Democracy by way of Emancipator Education", In M. Kalogiannakis, D. Stavrou& P. Michaelidis (Eds.) Proceedings of the 7th International Conference on Hands-on Science. 25-31 July 2010, Rethymno-Crete, pp. 145 – 152 http://www.clab.edc.uoc.gr/HSci201

Fragkaki, M (2008). Create e-learning community for the pedagogical use of Information and Communication in educational practice: Study of a polymorphic model with emancipatory cognitive interest, Doctoral Thesis. National and Kapodistrian University of Athens (in press).

Gee, J P (1999) "An Introduction to Discourse Analysis: Theory and Method", London, Routledge.

Gore & Zeichner, K M (1995) "Connecting action research to genuine teacher development", in J. Smyth, "Critical Discourses on Teacher Development." London: Cassel (203-214).

Grundy, S (1987) "Curriculum: Product or Praxis", Lewes: Falmer.

Hollan, J et al (2000) "Distributed cognition: Toward a new foundation for human-computer interaction research" ACM Transactions on Computer-Human Interaction: 7(2), 174 – 196.

Kapp, K M, (2012) "The Gamification of Learning and Instruction: Game-based Methods and Strategies for Training and Education". John Wiley & Sons.

Komis, V & Avouris, P (2004) "The modern collaboration in distance learning environments" in Anastasiadis P. (Ed.). In Distance Education, University of Crete, Rethymno, October 2004.

Kostoula-Makraki, N & Makrakis, B (2006) "Interculturalism and Education for a Sustainable Future", Publisher: E-Media: Digital Educational Resources Center University of Crete.

Lave, J & Wenger, E (1990, 1991) "Situated Learning: Legitimate Peripheral Participation" Cambridge, UK: Cambridge University Press.

Lave, J (1988) "Cognition in Practice: Mind, Mathematics and Culture in Everyday Life", Cambridge: Cambridge University Press.

Lindner, M, 2007 "What is Microlearning", in Microlearning 2005: Emerging Concepts, Practices and Technologies after e-Learning, M. Lindner and P. Bruck, Editors.

Lionarakis, A (1998) "Polymorphic Education: A pedagogical framework for open and distance learning" In A. Szucs & A. Wagner. (Eds), "Transformation, Innovation and Tradition Roles and Perspectives of Open and Distance Learning", Italy: University of Bologna, Universities in a Digital Era.

Lionarakis, A & Frangakis, M, (2010) "Versatile Model of Critical Electronic learning communities: Types and Components of a Quality Noimatodotimenis distance learning", Issues in Science and Technology Education. Volume 2, Issue 1, Pages 29-52, Prentice Hall.

Looi, C et al, (2010) "Leveraging Mobile Technology for Sustainable Seamless Learning: a Research Agenda". British Journal of Educational Technology 41 (2): 154–169.

Lovat, T J & Smith, D L (2003) "Curriculum: Action Research" (4th Ed.). Sydney: Social Science Press.

Lovat, T J, & Smith, D L (2003) "Curriculum Action on Reflection" (4th ed.). Sydney: Social Science Press.

Lymbouridis C & Sevastidou A (2007) "Information support for the teaching of science in elementary school", Pedagogical Institute of Cyprus, Office of Program Development, Nicosia.

Makrakis V (1998a) "Principles of educational planning and development of open and distance education via the World Wide Web (www)", in Tsamasfyros, G. (Ed.), tele: The current situation in Greece. Proceedings of scientific conference NTUA (54-64).

Makrakis V (1998v) "Debunking the methodological monism", in Papageorgiou, G. (Eds.), Methods in Sociological Research. Athens Tipothito.
Matsagouras H (2000) "Teaching Strategies. From Information to Critical Thinking", Volume II. Athens: Gutenmerg.
Mezirow, J (1991) "Transformative Dimensions of Adult Learning" San Francisco, CA: Jossey- Bass.
Millwood, R, (2008) "An Analysis of Delight", Web published, http://blog.richardmillwood.net/2008/05/15/an-analysis-of-delight/.
Millwood, R, (2009) "The learner at the centre", Web published, http://blog.richardmillwood.net/2009/01/16/teachmeet-09-the-learner-at-the-centre/.
Millwood, R (2012a) "Expressive Constructivism", Web published http://phd.richardmillwood.net/en/theoretical-and-conceptual-framework/expressive-constructivism
Millwood, R (2012b) "How does technology enhance learning", Web published, http://blog.richardmillwood.net/2012/06/30/how-does-technology-enhance-learning/.
Millwood, R (2013a) "Learning Theory - What are the established learning theories?", Web published, http://cmapspublic3.ihmc.us/rid=1LNV3H2J9-HWSVMQ-13LH/Learning%20Theory.cmap
Millwood, R (2013b) "Action Research poster", Web published, http://phd.richardmillwood.net/en/portfolio/media/ActionResearchposter.pdf
Millwood, R (2013c) "Teacher - how can technology help me?", Web published http://localhost:8700/phd/en/portfolio/media/Teacher%20-%20how%20can%20technology%20help%20me-%20-%20poster.pdf
Millwood, R (2013d) "How does technology help the organisation?", Web published http://localhost:8700/phd/en/portfolio/media/How%20does%20technology%20help%20the%20organisation-%20-%20poster.pdf
Muntean, C, (2012) "Raising engagement in e-learning through gamification" Web published http://www.icvl.eu/2011/disc/icvl/documente/pdf/met/ICVL_ModelsAndMethodologies_paper42.pdf
Murphy, C (2003) Literature Review in Primary Science and ICT (Report 5), NestaFuturelab Series.
Osborne, J & Hennessy S (2003) "Literature Review in Science Education and the Role of ICT: Promise, Problems and Future Directions (Report 6)", Nesta Futurelab Series.
Piaget, J (1969) "The Mechanisms of Perception" London: Routledge & Kegan Paul
Politis, P & Komis, V (2001) "Study the correlation of the learning type of service in use hypermedia learning environment", In Makrakis B. (Ed.), New Technologies in Education and Distance Learning, Proceedings of National Conference with International Participation PTDE Pan / miouKritis, Rethymnon. Athens: Path (535-548).

Raptis, A & Raptis, A (2006), "Learning and Teaching in the Information Age: Total Approach", Vol. A & B Athens.

Strayer, J (2007) "The Effects of the Classroom Flip on the Learning Environment: a Comparison of Learning Activity in a Traditional Classroom and a Flip Classroom That Used an Intelligent Tutoring System", Thesis, Ohio State University. http://etd.ohiolink.edu/view.cgi/Strayer%20Jeremy.pdf?osu1189523914

Taylor, A (1996) "Education for democracy. Assimilation or emancipation for aboriginal Australians", Comparative Education Review, 40(4): 426.

Tissot, P et al (2011) "Glossary- Quality in Education and Training", 23. CEDEFOP- The European Centre for the Development of Vocational Training, Luxembourg: Publications Office of the European Union. http://www.cedefop.europa.eu/EN/Files/4106_en.pdf

Vosniadou, S (2001) How Children Learn, Educational Practices Series, The International Academy of Education (IAE) and the International Bureau of Education (UNESCO).

Vosniadou, S (2002) "ICT in Education: Prospects, Problems and Proposals", in Dimitrakopoulou (Ed.) "Technologies of Information and Communication Technologies in Education", University of the Aegean, Proceedings of the 3rd Hellenic Conference with International Participation, Rhodes 26-29 September 2002, Volume I (49-54).

Vygotsky, L S (1993) "Σκέψη και Γλώσσα" (μτφρ. Α. Ροδή), Εκδόσεις Γνώση, Αθήνα.

Vygotsky, L S (1978) "Mind and Society: the Development of Higher Psychological Processes", Harvard University Press, Cambridge. MA

WebQuest (2008) "The WebQuest page", Educational Technology, Department at San Diego State University, http://webquest.sdsu.edu/index-2007a.html (τελευταία πρόσβαση 9-2-09).

Weibell, C J (2011) "Principles of learning: A conceptual framework for domain-specific theories of learning". Retrieved April 30, 2013 from [http://principlesoflearning.wordpress.com].

Wheeler, S, (2013) "Learning Futures: Emerging technologies, pedagogies, and contexts", invited speech given to the Technology in Higher Education Conference, National Convention Centre, Doha, Qatar. 16 April, 2013.

Zeichner, K.M. & Liston, D. P. (1987) "Teaching student teachers to reflect", Harvard Educational Review. 56(1), 23-48