smart VET

Interactive Whiteboards in Vocational Education and Training

Learning Manual on Interactive Whiteboards for VET Teachers

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The Learning Manual comes from the experience in the EU Project Smarteach and relies on the contributions from the group of KWETB teachers (IWBs Champions), who have been involved in SmartVET from the beginning.
This Manual as well as all the other documents of the SmartVET Project are available for download in digital format in the SmartVET online community at: http://etuitionnetwork.ning.com

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> FIT - Fast Track into Information Technology Limited - Ireland

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Introduction

The Interactive Whiteboard (IWB) is a device that, unlike other technological devices, was designed specifically *for* the school and *with* the school.

It is the size of a traditional blackboard on whose surface we can write, manage images and video clips and consult web resources. A projector projects the computer desktop onto the board's surface where users control the computer using a pen, a finger, a stylus, or other device (Wikipedia 06/2013).

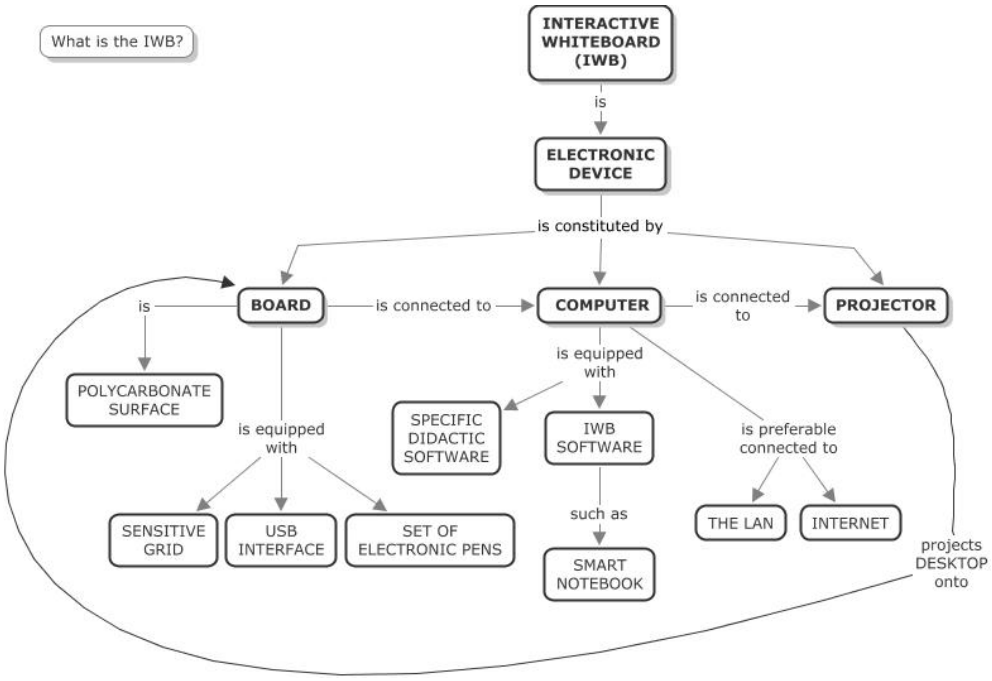


Figure 1. IWB structure.

Talking about interactive whiteboards means facing a complicated issue, since we are not in the presence of an already structured and shared knowledge but in an area of research and innovation that arouses much interest, but at the same time criticism and doubts.

In this manual we will therefore provide a guide that is derived from the experiences of teachers who work with the IWBs; we will see the advantages and innovative features, but will not ignore the limitations of this device.

Our assumption is that the IWB (and the technology in general), as new and innovative as it is, **cannot itself change the didactics**, but that **it may be an opportunity to rethink the teaching and so to innovate the didactics**.

This means considering not only the IWB as a product, but in association with **processes**, where the focus is on what the IWB represents - for teachers, students and for didactics.

Therefore we do not intend to present technical characteristics of IWBs with the idea of teaching how to use this new hardware/software, but to reflect on what happens between the actors in the learning process; what results can be achieved through intentionally designed educational activities and how using the IWB can transform cognitive and emotional spaces.

USING THE IWB: ADVANTAGES

Students are very interested in using IWBs, as is normal with new things. Research shows that IWBs have a direct effect on learner involvement in lessons. Their use often results in improved presentation of content based on the use of images and movies that can attract attention and have a positive influence on learners.

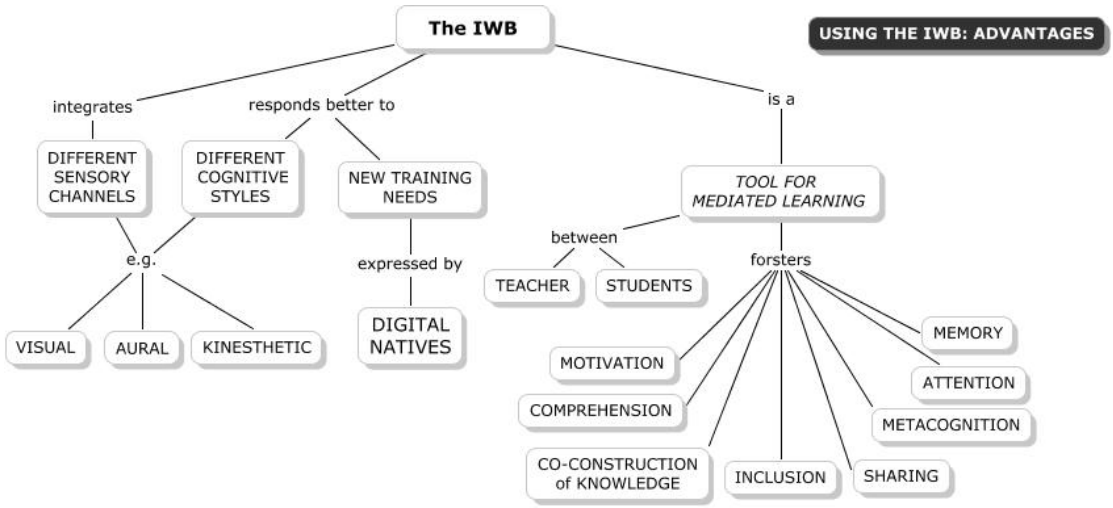


Figure 2. Advantages of using IWBs.

As we shall see, according to the literature, the use of the interactive whiteboard has advantages that can be expressed on several levels:

- immediate impact on students: increased motivation and understanding of learning content;
- immediate impact on teachers' work: saving lessons and reusing teacher materials;
- medium and long-term impact: development of intelligences and skills, but also reflection on the process of learning/teaching.

> EFFECTS ON STUDENTS

In summary, the IWB:

- **INCREASES MOTIVATION AND PARTICIPATION**
  - Makes lectures more engaging
  - Attracts the attention and makes the content more interesting
  - Promotes interaction
    - with contents
    - with the teachers
    - within the whole class
- **SUITS A RANGE OF DIFFERENT COGNITIVE AND LEARNING STYLES**:
  - Integrates different languages (oral and written, iconic, multimedia, etc.)
  - Allows the manipulation of learning objects and the activation of all sensory channels
  - Allows and encourages multiple types of/ approaches to learning
  - Overcomes the digital divide
- **PROMOTES COLLABORATIVE AND COOPERATIVE LEARNING**

List 1. Using IWBs: benefits for learners.

1. INCREASING MOTIVATION

Teachers note that students are caught by the potential, or 'magic' of the whiteboard, and interest in what happens on the display is high (Wall, Higgins and Smith, 2005; Slay, Sieborger and Hodgkinson-Williams, 2008). In this way, the lesson becomes more engaging and fun (Beeland, 2002; Levy, 2002).

Students tend to be motivated to get directly involved in the lesson, intervene during the explanation, pose more questions and provide a greater number of responses to questions posed by teachers. They spontaneously go to the board to solve problems and they often ask to be the "teachers" themselves (Slay et al., 2008).

They feel happy if they can present their work to classmates (Wall at al., 2005), they wish to demonstrate and display their knowledge and attitudes. For most of them, to go to the digital board is like a game and they complain (Wall et al., 2005) if they cannot go each time they wish, because of time constraints; they believe this prohibition will limit their ability to speak and understand the contents of the lesson. Not surprisingly, teachers often use this argument as "reward" for deserving students, allowing them to go to use the IWB.

From this point of view, many studies have concluded that **the positive effects are directly related to the possibility for students to use the interactive whiteboard autonomously (or in a group)** without the mediation of the teacher.

Access to multimedia resources, as well as the possibility of searching on the Internet and using the IWB software gives students more tools for taking an active part in lessons.

2. ENHANCING LEARNING

In fact, the interactive whiteboard introduces the benefits of **visual and multimedia learning** in the classroom: figures, animations, images and written text more easily draw attention to the content and facilitate the comprehension of what the teacher is saying and explaining. This is particularly true for students with visual and verbal cognitive styles[1] (Wall, Higgins and Smith, 2005) and for students who have language difficulties, either because they are being taught in a language that is not their first language or because they are dyslexic.

Furthermore, the digital board tends to favour greater student involvement and interaction between teacher and students and among students themselves, thus responding positively to the need expressed by learners who have a verbal style[2], who can express and share ideas with other classmates and then discuss and interact with teachers regarding what was presented on the whiteboard.

According to the research, learners perceive and welcome the IWB as a tool that introduces and facilitates their learning process, commenting that the visual nature of the board promotes, through different ways of presenting and processing information, greater concentration and attention. The IWB enables students to "see" and "understand" the content better when it is presented in a visual way and accompanied by the explanations of the teacher: "*You can see what's happening while you're thinking*" (Higgins, S., Clark, J., Falzon, C., Hall, I., Moseley, D., Smith, F. et al., 2005).

Using the IWB, the skills of synthesis (visual representation) and analytical and narrative description (verbalization) dynamically interweave. This aspect facilitates the achievement of higher levels of learning and representation of abstractions (Cornoldi, Mammarella, Pazzaglia, 2004).

[1] See Annex 1.
[2] Idem.

Furthermore, the use of touch-screen models, on which one can work directly with the hands, also allows kinaesthetic approaches: moving what appears on the screen; writing with the fingers; painting with digital markers or different types and sizes of brushes for drawing. Writing with the fingers enables students to "perceive" the shapes of words. This is particularly useful for children; for learners with learning difficulties and for those who are learning a new language. When they write, they "feel" (tactile point of view) the letters they are creating. Consequently they associate words with sounds more easily (Solvi, 2004).

3. MEET THE NEEDS OF DIGITAL NATIVES

Interactive whiteboards respond to new educational needs expressed by the so-called 'digital natives'.

The use of technology has changed the social and cognitive behaviour of the younger generations. Today's students are considered "natural speakers" of the digital language of computers, video games and the Internet (Prensky, 2001The digital technologies are part of their "natural" or native language and have changed their ways of thinking, of representing and knowing the world, their cognitive habits and their ways of learning (see annex 2).

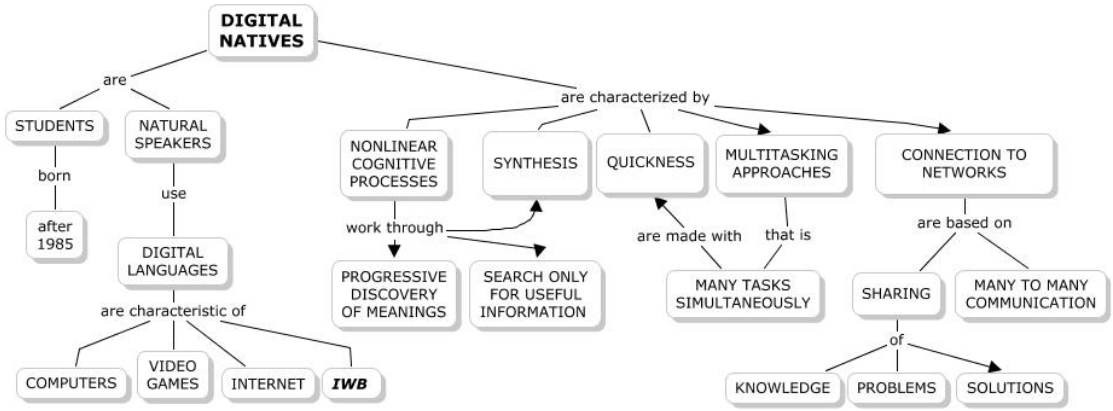


Figure 3. Characteristics of 'Digital Natives'.

"*Digital Natives are used to receiving information really fast. They like to parallel process and multi-task. They prefer their graphics before their text rather than the opposite. They prefer random access (like hypertext). They function best when networked. They thrive on instant gratification and frequent rewards. They prefer games to "serious" work. (Does any of this sound familiar?)*" (Prensky, 2001).

The Interactive Whiteboard introduces digital technologies in VET schools (in classrooms, not in the computer labs) and helps teachers to get in contact with these learners, in order to enhance their skills but also to 'correct' them, if necessary, and to offer different cognitive strategies, whereas those typical of digital natives are not effective.

More generally, if the aim is to give students the capacity to know the world and act on it, transform it and provide them with the competences necessary to designing their own life, it requires a learning process centred on meaningful learning, on several languages, on social, emotional and interpersonal communication, in a context that is becoming relational and cooperative, supportive and participative.

The IWB is a tool that is well suited to these objectives, because it helps teachers to take into account the diversity of their students and to enable everyone to make the most of their potential.

4. EXPLOITING THE INDIVIDUAL LEARNING DIFFERENCES

Teachers have to deal with very heterogeneous learners: groups of very different ages (from young "digital natives" to adults), learners from different backgrounds, students with special educational needs or disabilities, with cognitive and personal characteristics that are very different. Faced with this situation, education has responded by offering educational and training programs based on individualisation and personalisation, but they are often not put into practice. The use of IWBs renews and re-contextualises the possibilities of individualisation and personalisation of learning through the use of technology.

Many studies have demonstrated the close relationship between technologies (digital and otherwise) and the different forms of intelligence or learning styles (Gardner, 1983). According to McKenzie (McKenzie, 2006), technologies (and particularly digital technologies) may become useful tools for stimulating different forms of intelligence and responding to the demands of a changing society (Morin, 2000; Frabboni, 2008). From this point of view, the IWB is proving very useful. Through the simultaneous use of many sensory channels (visual, verbal/auditory, kinaesthetic) it allows teachers to improve their response to the different cognitive styles and intelligences. Above all, if well used, it fosters student reflection on their cognitive and learning styles and on those of their classmates.

Using the IWB with an interactive and collaborative approach, students can bring, share and negotiate different knowledge, prospects, experience and perspectives with others, and can also bring their own personal way of interpreting the reality surrounding them and their own cognitive styles to the classroom.

In this way, individual differences, traditionally considered critical for teaching, become resources, opportunities for metacognitive, peer-to-peer and mutual learning, because they express different points of view in the acquisition and processing of information.

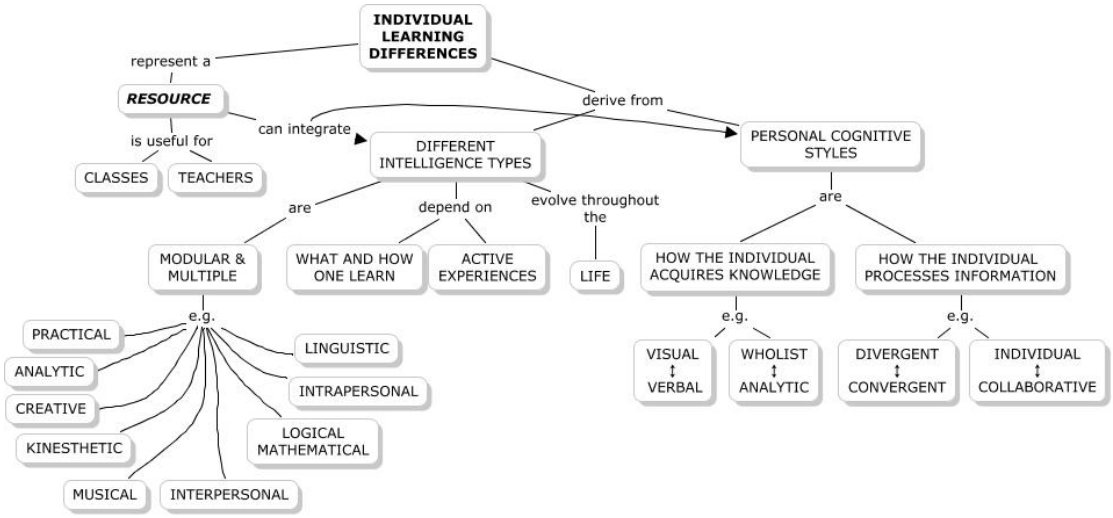


Figure 4. Multiple Intelligences & Cognitive Styles.

Nevertheless, the IWB is not a magic device through which one learns by simply watching. It is most useful when used as much as possible for integrating the use of different sensory channels and different teaching methods.

5. MEETING SPECIAL EDUCATIONAL NEEDS

The recognition and appreciation of learner differences also includes Special Educational Needs (SEN), due to disabilities, disorders and learning disabilities, or to temporary difficulties caused by a subject's state of health or economic, social and cultural background (WHO, 2001).

There is a growing body of evidence suggesting that IWBs have benefits for teaching students with learning difficulties (Somekh et al., 2005), especially those with motor skill difficulties who may find it difficult to use more 'traditional' technologies (Goodison 2002; Bell 2002).

Using the IWB, teachers can use any kind of multimedia resources and plan educational activities based on them, choosing the most effective ones depending on the needs of students.

They can easily adapt, deconstruct and simplify the learning material presented to the entire class, replacing and modifying the language or communication channels through which the material is taught. In addition, teachers can use software or specific activities designed for students with specific learning disabilities (SLD) or other disabilities to include the whole class.

Finally, both teachers and students can break down the materials, move, zoom, copy, capture, hide, and then resume items. In one word, they can "manipulate" learning objects in a single platform.

6. SUPPORTING ADULT LEARNERS

If younger students' classes are heterogeneous, in adult education the degree of heterogeneity widens dramatically, because age, educational qualifications and previous experience come into play. Furthermore, a number of years may have elapsed since they participated in an education environment, which would have enhanced their self-esteem.

Motivation is even more important for young people, and it concerns both *intrinsic motivation* and *extrinsic motivation*. *Intrinsic motivation* is related to the perception that the subjects have of themselves and their own value. *Extrinsic motivation* relates to external factors which may have an impact on the decision to return to education, such as awareness that the social environment and the labour market require skills that they do not possess. Moreover, in adults there is an urgent need to acquire "immediately usable skills". Training therefore has value only if it is personalised and considered relevant.

As we have seen, the IWB provides the teacher with the possibility to personalise and adapt lessons to the learners' emerging needs. Its use also allows teachers to apply those non-formal and informal ways of learning that usually characterise the experience of adults, such as learning derived from 'managing' one's own life, on the job training, learning opportunities commonly offered in a community-based setting, etc. (Merriam, Caffarella & Baumgartner, 2007; Knowles, Holton & Swanson, 2005).

At the same time, the IWB allows learners to overcome the **digital divide**: it offers all of those students (adults or young people) who may not use these technologies and who do not have the skill to handle the tools of the digital and electronic world, the opportunity to use the Web, run a search on the Internet and to take advantage of opportunities that the online world makes available to them.

> EFFECTS ON TEACHERS' WORK

The use of IWBs also significantly impact on the motivation of teachers. The main motivation comes from the chance to use a vast amount of digital material that is available both on the Internet and in educational software, and from the ability to produce their own digital content (text, audio, images, video) to use in class.

THE IWB ALLOWS TEACHERS TO

- Prepare materials at home to reinforce the explanation and to facilitate understanding
- Review, modify or structure the lessons depending on learners' emerging needs
- Personalise content for different classes and students
- Create libraries of multimedia, hypertext and interactive resources, which are easily retrievable and immediately usable by students, and used for revision throughout the school year.
- Reuse, assemble and reassemble materials
- Record and document the learning activities, to review them with students and so consolidate learning (metacognitive function) and also reflect on teaching practice
- Easily create interactive exercises and tests of on-going evaluation, used in class and reusable over time
- Focus on content and pay more attention to student feedback and lesson pace
- Reflect on their teaching.

List 2. Using IWBs: benefits for teachers.

Many studies (Kennewell, 2004, Hodge and Anderson, 2007; Schuck and Kearney, 2007, Cutrim Schmid, 2008) emphasise the benefits of rigorous design of teaching materials, which may initially require considerable time expenditure but which then may be modified, reused and exchanged with colleagues, creating more rewarding lessons for students and for the teachers themselves.

CRITICAL ISSUES

The IWBs are electronic devices that do not require very substantial effort to be used properly. Many of their features are intuitive, are very easy to learn and only the management software requires a greater commitment. IWBs are also containers and channels for many technologies offered by the digital world and the World Wide Web.

In this sense IWBs are affected by all of the problems concerning the use of new technologies in schools and classrooms. These problems are usually related to technical skills such as knowing how to use the tools, software and electronic communication channels (forums, blogs, wikis, social networks, virtual worlds, etc.) for teaching.

In fact, much of the criticism of IWBs refers to **'technical' difficulties** such as the need to recalibrate the Interactive Board, interruptions due to problems with the software or the Internet, poor visibility and the consequent waste of time which annoys students and slows down the pace of the lesson.

Research has shown that IWBs attract more attention and involve the students more, who ask more questions, participate enthusiastically in the lessons, but **they promote fewer *deep* questions**. Questions and answers tend to stay at a more superficial level, and their quality is less satisfying, with many short-term responses, which do not exhibit a structured and articulated explanation of thought.

Multimedia materials, the increased participation and the exchange of quick questions and answers also affect the **pace of the lesson**, with fewer pauses, more questions and more answers, more interventions and more stimuli in general.

All this, however, on one hand encourages involvement and motivation; on the other hand, it may hinder the ability to make connections between different questions and different topics presented in the lesson.

The fast pace of the lesson, too much material and information, too many simultaneous stimuli may prevent students from paying attention to important content and so generate **cognitive overload**. Cognitive overload refers to an excessive amount of labour demand for short-term memory (or working memory), which makes it difficult if not impossible to select and retain information.

This applies especially to new generations of students (the 'digital natives'), who are used to dealing with many things at once, to receiving information simultaneously from many different channels and therefore have difficulty in selecting relevant information.

There is a risk of reducing students' ability to store and reprocess information leading to the **superficial acquisition of knowledge**, which is mainly *functionalistic*.

The above problems affect all new technologies, because of the large amount of information they make available, so **rigorous instructional design is very important**. The use of digital and interactive materials requires a significant commitment and deep reflection on the objectives and strategies to be used by teachers during the lesson.

This task is difficult but extremely useful for teachers who are motivated to use IWBs, which will create opportunities for further study and comparison of their "modus operandi", even more than is possible with the traditional tools and strategies of teaching.

IWB AS A MINDTOOL

Introducing an interactive whiteboard in the classroom allows teachers to "open up" the class to the digital world, reversing the direction of technology. Students no longer go to "computer time" in the computer lab. Instead multimedia comes into the classroom and becomes image, video, web, interactive resources which provided significant stimulation.

This means we must first consider the IWB as 'an assembly table of knowledge' (G.Biondi, 2007), or as a '**mind tool**' (Jonassen, 2006) for extending students' cognition, supporting knowledge construction and including non-linear learning in order to promote the development of higher-order skills and flexible and creative thinking.

The interactive whiteboard is a resource that can enhance the other resources involved in the learning process.

Thanks to the IWB the classroom changes to become a learning and training environment, which allows participants to connect with different media - particularly the Internet, social networking, sites for podcasting, for example. More importantly, the use of technology in the classroom can generate new interactions with different forms of knowledge, content and ways in which to build knowledge.

This "multimedia learning environment" can also draw on the resources of the virtual environment (using virtual classrooms and the social networks of Web 2.0: wikis, blogs, video lessons, video conferences, forums, etc.). This is the concept of the 'extended classroom' in which the digital environment becomes part of the classroom, extends its functionality and features, and also potentially creates a so-called 'flipped classroom'.

The teacher can then create features that allow flexible use of resources and the use of the content at different times, which allows them to work with students individually or in small groups with other students, to provide greater or even store and distribute materials,

lessons and work done in class to students (using e-mail, communities of practice, social networks, etc.).

The IWB is therefore a potential catalyst for the use of resources and processes that are activated in the context of learning, but which also provides an opportunity to reflect on evolving teaching practices and pedagogical perspectives that are emerging as a result of the development of the knowledge society.

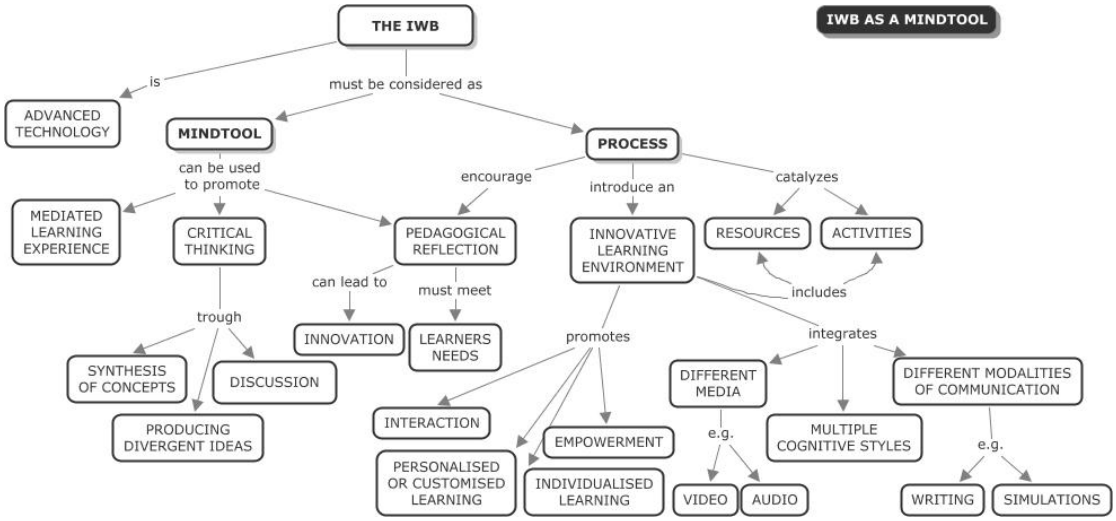


Figure 5. IWB as mind tool.

How to Use the IWB: Teaching Approaches

The interactive whiteboard is a 'flexible tool' that can be used with different teaching strategies, which can be summarized as follows:

Approach about IWB	Description	Pedagogical Methodology
EXPOSITION	The IWB is used to 'project' the contents	TEACHER-CENTRED (LECTURE)
ENHANCING EXPOSITION	The IWB is used to explain the content using multimedia resources.	TEACHER-CENTRED (MULTIMEDIA LESSON)
INTERACTION	The students go to the IWB to carry out exercises, activities.	LEARNER-CENTRED (INTERACTIVE LESSON)
ENHANCING INTERACTION	The students interact with the IWB, the content, the teacher and each other.	TEAM-CENTRED (COLLABORATIVE LESSON)

Table 1: Pedagogical Approaches to IWB Use.

These approaches generally correspond to the stages through which teachers develop their expertise in the use of the interactive whiteboard and at the same time, they coincide with the implementation of instructional strategies increasingly focused on the students (Miller & Glover, 2007).

EXPOSITION – TEACHER-CENTRED USE

Teachers primarily use the IWB to 'show' what they are saying. The whiteboard is perceived as a tool for presentation, as a slide projector. In fact it is used in the same manner as a conventional blackboard.

This approach is teacher-centred and it generally characterises the initial stages of use of the interactive whiteboard. The digital board is mainly used to show documents prepared in advance (word documents, PowerPoint or slides with IWB software) and / or for writing and producing diagrams by hand as a result of interactions with the class during the lesson.

Generally, the teacher uses the whiteboard tools in limited ways; he/she works alone and does not share resources with others.

This approach is risky for teachers, because the efforts required to use the IWB in this way are likely to be much higher than the perceived potential benefits. Yet it is often a required step for teachers to become familiar with the features of the IWB.

ENHANCING EXPOSITION

With this approach, the IWB is used mainly by the teacher to 'illustrate' and explain the content of the lesson through multimedia resources (web pages, audio clips, video, simulations, etc.) that attract the students' attention, facilitate the explanation of processes, the description of situations and environments and the analysis of texts. In brief the IWB is used to explain what the teacher is talking about.

In this case the digital board is still perceived as a tool for presentation. The multimedia and interactivity serve only to clarify or deepen the concepts, while the students' role remains passive. Typically, it represents the second stage in the use of the IWB.

Teachers can project multimedia materials on the digital board, drawing on them with the special digital pens or for drawing objects and saving the presentation at the end of the lesson on a computer. They can take snapshots of the screen, for example stopping a movie to capture a frame, opening it in image processing software and analysing the image to comment on the content. Alternatively, they can use fragments of video or animation to enhance the activity of explanation and support understanding of the concepts, instead of using simple diagram, they can zoom in on high-resolution images for the analysis of specific details; and use interaction with laboratory simulations directly on the screen.

With this approach, the use of multimedia resources has the advantage of drawing the attention of learners and serves to motivate and engage students, However, this curiosity and initial interest, in other words, the 'wow effect' (Beauchamp & Parkinson, 2005) is likely to be transient.

INTERACTION

A more mature approach to technology emerges in the development of interactive lessons.

With this approach the IWB becomes a tool for bringing the issues of learning through multiple modalities and multiple languages (verbal, visual, kinaesthetic, etc.) but also through simple interactions or exercises that involve students in activities on the interactive board, including exercises such as sorting, grouping processing of forms and shapes and using the hide and reveal function.

With the availability of educational software, simulations and interactive activities, students can be involved in the exploration of virtual environments, experience the scientific method, and operate technological fields. The teacher can use the digital board for revision activities and questions by projecting interactive quizzes or images and movies that can be commented on by students and, for example, using blank maps, artworks, chemical reactions and mathematical formulas.

These activities allow students to manipulate the concepts presented by the teacher, using the material learned in new and concrete situations applying and reflecting on rules, methods, laws and principles.

ENHANCING INTERACTION

Finally, "enhancing interaction" is the more advanced approach.

The screen of the interactive whiteboard is not used only to show or manipulate, but to communicate. The contents provide stimuli for discussion, for the wording of hypotheses and for the resolution of problems.

The teacher adopts different methods, varying the classical dynamics of teacher-centred lectures with small group activities and encouraging communication between peers and cooperative learning, through presentation of the work on the interactive whiteboard,.

The IWB is particularly suited to the presentation of papers, since it allows the display of photos, tables and movies made by students working all of the controls directly from the whiteboard.

The management software supplied with the interactive whiteboard generally allows the export of files into a format compatible with the web, a function that can be used, for example, to publish the works in the school's virtual learning environment or website, sharing knowledge produced with the whole class and with other classes.

If the computer with the IWB is connected to the Internet, it is possible to surf the web with a common browser, performing searches on the web that involve the entire class, highlighting objects of interest, saving snapshots of the video, and storing and using them later for a summary or report.

FROM THE LECTURE TO COOPERATIVE LEARNING

We believe that all of the approaches listed above are legitimate, because the choice of teaching strategy must consider several aspects including learning objectives, content, characteristics of learners, environmental and time constraints, not forgetting the teachers' implicit theories of learning.

These implicit theories may affect the educational activities, as well as the perception of their effectiveness (Albanese & Fiorilli, 2006), and have an impact on the choice of approach to be taken with a relatively new technology such as the IWB.

It is no coincidence that several studies (Smith H.J. & ass., 2005; Smith, Hardman, Higgins, 2006; Wood & Ashfield, 2008) show that the IWB is often understood as a tool for expository teaching methods, addressing the whole class and in particular it is used with a strategy defined as 'recitation script' (Tharpe and Gallimore, 1988), based on the three classic phases of the initial stimulus from the teacher through a closed-ended question (or open, less frequently), a response from the student and subsequent feedback from the teacher.

However, we believe that using the IWB only to lecture is limited and it risks the IWB being underutilised and essentially, a wasted resource. When we begin to use an interactive whiteboard, we should first ask ourselves what new opportunities can be introduced in teaching and in classroom life and how they can be used to improve learning and development for all students. As we have seen, its characteristics adapt well to a flexible teaching approach and particularly to **an interactive and collaborative learning environment**.

Cooperative learning is recognised as a teaching approach that fosters deep and meaningful learning (Blythe, 1998). In co-operative learning models, teachers establish small heterogeneous groups through which students work together to maximize their learning level and that of other group members.

Specifically, using the IWB with a cooperative approach can enhance students as responsible agents of their own learning; while at the same time enhancing the intrinsic potential of the IWB. In addition, small groups of students who work together, helping each other to

experience developing skills and to achieve more advanced educational goals, such as those indicated by the European framework of key competencies.

From this perspective, we think that the interactive whiteboard complements interactive and collaborative teaching approaches. The teacher uses the IWB as an initial stimulus for the activities to be conducted in class or small groups; then the students use the IWB to present and share their work with the rest of the class.

The IWB can be used at different stages of work and can become a showcase for the whole class to gather, share and analyse the initial proposals, the development of those proposals, the final synthesis, the construction of maps, the presentation of tasks and the work done. The IWB also provides a space in which to discuss how students and groups have achieved their results, as they realised the learning activity, and for debriefing them about whether they have achieved their objectives and whether the relationships within the group have been effective and useful.

These discussion and review activities are particularly useful because they allow students to analyse how they work and how their classmates work, activating the metacognitive learning to learn and leading to continuous improvement of learning processes.

In fact, a small number of adaptations are sufficient to make even an expository lecture more flexible; for example, by inserting more interactive and cooperative elements. Through the IWB the correction of homework can become an opportunity for students to reflect upon their ways of learning and studying and also to learn from their mistakes.

In particular the transition from a 'multimedia' lesson to an 'interactive' is very short: teachers, for example, can use a simulation and show what happens if they change some variables, or they can ask learners to use the simulation to make them think about what's going on and then 'manipulate' ideas and concepts.

The teacher could create simple activities on the IWB by presenting stimuli and asking students to reflect on them, as in the following examples:

TEACHER SHOWS ON THE SCREEN	TEACHER ASKS LEARNERS:	MENTAL OPERATIONS ENABLED
Two images or figures	Watch these two figures carefully and compare them	Compare these two figures and define the same or different characteristics
A short video (stopping it before the end), an image, a painting	What do you think will happen when ...	Make inferences, and make assumptions
A short video, the description of a problem to be solved	Analyse this problem: what are its characteristics?	Problem solving, formulate hypotheses
An animation of a law of physics, or of a particular geometrical rule or of a mathematical principle	See what happens and define when you can use it	Contextualise, applying rules, make inferences, make assumptions
A list of disorderly actions, words or images	Read these words (notes these images) and put them in order	Categorise, build and use conceptual categories

Table 2. Teaching activities with IWB (examples).

This strategy is particularly effective if the work is done in pairs or small groups. We emphasize too the importance that students should have the opportunity to use the IWB independently, as a true mind tool for working, understanding and learning.

Teaching and Learning with IWBs

To meet the needs of the knowledge society, education should promote meaningful learning[3]: students should be able to understand and act in the world around them because of their own personal, professional or social objectives.

According to Jonassen (2008), meaningful learning is characterized by being active, constructive, intentional, authentic and cooperative. When used well, the interactive whiteboard can do much to make learning more active, supporting learners' construction of meaning allowing students to pursue goals of their own choosing, engaging with real problems and cooperating beyond the limits of the classroom. Learning is not limited to what happens in school and these aspects of meaningful learning can be found in learners' informal learning.

The use of an IWB makes sense when applied to engage students in meaningful activities, aimed at understanding rather than for the reproduction of knowledge.

Because of this, teachers should always ask (at each phase of design), 'what is the reason for using the interactive board?'

DESIGNING LEARNING ACTIVITIES

The implementation of teaching and learning activities with the IWB requires a design process, that does not differ from those commonly used in teaching and training and that we can summarize as follows:

- Design
  - Define the learning objectives
  - Define the measurable outcomes to assess
  - Define the pedagogical approach and methodology
  - Define the teaching methods
  - Organizing teaching materials
- Creating Contents
- Preparing any Supporting Resources

List 3: Steps of lessons design.

Using the IWB, however, involves a series of decisions that must first consider the value added the IWB can bring to teaching. This means rethinking the teaching approach in particular, the choice of media and materials that we will use, and paying attention to how the content will be arranged.

[3] See Annex 7.

PROJECT FORM

To simplify the design of lessons with the IWBs we have prepared a form that can be used to define and summarise the learning objectives and the activities to be implemented (some examples of compilation in Annex 8).

SmartVET - TEACHING WITH THE IWB - Field experimentation Project Form4

TEACHER NAME & SURNAME:

COLLEGE/ORGANISATION NAME:

Education Sector: e.g.; PLC/VTOS/Youthreach	**Subjects/Components, including Level and Component Code**	**The Learning Experience: What will be delivered to Learners**	**Added value for teaching – what you think the IWB will add to the teaching**
Indicate the education sector:[5] • Back to Education Initiative • Post Leaving Certificate College • Youthreach • Vocational Training Opportunities Scheme • Adult Basic Education • Community Education • Second Level School/community College • Other (indicate)	Indicate the subject area and the topics of learning *E.g. Drawing L5 5N1862*	**BRIEF DESCRIPTION OF THE TEACHING ACTIVITIES:** • Number of students in the class • Learning objectives • Overall duration of classes (how many classes over what time?) • Progression of activities over the time (i.e. What do you plan to do in the first session, second session…And so on…) • Expected outcomes and products (e.g. – Lesson plan for (-) using (-) function of the Interactive Whiteboard) **METHODOLOGY (How you are going to teach the topic)** *(e.g. group tutorials, group discussion, individual interaction with board, coaching, demonstrations, Q & A, practical skills development, peer tutoring).* Describe the teaching methodology you will use and how you intend to use the IWB. What will you, as a teacher, be doing? What will the students be doing?	What is the added value expected from the use of IWB? *How will the IWB enhance the students' learning, the learning evaluation or any other aspect of the teacher's work?*

Blank Project Form

[4] The title refers to the SmartVET project and can be adapted to the context of interest.

[5] These options refer to the SmartVET project and can be adapted to the education sector, grade levels, age of interest.

THE DESIGN

The design includes some steps that are not necessarily consequential. For beginners especially, it is advisable to start from own traditional lecture and planning:

- which sequence or part of the lesson 'translates' to the IWB?
- when will the IWB will be used within the lesson 'script'?
- how will the IWB be used - in the classroom, in the laboratory, individually, with a group?

> LEARNING OBJECTIVES

A learning objective should **describe what learners should know or be able to do at the end of the lesson or course, which they could not do beforehand**. Learning objectives should be about student performance; they are not simply a list of the topics to be covered in the lessons.

Good learning objectives should not be too abstract (*the students will understand what good literature is*); too narrow (*the students will know what a ground is*); or be restricted to lower-level cognitive skills (*the students will be able to name the countries in Africa*) (MIT, 2012).

Each individual learning objective should support the overarching goal of the course, that is, the thread that unites all the topics that will be covered and all the skills that learners should have mastered by the end of the academic year.

These objectives may include:

- *Skills* - what students should be able to do ('learning how').
- *Knowledge* - what students should know and understand ('learning what').
- *Attitudes* - one's own cognitive pattern, the personal opinions, dispositions, expectations, values and beliefs ('learning to be').

It is also recommended that a strong, action verb (e.g. explain, describe, demonstrate, calculate, report, analyse, discuss, predict, compare, create) is used to clearly identify the learning objectives.

>ASSESSING MEASURABLE OUTCOMES

The interactive whiteboard allows for preparing exercises, for interactive activities for research, for the handling of content and also for the presentation of the work of individuals or groups, which allows teachers to 'naturally' assess the learning, the understanding and the underlying cognitive processes.

The assessment activities can be relatively simple - build a concept map on the subject studied, or demonstrate the solution to a problem with the application of the concepts just learned – or, more complex, such as problem solving, writing research or protocols of experiments, articles for scientific or literary journals, the design of multimedia, social surveys, and the organisation of seminars in which students are the experts.

> PEDAGOGICAL APPROACHES

The pedagogical approaches affect the methods that teachers will use in class and represent the intersection between *what* the teacher has to teach and *who* will be learning. The choice of methodology represents a coherent mediation between the conceptual content, the learners' characteristics, the elements of organisational context and the conditions within which the process of teaching / learning takes place.

In principle, we can distinguish three main teaching/learning models:

- The teacher-centred approach
- The learner-centred approach
- The group-centred approach

As shown in the figure below, different approaches can help achieve the optimal acquisition of specific learning objectives (adapted from Calvani & Rotta, 2000).

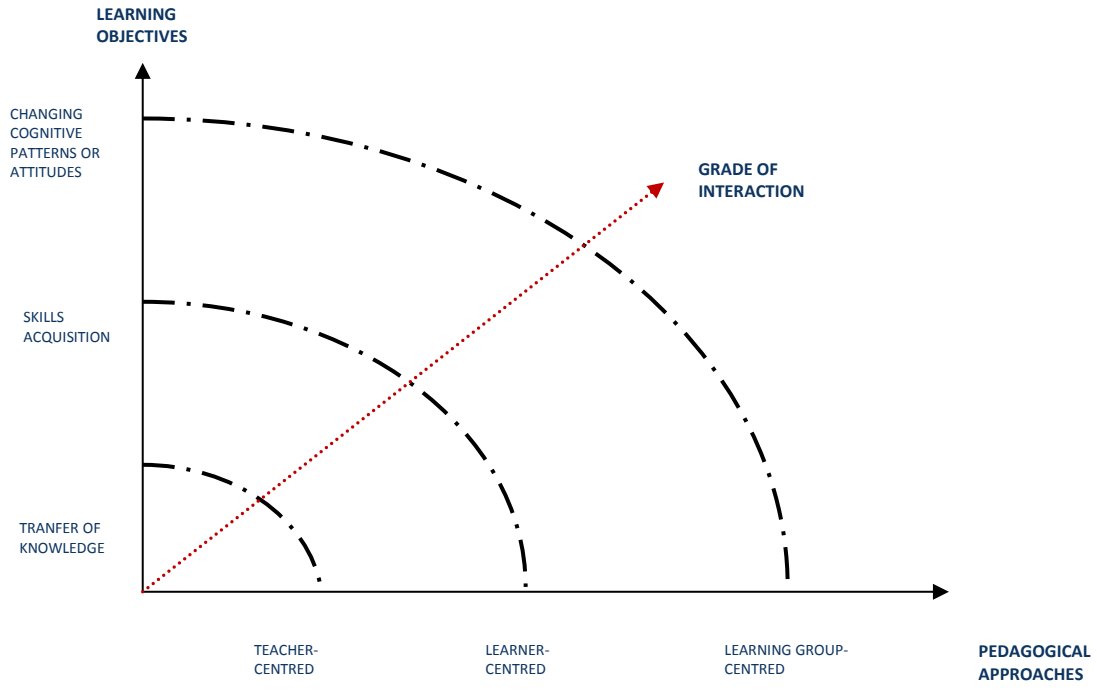


Figure 6: Relationship between pedagogical approaches and learning objectives.

Regarding the use of interactive whiteboards, we have already identified four general approaches (see 'How to use the IWB'), but as we have repeatedly stated, we believe that the interactive and collaborative approaches best exploits the features and the innovative potential of the digital boards.

> TEACHING METHODS

The teaching methods are the procedures, process, routes and activities undertaken by the teacher to facilitate learning (for details see **Annex 4**).

The specific purpose of a teaching method is to create conditions that allow students to activate their cognitive and intellectual functions to assimilate the learning content, if necessary restructuring their cognitive structure.

The choice of a method arises from the objectives (knowing the destination), the determination of the potential of learning (knowing the learners' characteristics or profile) and from understanding the properties of the specific subject.

When using the IWB it is not only possible but it is advisable to use multiple teaching methods. This makes lessons more engaging and effective because it offers different learning strategies, so each student can choose the one that best suits their cognitive style or intelligence, but also appreciate, get to know and then 'learn' (develop) different cognitive patterns.

> ORGANIZING TEACHING MATERIALS

When completing the Project Form, it is advisable to make an analysis or sort of mapping of the learning materials, in order to identify those already available, those to be produced and those to be adapted or changed.

This element also serves to bring into focus the content, in particular the network of meanings, structuring concepts or key ideas of the teaching subject.

- Identify the concepts (or key ideas) from which to start.
- Identify the concepts that must be repeated and emphasised.
- Identify areas of meaning that are peripheral or superfluous and evaluate what is best omitted from the course or class or best suited to individual study.
- Select the most suitable materials.
- Identify connections between subjects and between disciplines, between the theoretical study and practical activity and for promoting transfer processes in students' learning.

For this 'mapping' activity the teacher can use a mind or concept map (see **Annexes 6 and 7**).

The organization of learning materials involves the choice of which media to use. This choice must take account of the learning objectives and the characteristics of the media and of students. In practice, this means identifying the technologies and media that best meet the needs of different forms of intelligence (see **Annex 1**) and organizing materials to respond to as many intelligences as possible. A lesson that uses different media will change each time and so will stimulate students in more and different ways.

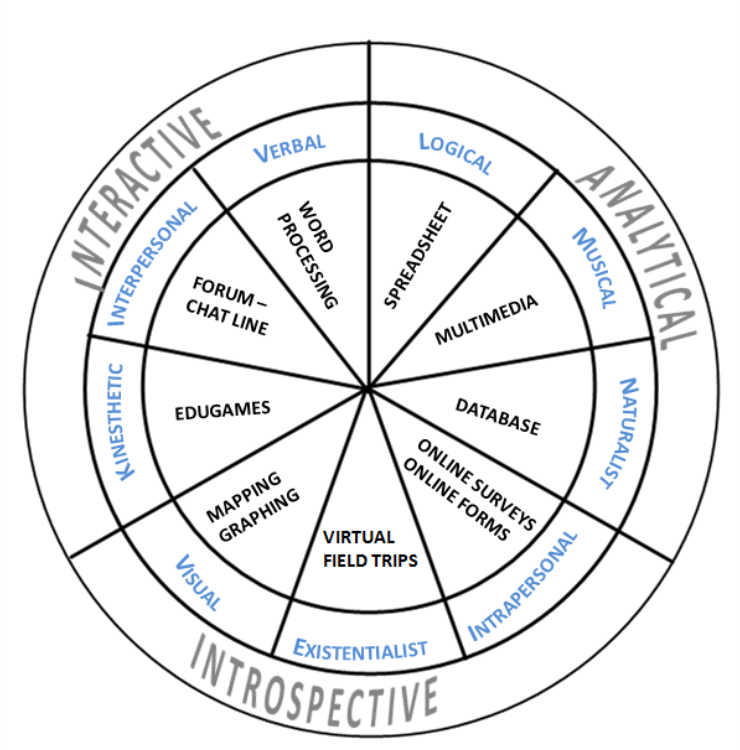


Figure 7: Relationship between intelligence and media (examples). Adapted from McKenzie, 2006.

Obviously, selecting the materials for the lesson also involves choosing activities that the learners can undertake. For example, a HTML editor (such as Dreamweaver) can seem like a visual tool, but we must also consider the intrapersonal and interpersonal dynamics between the students when they create a website for the class.

The following table provides some examples of media used on the IWB and its appropriateness for each intelligence. (McKenzie, 2006):

INTELLIGENCE	MEDIA/TECHNOLOGIES/TOOLS	EXAMPLES OF ACTIVITIES
VERBAL	Writing tools, digital worksheet, word processing, electronic mail, web based publishing (weblogs, forum) speech recognition devices	Speaking, listening, writing, reading, creating concept map, working in group, discussing and compare notes with peers, editing and revising written texts
• **LOGICAL-MATHEMATICAL**	Maths tools (ruler/yardstick, graphing calculators, measuring scales), tangram, spreadsheets, search engines, directories, WebQuest, programming languages	Calculate, measure, create concept map, analysing data through a spreadsheet, conducting queries using a search engine or directory, participating in the problem solving process of a WebQuest, mastering a programming language or a networked system of computers.
• **VISUAL-SPATIAL**	Interactive whiteboard, drawing tools, images, digital cameras, scanners, graphics programs, HTML editors, film / digital video clips, slide shows, charting and graphing, visual blogs	Draw pictures, scheme, concept maps, tables, website design, digital animation, videos and podcasts construction
• **BODILY-KINESTHETIC**	Touch screen IWB, materials to handle, joystick, simulations that require hand-eye coordination, technology assistive, spreadsheet softwares (e.g. Google Sketchup, Buildings)	Draw diagrams, manipulate materials, diagramming on the board, sorting manipulative materials by attributes, participating in a group simulation, using simulations in group or use a device to communicate with the IWB
• **MUSICAL**	Pattern blocks, puzzles, musical instruments, music player/recorder, digital sounds, online pattern games, multimedia presentations	Listening to and creating music, working with pattern blocks, recording sounds in one's environment, drawing visual patterns, finding patterns in sequences of numbers, playing online pattern games like Mastermind and Concentration, learning a foreign language, deciphering code
• **INTRAPERSONAL**	Weblog diaries, surveys, online surveys, online forms, digital portfolios, self-assessment systems	Conducting a class debate, completing online surveys or an online form, evaluating own digital portfolio, creating mind maps (or concept maps)
• **INTERPERSONAL**	Digital greeting cards, digital board games, social networking tools: chat, message boards, instant messenger, wiki	Class discussion, collaborative projects, synchronous chat between groups of students or with experts, participation in newsgroups or mailing lists, writing wiki, collaborative creation of concept map
• **NATURALIST**	Magnifying glass, microscope (IWB tools), database, file manager, semantic mapping tools, online encyclopedias, virtual explorations tools (e.g. Google Earth, Climate Change Simulation)	Organizing of information in categories, creating a database, building mind and concept maps, creating docu videos, using simulations and virtual explorations tools
• **EXISTENTIAL**	Virtual communities, virtual art exhibits, virtual field trips, MUDs, virtual reality, simulations, movies	Attending to virtual communities, virtual art experiences and field trips, online interaction with significant people through interviews and archives

Table 3:. Relationship between intelligence and technologies.

The aim is to respond to multiple types of intelligence specifically to offer more learning strategies, including developing those that students use less.

CREATING CONTENT

Using the IWB, teachers can create new content or use readily available digital materials. Using a scanner they can also acquire and use paper documents.

The IWB allows endless transformations and adaptations of paper-based materials, allowing the organisation of content and exercises in a different order (e.g. retrieve an exercise contained in the previous unit to integrate it as a review in a new lesson). It also allows teachers to present content in different ways, adapting it to the class level, the prior knowledge and the learning objective (e.g. transforming individual exercises for group or individual activities for use with the interactive board).

The IWB also has the advantage of being able to exploit resources such as images which usually tend to have a secondary function, more aesthetic than didactic, when they are printed on paper.

The potential for reorganisation and adaptation of digital materials is much higher. Proprietary IWB software is supplied with a library of digital resources (images and animation) available to teachers and students. The Internet and new digital media offer a wealth of multimedia resources (text, images, photographs, videos, audio files and e-book), which can be used in the classroom. Finally, the teacher can use all the resources produced independently with digital cameras and camcorders, as well as with cell phones or smartphones.

The structure of content may vary from the traditional presentation (similar to those made with PowerPoint) to the simple list of links to web and multimedia resources and from self-evident learning objects (including the assessment tests), to a sort of plot or script or ladder that contains only the essential points, that the teacher will complete during the lesson.

The teachers may also decide not to prepare any content; the lesson may focus on using specific software. In this case, through the features of the IWB they can capture the screen shots, add notes, etc. or may choose to write content during the lesson, as is routinely done on the blackboard (possibly using the functions of the IWB to record the lesson).

The interaction with the content through the IWB allows teachers to give adequate support to the explanation and allows students to see an immediate representation of what is explained (even in detail) and immediately try to put into practice what they learn and test the accuracy of their knowledge and understanding.

However, we must always keep in mind that using too much content can undermine the benefits to students' attention (in this regard, see paragraph 3.3).

The teacher may also decide to prepare lessons in which the students themselves will use the IWB to submit individual or group papers and 'document' learning projects.

This also has the advantage of promoting students' ability to speak in public and to learn the rules of using technological tools to achieve a clear, focussed and original statement.

This will encourage forms of self-assessment, awareness of mistakes made and will promote debate among the students and learning groups, leaving the teacher to supervise what was done, the assessconsistency with the objectives of the work and focus on exposure of the content.

Furthermore, using the IWB, the teacher can enhance students' digital skills.

PREPARING SUPPORTING RESOURCES

Finally, teachers should prearrange the appropriate support resources, which can be used in the classroom or during the study and homework. In addition, in this case they can create the materials from scratch or use prepared materials.

These resources are useful for the individualisation of learning and may include materials for students' review, the lesson content adapted for students with special needs (simplified texts, concept maps, schematization, interactive multimedia and hypertext resources), or other texts, presentations, references, web links, glossaries, etc. to deepen arguments.

DESIGNING IWB SLIDES AND NOTEBOOKS

As we have seen, to plan, write and use content for learning means thinking about how to integrate the various 'media' in the presentation slides.
Based on studies of cognitive psychology about memory and learning, we must first be aware of the following.

- Verbal information and visual information are processed cognitively in two separate channels (Paivio). "When information is presented to the eyes (as picture, animation, video or text) the information is processed by the visual system; when the information is presented in the form of sound (such as narrative or nonverbal sounds), the information is processed through the auditory-verbal channel" (Mayer, 2005);
- The amount of information which can be processed in each channel is limited (Miller, 1956).
- To learn in a meaningful way, students must commit to select, organise and integrate new knowledge based on their own prior knowledge (Ausubel, 1963, Novak, 2001).

Therefore, according to cognitive theory of multimedia learning (Mayer, 2001), the meaningful learning occurs when a learner engages three cognitive processes.

- Selects relevant words for verbal processing and selects relevant images for visual processing.
- Organises words into a coherent verbal model and organises images into a coherent visual model.
- Integrates corresponding components of the verbal and visual models.

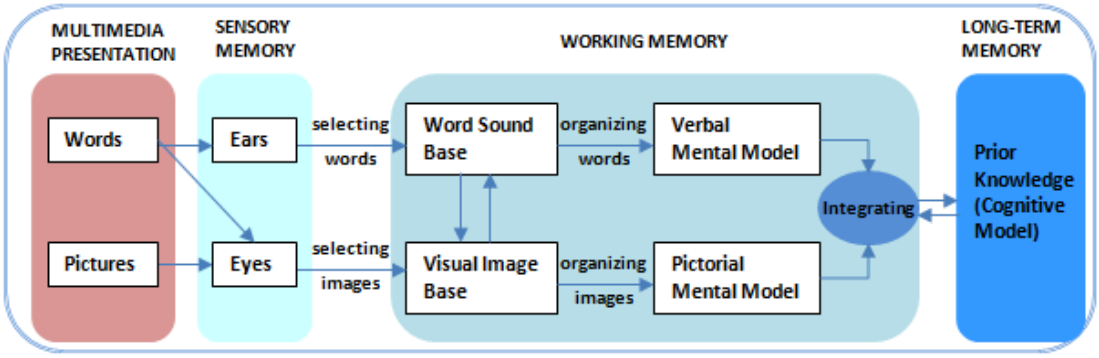


Figure 8: Description of the cognitive theory of multimedia learning (Mayer & Moreno, 2000)

This theory also provides some basic principles (Mayer, 2001), that it advisable to respect when using the IWB. According to Mayer, in fact, people learn better:

- from words and pictures than from words alone (*Multimedia Principle*);
- from animation and narration than from animation and on-screen text (*Modality Principle*);
- from animation and narration than from animation, narration, and on-screen text (*Redundancy Principle*);

- when corresponding on-screen text and visual materials are physically integrated rather than separated (are presented near rather than far from each other) (*Spatial Contiguity Principle*);
- when verbal and visual materials are temporally synchronized rather than separated in time (*Temporal Contiguity Principle*);
- when extraneous material is excluded rather than included (*Coherence Principle*);

Also, the foregoing principles are more important for low-knowledge than high-knowledge learners, and for high-spatial rather than low-spatial learners (*Individual Differences Principle*).

These principles have immediate significance for teaching practice.

First, in the design of lessons with the IWB we must **avoid a redundancy of information**, we must be careful not to convey in both channels (verbal and visual) exactly the same information. Therefore, **what is presented through images and video should not be reproduced as a text**.

Animations and images are more effective if accompanied by a verbal explanation, such as a direct explanation from the teacher, but also in the form of audio that accompanies the animation. A written text alongside the video distracts the attention of the student and does not allow for effective learning (Mayer & Moreno, 2000), especially if it also adds a verbal explanation (which is what happens when the teacher actually 'reads' the text on the slide).

The multimedia content should allow students to focus attention on key points of the argument and should give an opportunity to learn even one specific aspect that it is not possible to fully understand with only verbal and textual exposition.

This observation leads us to the second important indication arising from Mayer's principles: to exploit the potential of the IWB, we have to select the material that makes up our lesson. This means do not add new stuff, but probably decrease it, subtract it.

Finally, the content should connect as much as possible with prior knowledge already possessed by students. In this regard, we could use the IWB together with concept maps or exploit the multimedia resources to bring real-world examples, using information that we derive from the students' geographical, historical and cultural traditions.

On this basis, we can summarise some guidelines for creating the IWB presentation slides.

- Present an explanation in words and pictures (or videos or other multimedia).
- The resources have to be significant.
- Prepare only the main and relevant content (words/images): providing insights and less important information through hyperlinks, to allow alternative routes.
- Avoid extraneous words and pictures or videos.
- Prefer a synthetic text (key words, list), schemes, and maps.
- Images and written text have to be simultaneous and/or contiguous (but they must not be redundant).
- Avoid text animations.
- When giving a video or simulation, explain with a narration rather than with on-screen text.
- Avoid overlapping the text by reading it.

List 4: Guidelines for creating IWB slides.

ADVICE

Before starting to use the IWB, we would like to conclude with some practical advice.

- Do not use the interactive board for tasks that are too short.
- Use only when it brings real added value.
- Use when one masters it well enough.
- Always start from simple and easy to manage tasks.

This advice leads to the use of the interactive whiteboard initially as a tool primarily for the presentation of content and exercises, in a way that is similar to that of a video projector, but with the IWB it can easily be turned into an interactive and more immersive experience for learners.

In this regard, we suggest:

- switching from traditional expository lectures to interactive and collaborative lessons;
- a preference for student and group-centred approaches; and
- fostering an 'interdisciplinary' approach.

Finally, the use of IWB is based on (Ellerani, 2010):

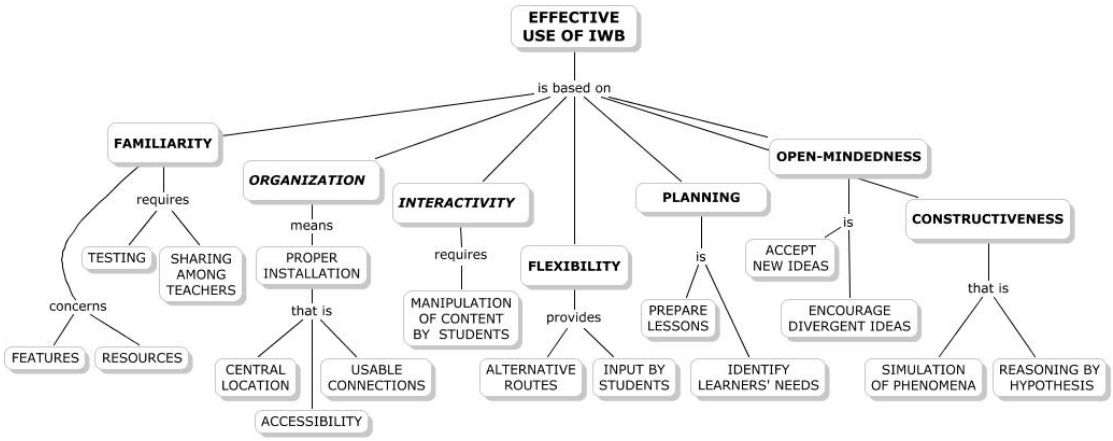


Figure 9: Guiding Principles for effective use of IWBs (for teachers).

Educational Applications: ideas/examples

TEACHER-CENTRED LESSON EXAMPLE

TITLE	**ANALYSIS OF A NARRATIVE TEXT (SHORT STORY)**
LEVEL	Second Level and Further Education and Training
AIMS	Analyse a short story and identify its component parts (the plot; the characters; the locations; the literary genre; the narrative techniques used by the author, etc.) and its organizational structure.
DIDACTIC APPROACH	Expository Method

PROCEDURE

STEP	*LESSON*	*WHO DOES WHAT*	*ACTIVITIES*	*TOOLS*
1	LECTURE	Teacher explains	Explain all steps of the story analysis, displaying and distributing them in a number of different slides. For example: • Story structure • Analysis of sequences • Story and plot • Narrative time • Narrative space • The system of characters • Narrator • Point of view	Pen tool Text-entry box for typing Copy & Paste Highlighter
2	LECTURE	Teacher explains	Introduce analysis activity by reading aloud some short (short but significant for the plot) passages of text, selected from a works of fiction. For example from: Charles Dickens, *A Christmas Carol*	Highlighter Zoom Spotlight Disappearing ink Screen shade Add Attachment
3	LECTURE	Teacher explains	Highlight the most important passages and capture them	Highlighter Pen/writing tools Screen capture
4	LECTURE	Teacher explains	In these passages of text, highlight: 1. Characters 2. Environmental descriptions 3. Objects Descriptions 4. Narrative sequences	Copy/Paste Capture Highlighter
5	LECTURE	Teacher explains	Rebuilding the storyboard of the story (using only the text or online software to build timelines as http://www.xtimeline.com/index.aspx)	Copy/Paste Drag & drop Lines, shapes

VARIATION (1)				
STEP	***LESSON***	***WHO DOES WHAT***	***ACTIVITIES***	***ADDED TOOLS***
1	MULTIMEDIA LECTURE	Teacher explains	The teacher can explain all steps of the story analysis, with the help of multimedia resources (web video or other). For example: videos on "Text Analysis": videos on " http://www.youtube.com/watch?v=RUfegmFYzYY	Add Hyperlink Internet browser
2	MULTIMEDIA LECTURE	Teacher explains	Introduce analysis activity by showing some short video before reading aloud the passages of text. For example: Charles Dickens, *A Christmas Carol*: http://www.youtube.com/watch?v=JvdMjXhPGd0	Add Hyperlink Internet browser

VARIATION (2)				
STEP	***LESSON***	***WHO DOES WHAT***	***ACTIVITIES***	***ADDED TOOLS***
3	INTERACTIVE	Teacher leads Students from the desks or at the IWB	The teacher asks students aid to highlight the most important passages and capture them	
4	INTERACTIVE	Teacher leads Students from the desks or at the IWB	The teacher asks students to analyse the short story	
5	INTERACTIVE	Teacher leads Students from the desks or at the IWB	The teacher asks students to rebuild the storyboard of the short story	

VARIATION (3)				
STEP	***LESSON***	***WHO DOES WHAT***	***ACTIVITIES***	***ADDED TOOLS***
5	COLLABORATIVE	Teacher manages Students groups work	The teacher divides the students into groups of 4 or 5 and explains that they have to rebuild the storyboard of the short story. When they have finished, the teacher invites a student from each group to come to the IWB and show their own group's proposal. The whole class evaluates the proposals	
6	COLLABORATIVE	Student groups work	The teacher asks groups to write a storyboard for a new tale, based on what they saw earlier. Then, each group shows their own work at the IWB	

MULTIMEDIA LECTURE EXAMPLE

TITLE	**FORCES AND MOTION**
LEVEL	Second Level and Further Education and Training
AIMS	Analyse and predict, qualitatively, how an external force will affect the speed and direction of an object's motion.
DIDACTIC APPROACH	Expository Method

PROCEDURE

STEP	*LESSON*	*WHO DOES WHAT*	*ACTIVITIES*	*TOOLS*
1	MULTIMEDIA LECTURE	Teacher explains	Explain the effect of forces on the motion of objects and the contributions of Galileo Galilei and Isaac Newton to the study of motion, illustrating it through a computer simulation. For example: Forces and Motion Basics PhET simulation http://phet.colorado.edu/en/simulation/forces-and-motion	Add Hyperlink (Internet browser)
2	MULTIMEDIA LECTURE	Teacher explains	Highlight the most important passages and capture them.	Add Hyperlink (Internet browser) Pen/writing tools Screen capture

VARIATION (1)

STEP	*LESSON*	*WHO DOES WHAT*	*ACTIVITIES*	*ADDED TOOLS*
2	INTERACTIVE	Teacher leads Students at the IWB	The teacher asks the student to use the simulation on the IWB.	
3	INTERACTIVE	Teacher leads Students from the benches or at the IWB	The teacher asks the students to explain the effects of forces on the motion with the help of a free body diagram[6]. Then he/she asks: Use free body diagrams to draw position, velocity, acceleration, force graphs. Explain how the graphs relate to one another. Given a scenario or a graph, sketch all four graphs.	

[6] For high school or college students.

INTERACTIVE LESSON EXAMPLE

TITLE	**BRAINSTORMING: THE ARGUMENTATIVE TEXT**
LEVEL	Second Level and Further Education
AIMS	Analyze an argumentative text and identify its Structure and characteristics
DIDACTIC APPROACH	Interactive

PROCEDURE

STEP	*LESSON*	*WHO DOES WHAT*	*ACTIVITIES*	*TOOLS*
1	MULTIMEDIA LECTURE	Teacher shows	Explain the characteristics of argumentative text using clips from *Julius Caesar movie (Shakespeare's drama),* in particular*: the Brutus' speech (e.g.* http://www.youtube.com/watch?v=IW7X0TC6sq8) *the* Mark Antony's speech (http://www.youtube.com/watch?v=7X9C55TkUP8)	Add Hyperlink (Internet browser)
2	INTERACTIVE	Teacher leads Students from the benches	Brainstorming on the IWB. The teacher leads a discussion about: *What are the objectives of each speaker?* Students review the clips and analyse the speeches. The teacher, using the pen, stops the clip and notes the observations on the new pages, capturing the most significant sequences	Screen capture Pen tool Lines, arrows Copy/Paste
3	INTERACTIVE	Teacher leads Students from the benches	• Brainstorming on the IWB. The teacher leads a discussion around a definition of argumentative text – in the context of the two speeches? The teacher writes on the IWB the students' reflections	Pen tool Lines, arrows Copy/Paste
4	INTERACTIVE	Teacher leads Students at the IWB	Students reconstruct the speeches on the IWB, drawing a diagram that summarises the speakers' theses and arguments. Students work in turn on the IWB	Pen/writing tools Shapes, lines, arrows Drag & drop Highlighter
5	INTERACTIVE	Teacher leads Students from the desks and at the IWB	The teacher suggests a topic for discussion and asks students to identify two opposing views. Students look for arguments to support both points of view and build two speeches. Afterwards, they draw a diagram on the board with their arguments.	Pen/writing tools Shapes, lines, arrows Copy/Paste Add file Drag & drop Highlighter
6	INTERACTIVE/ COLLABORATIVE	Students from the desks and at the IWB	Students analyse all the speeches, to highlight their strengths and weaknesses	Copy/Paste Pen/writing tools Drag & drop Highlighter

COLLABORATIVE LESSON EXAMPLES

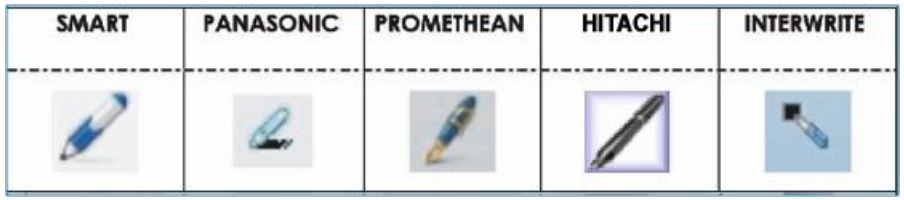
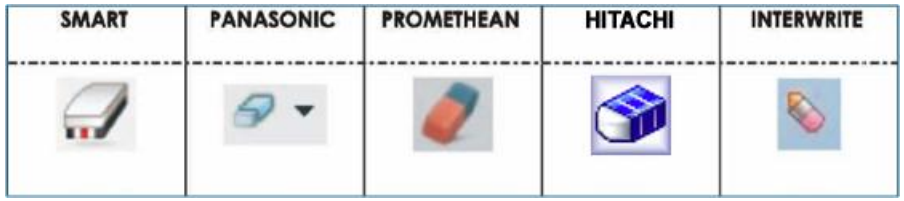
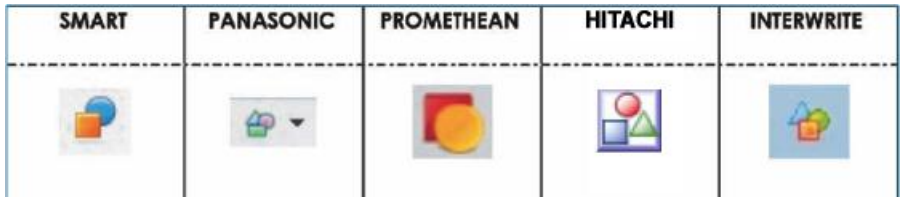
TITLE	**CONCEPT MAP**
LEVEL	All
AIMS	Synthesize a learning topic and develop metacognition
DIDACTIC APPROACH	Collaborative learning

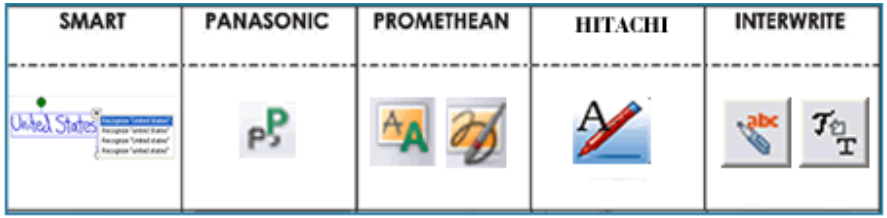
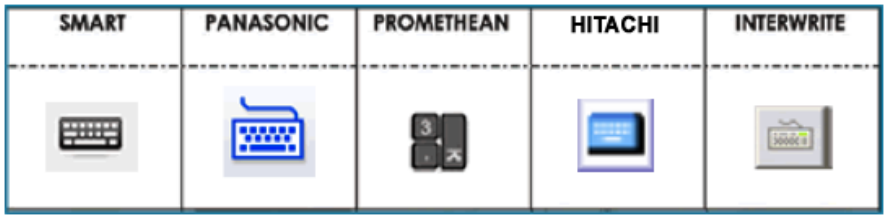
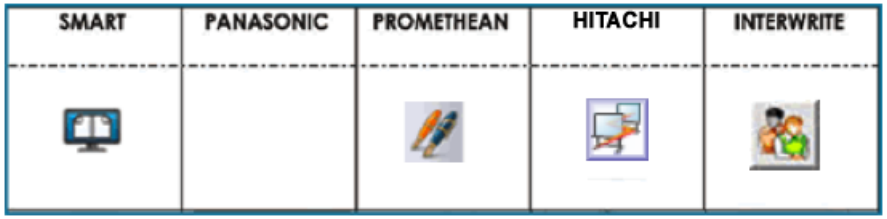
PROCEDURE

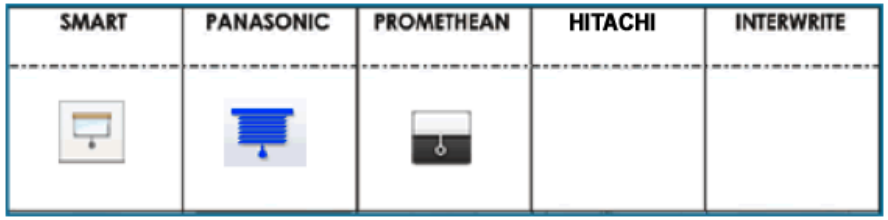
STEP	*LESSON*	*WHO DOES WHAT*	*ACTIVITIES*	*TOOLS*
1	INTERACTIVE	Teacher leads Students from the desks	Brainstorming on the IWB. The teacher leads a discussion to identify facts, terms, and ideas that students think are in anyway associated with the topic. The teacher, using the pen, makes a list of these items and writes them in very brief form, i.e. a single word or short phrase.	Pen tool Lines, arrows Copy/Paste
2	COLLABORATIVE	Students groups work	Divide the students into groups of 4 or 5 and explain that they are going to construct a concept map about the topic. When they have finished, the teacher invites a student from each group to come to the IWB and show his/her own group's concept map.	Add file/image Screen capture Pen tool Lines, arrows Copy/Paste or IHMC Cmaptools software
4	INTERACTIVE/ COLLABORATIVE	Students from the desks and at the IWB	Students analyse all the concept maps, to highlight their strengths and weaknesses	Pen tool Lines, arrows Copy/Paste Highlighter IHMC Cmaptools software
5	INTERACTIVE/ COLLABORATIVE	Teacher leads Students from the benches	Students construct the concept map of the class. They work in turn on the IWB.	IHMC Cmaptools software

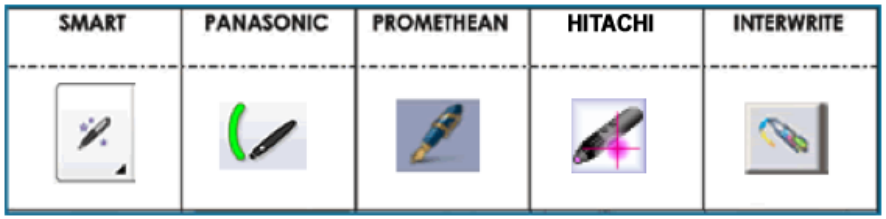
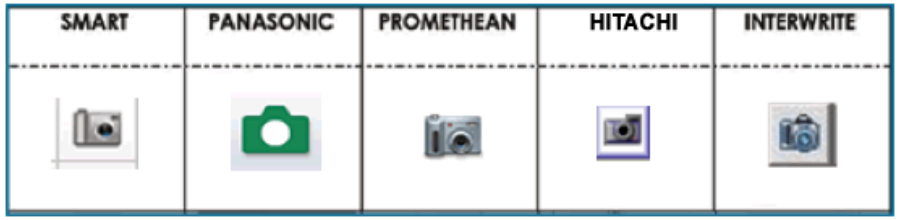
How to Use the IWB: Tools and Features

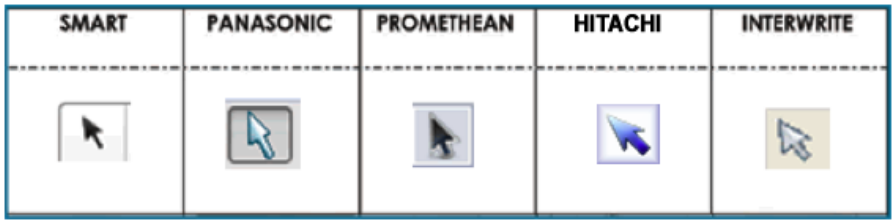
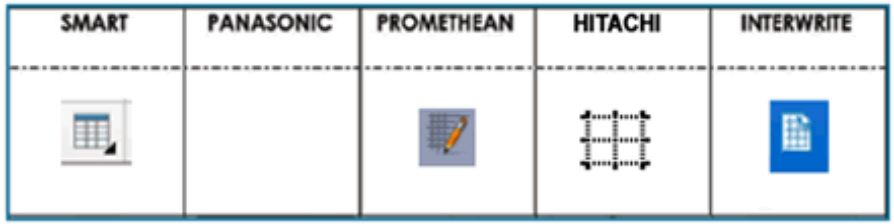
Below is a summary of the main features and teaching applications of IWBs.

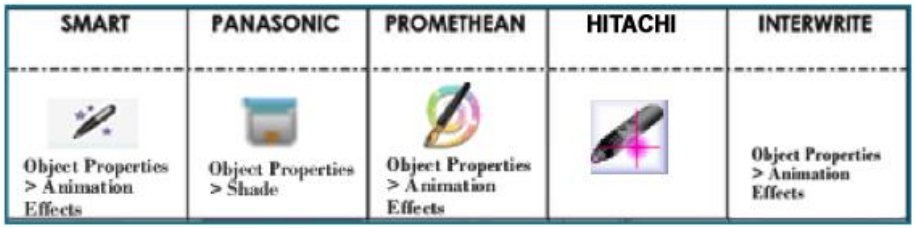
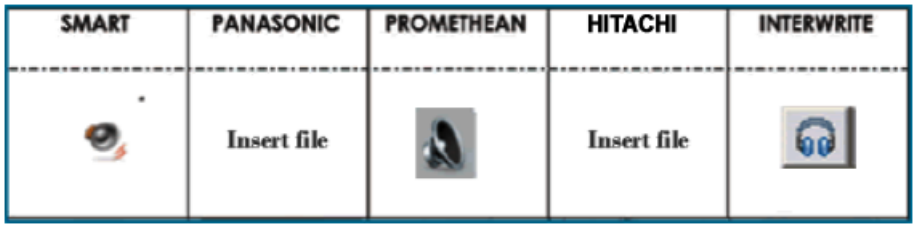
IWB Features		What does it do	What's that for
Writing Tools **PEN TOOLS**		Write, draw, and erase the screen (white pages of the IWB software, text, images or frames of video), information, questions or ideas that emerge.	Deliver a more interactive lesson and track it
ERASER			
SHAPES		Draw perfect geometric shapes	Facilitate the recognition and the construction of geometrical shapes even for those with dyspraxia

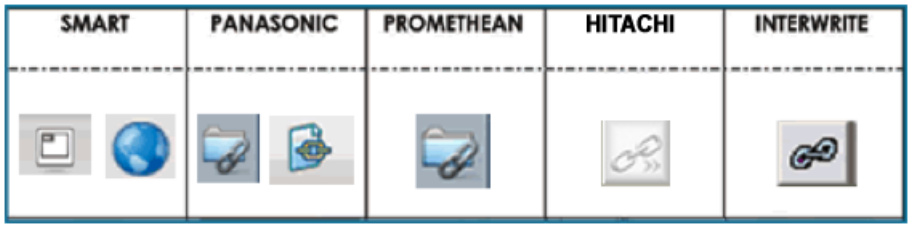
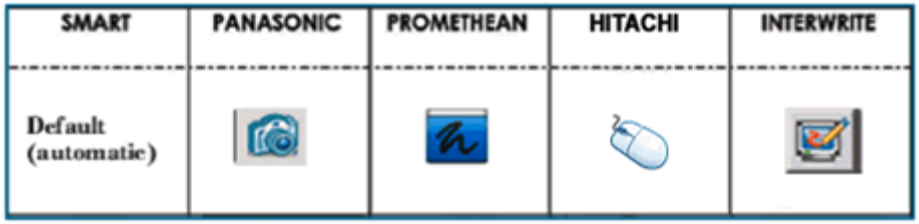
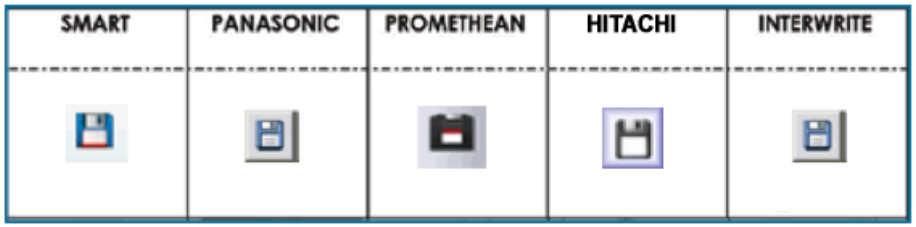
IWB Features		What does it do	What's that for
Writing Tools **HANDWRITING RECOGNITION TOOL**		Processing handwritten text in printed form	Making it easier to read the text. Reflecting on the correct spelling of words. It is especially useful with students who have language difficulties (dyslexia, ESOL students, etc.).
FLOATING OR ON-SCREEN KEYBOARD		Writing using printed characters during the interaction with the interactive screen.	Making easier reading (see above) and writing notes without interrupting the explanation. It is especially useful for learners with sensory-motor problems, or dysgraphia.
SPLIT SCREEN TOOL		Working on two sections separately or interacting with two people.	Comparing two versions of a document, two activities, etc. Working in parallel (e.g., answer questions, exercises, etc.).

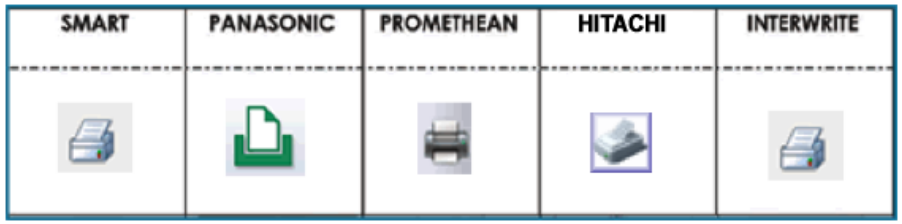
IWB Features		What does it do	What's that for
HIGHLIGHTER TOOL		Highlight texts, parts of the page and/or objects	Drawing attention to the relevant aspects (texts, images, etc.).
SHADING TOOL (SCREEN SHADE)		Hide or make visible only a part of the page or screen.	Focus attention on speech concepts or objects (texts, images, etc.) as they are introduced. Describe an element at a time to get used to a sequential logic.
SPOTLIGHT TOOL			

IWB Features		What does it do	What's that for
UNDERLINING TOOL		Underlining text, images and objects with different colours.	Drawing attention and analyse the main aspects: the colours help to compare and differentiate materials, ideas, phases, words, etc.
CAPTURE AND INSERT IMAGES		Capturing what appears (simulation, video, images, etc.) and the actions performed on the screen of IWB, then insert it as an image.	Obtain images to analyse and use them later. Showing, discussing and saving example. Break up processes, procedures, simulations. Building stories or sequences. Building a storyboard of the lesson.
INSERT IMAGES AND OBJECTS FROM LIBRARIES		Insert images or interactive objects available from the IWB library.	Supporting explanations with examples and activities. Preparing materials in advance that can be used during the lessons. Use teaching materials prepared by other teachers.

IWB Features		What does it do	What's that for
DRAG AND DROP TEXT AND/OR IMAGES		Handle objects (texts, images, etc.): move, zoom, rotate, reflect, overlay them, etc.	Help the vision and reading. Handle makes some abstract concepts more visible and concrete. Categorize, identify similarities and differences. Building group concepts, maps.
TABLES/GRID		Insert grids or tables.	Grids help the reading (in particular for dyslexics). Tables help organise and synthesize information and concepts.
CHARTS/ DIAGRAMS (CONCEPT MAPS, MIND MAPS)		Creating charts or diagrams with drawing tools (shapes, lines, colored pens)	Synthesise elements, information, knowledge and concepts, highlighting the concrete, conceptual, or logical structure.

IWB Features		What does it do	What's that for
HIDE AND REVEAL TOOL: MAGIC PENS		With the magic pens (smart & interwrite), underline disappears after a few minutes. Create animation effects (disappearance, appearance, etc.)	Drawing attention to compare and differentiate objects, words, etc. (and when underlining disappears, it does not change the content)
PLAY AUDIO FILES		Insert and play audio files	Listen to and analyse music, understanding speech, pay attention to the rhythmic and phonetic aspects of a poem or a reading, become familiar with a foreign language, etc.
PLAY VIDEO CLIPS		Insert and play video files	Show examples and simulations, analyse behaviours or relationships, become familiar with a foreign language, take trips of virtual instruction, analyse speeches, etc.

IWB Features		What does it do	What's that for
ADDING HYPERLINKS		Insert hyperlinks between pages. Add hypertexts and web pages.	Facilitate navigation between the flipchart pages. Use multimedia resources to make the lesson more interesting. Make the lesson more interactive following the evolution of the lesson.
SAVE ANNOTATIONS		Add notes to the screen (to texts, video frames, etc.)	Make lecture more interactive and keep track of emerged questions, comments, ideas.
SAVE FILE		Save the presentation.	Save materials to re-using them, to build new presentations, to reflect on the content of the lesson, to evaluate the work done by students, to document the activities carried out, etc.

IWB Features		What does it do	What's that for
PRINT OFF		Print off the presentation	Use the materials for paper and pencil activities (games, projects, tests), self- study, documenting and archiving the didactic activities carried out, etc.
RECORDING		Recording lessons and on screen activities	Re-using the lessons; building new interactive lessons; reflecting on project activities or on procedures or on cooperative work; evaluating the didactic process; documenting the activities, etc.
USING ADDITIONAL IWB-RELATED DEVICES		Add voting or response systems, interactive tablets	Makes the lesson more interactive and dynamic; engaging students encouraging their participation, makes the assessment into a "game", using tests for discussion and sharing, documenting the process

Resources

DIDACTICS

http://www.ted.com/

ABOUT IWBS

Benefits of the smart boards (video) - http://www.youtube.com/watch?v=RGNVcD5ADK8

Community of teachers - http://teacherslovesmartboards.com/

Information about the features of SMART Board interactive whiteboards that can help students who have special learning needs - https://www.blossomlearning.com/ShowResource.aspx?rid=56

SMARTBOARD

Community Smart Exchange - http://exchange.smarttech.com/index.html?lang=en_IE#tab=0

Smarttech web site with resources and support about smart boards. http://smarttech.com/

Interactive sites for Smart Board use: www1.center.k12.mo.us.

STARBOARD HITACHI

Resources and tools - http://www.hitachisolutions-eu.com/

Hitachi Community about StarBoard - http://www.hitachisolutions-us.com/starboard/

Demonstrations on StarBoard - http://www.youtube.com/hitachistarboard

PROMETHEAN

Community for teachers - http://www.prometheanplanet.com/en/

Community for teachers - http://www.prometheanworld.com.

Promethean KB web site - http://www.prometheankb.com

INTERWRITE

Einstruction Community - http://legacy.einstruction.com/

Eicommunity: https://www.eicommunity.com/Pages/home.aspx

IQ BOARD

IQBoard.net Community - http://www.iqboard.net/iqboard/p4.html

IQBoard.ie Website - http://iqboard.ie/

IQBoard.com Community for teachers - http://www.iqboard.com.au/downloads.html

PANASONIC

Panaboards Blog about Panasonic boards - http://blog.panaboards.com/

MIMIO

Mimio website Resources for teachers and educators - www.mimio.com/

Mimioconnect Teaching Community - http://www.mimioconnect.com/

LESSON RESOURCES

ADULT LEARNING

http://www.alresources.com/

SECONDARY SCHOOL

http://www.tes.co.uk/secondary-teaching-resources/

ALL SUBJECTS

http://www.edmodo.com/

http://www.topmarks.co.uk/Search.aspx?Subject=11

http://www.bbc.co.uk/schools/
https://www.khanacademy.org/
http://www.clevernotes.ie/
https://www.studyclix.ie/
http://www.skillsworkshop.org/

- **ART**

http://www.instructionaldesign.org/domains/computers.html

- **BIOLOGY**

http://www.quia.com/shared/biology/
http://www.onlinemathlearning.com/high-school-biology.html
http://www.wiziq.com/tests/biology

- **BUSINESS/WORK EXPERIENCE**

http://www.teachingbusiness.co.uk/index-1.html
https://www.studyclix.ie/Subjects/Leaving-Certificate/Ordinary/Business
https://www.studyclix.ie/Subjects/Leaving-Certificate/Higher/Business

- **CHILDCARE**

http://www.childcareagency.ie/family/childcare-resources.html
http://www.aussiechildcarenetwork.com/Resources.php

- **COMMUNICATION**

http://www.ndt-ed.org/TeachingResources/ClassroomTips/Communication.htm
http://thecommunicationspace.com/group/teachingandlearningresourcesmediaandcommunications

- **DESIGN & COMM TECH**

http://steps.ie/maths
https://www.studyclix.ie/Subjects/Leaving-Certificate/Ordinary/Design-_and_-Communication-Graphics
http://www.t4.ie/design_resources.htm

- **ENGLISH**

http://www.quia.com/shared/english/
http://wwwedu.ge.ch/cptic/prospective/projets/anglais/exercises/
http://www.englisch-hilfen.de/en/exercises_list/alle_grammar.htm
http://www.englishpractice.com/
http://leavingcertenglish.net/
http://www.sccenglish.ie/
http://ienglish.ie/

- **FRENCH**

http://www.quia.com/shared/french/
http://fog.ccsf.cc.ca.us/~creitan/grammar.htm
http://french.about.com/od/francophonie/u/practiceperfect.htm
http://ml.hss.cmu.edu/fol/fol1/Exercises.html
http://www.frenchteacher.net/
http://www.zut.org.uk/index.html
http://www.mflresources.org.uk/

- **GERMAN**

http://www.quia.com/shared/german/
http://webgerman.com/german/forms/webforms.htm
http://www.deutsch-lernen.com/
http://www.babelnation.com/german/courses/01_02_exercb.html
http://www.mflresources.org.uk/

- **HEALTH**

http://resources.teachnet.ie/homeeconomicshelper/
http://www.helenhudspith.com/hsc.html
http://www.teachers-direct.co.uk/resources/quiz-busters/subjects/Health-and-Social-Care.aspx

- **HISTORY**

http://www.schoolhistory.co.uk/lessons/index.shtml
http://www.quia.com/shared/history/
http://www.agame.com/game/test-my-history.html
http://www.edcoexamcentre.ie/know_your_history/

- **ICT**

http://www.codecademy.com/
http://www.teach-ict.com/
http://www.hippasus.com/rrpweblog/

- **LITERACY**

http://www.skillsworkshop.org/literacy
http://www.nala.ie/
http://www.bbc.co.uk/skillswise
http://www.teach-nology.com/worksheets/language_arts/

- **MATHS**

http://www.ixl.com/
http://www.onlinemathlearning.com/
http://www.thatquiz.org/
http://www.quia.com/shared/mathematics/
http://www.geogebra.org
http://www.whiteboardblog.co.uk/iwb-files/
http://www.themathstutor.ie/
http://steps.ie/maths

- **MUSIC**

http://audacity.sourceforge.net/
http://www.artsalive.ca/en/mus/musicresources/teachers.html
http://www.educationscotland.gov.uk/learnlisteningonline/

- **SCIENCE**

http://www.periodicvideos.com
http://www.whiteboardblog.co.uk/iwb-files/

- **SPANISH**

http://www.quia.com/shared/spanish/
http://www.e-spanyol.hu/en/tests.php
http://www.trinity.edu/mstroud/grammar/
http://www.todo-claro.com/e_index.php
http://www.mflresources.org.uk/

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Annex 1 - Individual Learning Differences

The study of individual learning differences is based on the assumption that each subject is characterized by a preferred cognitive style, or learning style or intelligence, that are characteristic and identifiable methods of interacting with, taking in, and processing stimuli and information, and using a particular class of strategies in tackling a (cognitive and/or practical and/or social) task.

Various researchers (Dunn & Dunn, 1974; 1978) have attempted to hypothesise ways in which learning style theory can be used in the classroom The relationship between cognitive and learning processes and knowledge is more complex than the theories draw it, but many studies remind us of the importance of the individualization and personalization of learning. This requires that teachers must also be able to understand the different way in which "real" students learn.

LEARNING STYLES

KOLB'S MODEL

According to Kolb, the learning is a cyclic process; therefore the subject is constantly modifying his or her acquired knowledge through four principal phases, correlated to the perception and subsequent processing of information:

- Concrete experience;
- Reflective observation;
- Abstract conceptualisation;
- Active experimentation.

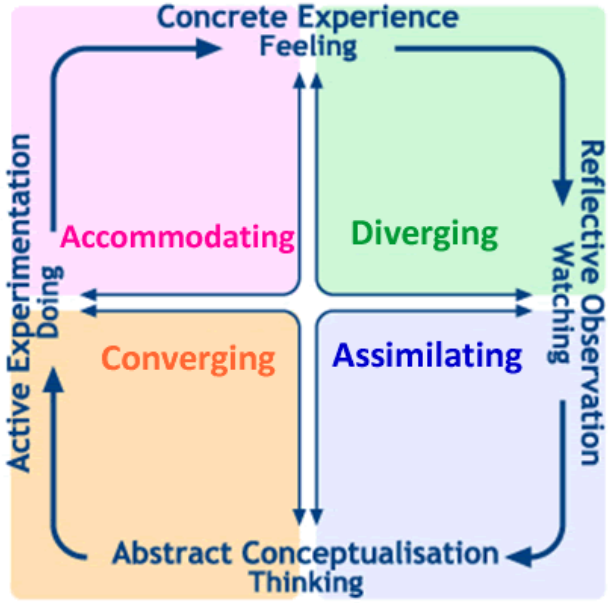

Figure 10. Kolb's Scheme about learning.

Each individual tends to prefer two of these phases and therefore ends up implementing different cognitive strategies, which Kolb defines as four different types of subject:

- the reflective type (diverging style), who prefers concrete experience followed by reflection (*feel and watch*);
- the theoretical type (assimilating), who prefers reflection followed by conceptual generalisation (*watch and think*);
- the pragmatic type (converging style), who relates conceptualisation and abstraction with experimentation and the application of thought categories to new objects and situations (*think and do*);
- the active type (accommodating), who prefers real experience and active experimentation (*feel and do*).

The reality is obviously more complex than any model; nonetheless, from Kolb's research we may draw a number of useful guidelines that can be applied to the design of teaching.

Diverging types are capable of observing real situations from several different viewpoints and, from there, identify links and connections between different situations or different problems. These students learn easily either through practice or reflection; they prefer observation to participation and reflect carefully before acting. According to Kolb, the question characterising the learning process in these subjects is "Why?" People with a diverging learning style have broad cultural interests and they like to gather information. They are interested in people, tend to be imaginative, emotional and to be strong in the arts. People with the diverging style prefer to work in groups, to listen with an open mind and to receive personal feedback. Within a class discussion, these persons may act as promoters of mechanisms for the externalisation of tacit knowledge, starting from their own personal practical experience or others' experience. Their ability to analyse situations and problems, to organise them by the identification of common elements and links with other practices and situations, may stimulate further elaboration and revive dialogue.

However, as they tend to be more reflective, these subjects may be less reactive to solicitation than others are, and they require more time to express their own opinion and more stimuli before they take an active part in a discussion or in the life of the class. In particular, these subjects are more likely to be drawn into participation by questions that lead them to search for the "why" of an issue.

Assimilating types are interested in the creation of abstract models that allow them to identify relationships between ideas, occurrences and situations in order to define a problem. These persons are more adept at understanding or elaborating theories and display little interest in practice.

The question characterising these subjects is "What?". Because of their inclination for theoretical speculation, they prefer discussions geared to the analysis or creation of general principles and models. In formal learning situations, they prefer readings, lectures, exploring analytical models, and having time to think things through. These subjects may contribute through references to intellectual schemes and validated, authoritative or shareable theories, steering the discussion towards logical reasoning, and are particularly useful in proposing an overall view and in helping find the best interpretation for ambiguous words. Their cognitive attitude makes them particularly suitable for the organisation and classification of explicit knowledge. They may, however, fail to be motivated by discussions based solely on how to apply a practice, or on pragmatic attitudes, which they may consider to be below their abilities, leading them into conflict with other members of the group class who prefer these thought strategies.

Converging types are motivated by the possibility of trying and testing ideas and theories, putting them into practice through experimentation and also concentrating on practical aspects. They easily learn abstract concepts, especially if expressed as “spot messages”, which stimulate their imagination and must be translated into an immediately useable form. Their learning process is characterised by the question “How?” They are more attracted to technical tasks and problems than social or interpersonal issues.

A converging learning style enables specialist and technology abilities. People with a converging style like to experiment with new ideas, to simulate and to work with practical applications. These subjects may contribute to the lessons by bringing the results of their own personal experience, of the experiments they have conducted, searching for new stimuli, in the shape of ideas, explicit knowledge, materials, possibilities, models and opinions that must be verified in the field. However, they become bored quickly when the discussion is too theoretical, or when it does not lead to the creation of behavioural models or practices that can effectively and immediately be experimented with and applied.

Lastly, ***accommodating*** types prefer action and real results, and they are stimulated by new situations, problems and opportunities and by the possibility of achieving concrete results. According to Kolb, the question characterising these subjects is “What if?” These subjects expect concrete and immediate solutions from the learning for equally concrete and immediate problems. They will tend to rely on others for information rather than carry out their own analysis. They may contribute to the class discussion and reflection by highlighting real problems, steering excessively theoretical discussions back towards concrete reality and by identifying practices that have proven to be effective in the field. Their role in the class may, however, be limited to one of contingent criticism, beyond which they find no motivation to discuss with the others. This learning style is prevalent.

Naturally, these profiles are not fixed or acquired once and for all by subjects; each one of you, at different points in your lives, will have experimented with being more instinctively theoretical, or with being more pragmatic. The type of learning task may also play a determining role; therefore, while it is true that persons who tend to be theoretical are more likely to choose speculative topics (philosophy, mathematics, theoretical physics, etc.), working in a more practical job may lead them to more pragmatic or reflective strategies.

Within a class, being able to count on members adopting different strategies offers a great opportunity: the teacher must work to integrate these strategies and promote, within each specific topics and tasks, joint decision and joint work activity and negotiation to define the most suitable path for the learning goals. For example, if the students have to understand, in a foreign language, the term “force”, a theoretical approach, entailing the analysis of models at the basis of different meanings attributed to the word, may help the students identify the most appropriate meaning of the term. If, on the other hand, the students have to create a text with a word processor, an active approach, which immediately produces a text, is more appropriate.

FLEMING'S MODEL

One of the most common and widely used categorizations of the various types of learning styles is Fleming's model (Fleming, 2001), that distinguishes:

- visual learners - students that have a preference for seeing (think in pictures; visual aids such as overhead slides, diagrams, handouts, etc.);
- auditory learners - people that best learn through listening (lectures, discussions, tapes, etc.);

- kinesthetic or tactile learners – people that prefer to learn via experience—moving, touching, and doing (active exploration of the world; science projects; experiments, etc.).

According Fleming, this distinction allows teachers to prepare classes that address each of these areas. Students can also use the model to identify their preferred learning style and maximize their educational experience by focusing on what benefits them the most.

COGNITIVE STYLES

Cognitive style is considered a particular 'footprint' or 'mark' showing how people use cognitive processes (perception, attention, memory and understanding).

According to Huteau (1987), cognitive styles can be considered as dimensions of human personality: they are cognitive behaviours taken naturally, occurring in the same way over time, but they also influence all aspects of personality, social interactions, attitudes and emotional reactions.

Every cognitive style is described as a dichotomy, in which subjects are characterized by their position on a *continuum* (Cornoldi & De Beni, 1993).

Countless studies in psychology have investigated the modes of preference with which each one of us gathers and processes information, outlining the following cognitive styles:

THE GLOBAL ←→ ANALYTICAL STYLE

The subject may initially turn towards a panoramic vision, an overview of the topic or issue as a whole, and then descend into detail (global: before the forest and then the trees), or alternatively, the subject may start from the details and individual concepts to gradually reconstruct a general overview (analytical: before the trees and then the forest).

With regard to learning, the student who has a global style prefers to have a first overview of the learning material and then to descend to the particular (try to build an overview of the topics before beginning to study), those who prefer an analytic style tend to start from the details then recompose the whole topic (learn the individual concepts at first and only afterwards put them in a relationship with a more general framework).

THE SYSTEMATIC ←→ INTUITIVE STYLE

The systematic approach searches for solutions by examining one variable at a time, proceeding in small steps and looking for all possible links; the intuitive approach proceeds by one theory at a time, which it tries to confirm or disprove.

Both can lead to satisfactory solutions: the intuitive style may be quick in pointing out a possible solution, but the reasoning may be approximate and limited to the first confirmed hypothesis, otherwise the systematic style requires more time and, theoretically makes a more certain solution, but there is a risk is of focussing too much on the detail.

Learning attitudes related to these styles are: when I am studying, I need books or texts that explain everything, word for word; on the contrary, when I am studying, I formulate a personal hypothesis trying to see if it is correct.

THE VERBAL ←→ VISUAL STYLE

Subjects using a verbal style prefer to use language (text, speech, etc.); those who use a visual style tend to prefer visual and spatial communication, such as static and moving images, summary charts, diagrams and tables.

The 'verbal' student prefers to read, studying repeating aloud the text; the 'visual' student needs images, maps, diagrams and tables to better understand the text.

THE IMPULSIVE ←→ REFLECTIVE STYLE

The impulsive subject tends to choose spur-of-the-moment, non-optimal solutions, conversely, the reflective subject responds more slowly and with more deliberation.

The reflexive students plan carefully all the steps before the study and they think about before making a decision; instead the impulsive students tend to study in their spare time or only before an examination, but the decision-making moves quickly to action.

THE CONTEXT DEPENDENT ←→ INDEPENDENT STYLE

Subjects with a context dependent approach tend to emphasise the connection between the context in which the topic stands and the topic itself, they focus particularly on the relationship between single concepts and topics; conversely, those who use a context independent style tend to isolate single topics from the rest, without worrying about creating links.

The context-dependent students tend to emphasize the links between the topic and the topic context and they try to find more relationships among concepts, ideas and themes. On the contrary, the context-independent learners tend to isolate individual arguments from the rest, to identify within a text the basic concepts, and to learn them without bothering to connect them to one another.

THE CONVERGENT ←→ DIVERGENT STYLE

Convergent thought is logical-consequential. It starts from the information to reach a single solution to the problem. Divergent thought, on the other hand, starts from the information and reaches the solutions via lateral, less direct and logical paths, creating a great variety of original and flexible answers.

The student who adopts a convergent style has a logical and sequential approach to topics or problems and tends to concentrate solely or primarily on what is necessary to pass the test or examination; the students with the divergent style is more interested in focusing on the topics to enrich their personal culture and relying on personal paths.

THE SOLVER ←→ ASSIMILATOR STYLE

Subjects using a solver style prefer action and real results. Therefore, when faced with a problem, they search for satisfactory solutions that are contingent and involve the least possible expenditure of energy/resources. Those using an assimilator style prefer to look for satisfactory results through exhaustive, complex pathways that are not necessarily of any practical use or limited to contingent necessities.

Regarding study, the 'solver' students prefer a text as clear and concise as possible to learn the core concepts; while the assimilator tends to investigate and compare the positions of multiple authors for a given problem or issue.

It is important to remember that each one of us may use different styles, depending on the situation and on the issue. However, teachers should be aware of their existence, so that they can anticipate potential problems and reformulate the presentations, concepts and knowledge included accordingly, to make them more easily understood by persons using different styles. Lastly, the teacher must try to highlight how different thought strategies may lead to the same conclusions or, conversely, how tackling an issue or a problem with different thought styles may lead to different, but often equally valid, conclusions. The integration of different approaches may help us to see the same phenomenon from dissimilar points of view, highlighting certain aspects rather than others and favouring innovative solutions or knowledge.

MULTIPLE INTELLIGENCES (MI)

Howard Gardner proposed the theory of multiple intelligences in 1983 as a model that not only considers intelligence as a single general ability, but differentiates it into various specific modalities.

Gardner (1983) defines the intelligence as "bio psychological potential to process information that can be activated in a cultural setting to solve problems or create products that are of value in a culture". Traditionally, schools have emphasized the development of logical and linguistic intelligence (mainly reading and writing), but there are more ways to solve problems or create products and there are more intelligences.

Gardner identifies nine types of intelligence (Gardner, 2000):

NATURALIST INTELLIGENCE (“NATURE SMART”)

It designates the human ability to discriminate among living things (plants, animals) as well as sensitivity to other features of the natural world (clouds, rock configurations). This ability was clearly of value in our evolutionary past as hunters, gatherers, and farmers. It continues to be central in such roles as botanist or chef. It is also speculated that much of our consumer society exploits the naturalist intelligence, which can be mobilized in the discrimination between cars, sneakers, kinds of makeup, and the other consumer products.

MUSICAL INTELLIGENCE (“MUSICAL SMART”)

Musical intelligence is the capacity to discern pitch, rhythm, timbre, and tone. This intelligence enables us to recognize, create, reproduce, and reflect on music, as demonstrated by composers, conductors, musicians, vocalist, and sensitive listeners. Interestingly, there is often an affective connection between music and the emotions; and mathematical and musical intelligences may share common thinking processes. Young adults with this kind of intelligence are usually singing or drumming to themselves. They are usually quite aware of sounds others may miss.

LOGICAL-MATHEMATICAL INTELLIGENCE (NUMBER/REASONING SMART)

Logical-mathematical intelligence is the ability to calculate, quantify, consider propositions and hypotheses, and carry out complex mathematical operations. It enables sequential reasoning skills, inductive and deductive thinking patterns, to perceive relationships and connections and using abstract, symbolic thought. Logical intelligence is usually well developed in mathematicians, scientists, and detectives. Young adults with lots of logical

intelligence are interested in patterns, categories, and relationships. They are drawn to arithmetic problems, strategy games and experiments.

EXISTENTIAL INTELLIGENCE

Existential Intelligence is characterised by sensitivity and capacity to tackle deep questions about human existence, such as the meaning of life, why do we die, and how did we get here. Students with this intelligence tend to be introspective and reflective and have firm understanding of their own personal convictions, preferences and beliefs. They enjoy activities which give them choice.

INTERPERSONAL INTELLIGENCE (PEOPLE SMART")

Interpersonal intelligence is the ability to understand and interact effectively with others. It involves effective verbal and nonverbal communication; the ability to note distinctions among others; sensitivity to the moods and temperaments of others, and the ability to entertain multiple perspectives. Teachers, social workers, actors and politicians all exhibit interpersonal intelligence. Young adults with this kind of intelligence are leaders among their peers, are good at communicating, and seem to understand others' feelings and motives.

BODILY-KINESTHETIC INTELLIGENCE ("BODY SMART")

Bodily kinesthetic intelligence is the capacity to manipulate objects and use a variety of physical skills. This intelligence also involves a sense of timing and the perfection of skills through mind–body union. Athletes, dancers, surgeons, and craftspeople exhibit well-developed bodily kinesthetic intelligence.

LINGUISTIC INTELLIGENCE (WORD SMART)

Linguistic intelligence is the ability to think in words and to use language to express and appreciate complex meanings. Linguistic intelligence allows us to understand the order and meaning of words and to apply meta-linguistic skills to reflect on our use of language. Linguistic intelligence is the most widely shared human competence and is evident in poets, novelists, journalists, and effective public speakers. Young adults with this kind of intelligence enjoy writing, reading, telling stories or doing crossword puzzles.

INTRA-PERSONAL INTELLIGENCE (SELF SMART")

Intra-personal intelligence is the capacity to understand oneself and one's thoughts and feelings, and to use such knowledge in planning and direction of one's life. Intra-personal intelligence involves not only an appreciation of the self, but also of the human condition. It is evident in psychologists, spiritual leaders, and philosophers. These young adults may be shy. They are very aware of their own feelings and are self-motivated.

SPATIAL INTELLIGENCE ("PICTURE SMART")

Spatial intelligence is the ability to think in three dimensions. Core capacities include mental imagery, spatial reasoning, image manipulation, graphic and artistic skills, and an active imagination. Sailors, pilots, sculptors, painters, and architects all exhibit spatial intelligence. Young adults with this kind of intelligence may be fascinated with mazes or jigsaw puzzles, or spend free time drawing or daydreaming.

CRITICISM OF MI THEORY

Some authors agree with Gardner that there are domains of intelligence that are autonomous of each other and some of the domains, such as verbal, spatial, mathematical, and social intelligence are identified by most lines of research in psychology, but the review of MI theory argues that there is little empirical evidence to support it. Nevertheless, many educationalists support the practical value of the approaches suggested by the theory. According to Gardner, they believe that the purpose of schooling "should be to develop intelligences and to help people reach vocational and avocational goals that are appropriate to their particular spectrum of intelligences. People who are helped to do so, [he] believe[s], feel more engaged and competent and therefore more inclined to serve society in a constructive way".

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Annex 2- The Digital Natives

Over the last 20 years, a number of labels have evolved to describe the young people currently studying at school, college and university, including 'digital natives', the 'net generation', the 'Google generation' or the 'millennials'. All of these terms are used to highlight the significance and importance of new technologies within the lives of young people born in the last two decades.

According to Prensky, one of the consequences of this technology rich environment is a hypothesized change in the brain structure that means young people think and process information in fundamentally different ways compared to older generations; they are all "native speakers of the digital language of computers, video games and the Internet" (Prensky, 2001).

NATIVES VS IMMIGRANTS

"Digital Natives are used to receiving information really fast. They like to parallel process and multi-task. They prefer their graphics before their text rather than the opposite. They prefer random access (like hypertext). They function best when networked. They thrive on instant gratification and frequent rewards. They prefer games to 'serious' work" (Prensky, 2001).

People who were born before the digital era (before 1980) are Digital Immigrants; they may learn to use new technologies but will still be in some way located within the past, unable to fully understand the natives. The difference between native and immigrants is a difference between learning a new language and being a native speaker, they do not talk the same language.

According to Prensky, characteristics of digital immigrants include: not going to the Internet first for information, printing things out as opposed to working on screen, and reading manuals rather than working things out online.

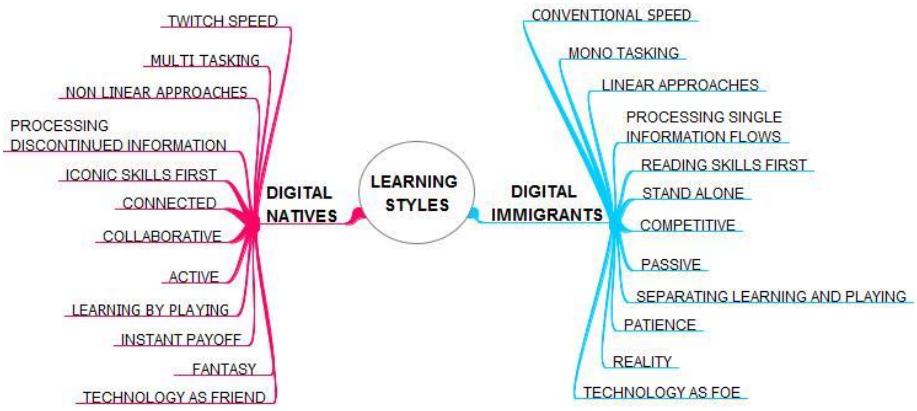

Figure 11. Differences between learning styles of digital native and immigrants (Prensky, 2001). Mind map.

The authors who support this concept suggest that the differences between these two groups have profound implications for education.

They argue that young people have a range of different preferences, tools and ways of processing and using information that do not fit well with current educational practices and they state that the teaching needs to change.

For example, Prensky suggests that educators have to communicate in a way that fits with the needs of the digital natives i.e., “going faster, less step-by step, more in parallel, with more random access, among other things” (Prensky, 2001). A powerful teaching method would be to use computer games.

According some authors, the differences between native and immigrants is true especially if we consider the second generation of digital natives which has been created by the rise of web 2.0 applications and which can be separated from the first due to their familiarity and immersion in this new, web 2.0, digital world.

Veen (Veen, 2006) defines this new generation as '**homo zappiens**', a generation for whom learning is an interactive process of searching for meaning and for whom knowledge is communication about meaning. They develop a range of metacognitive skills as:

- Enquiry based approaches
- Networked learning: thinking as part of networks
- Experiential learning: no punishments
- Collaborative learning: teams and roles
- Active learning: making choices, acting
- Self organisation: setting goals
- Problem solving strategies
- Explicating knowledge to others.

Consequently, they are creative problem solvers, experienced communicators, self-directed learners, for whom learning is playing and school is for meeting friends rather than for learning.

Thus, they need new teaching approaches.

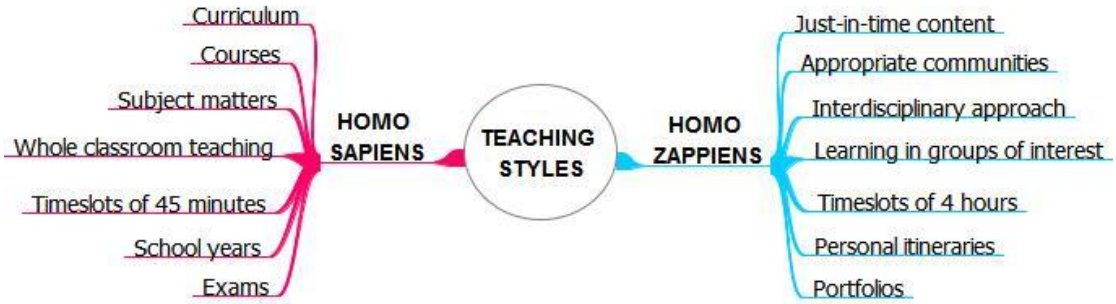

Figure 12. Differences between teaching styles for 'zappiens' and 'sapiens' learners (Venn, 2005). Mind map.

CRITICISM OF DIGITAL NATIVES CONCEPT

There are researchers who have questioned the validity of the generational interpretation of the digital native concept. According to them, the use of new technologies by young people is more complex. Actually, the proportion of young people who use the Internet and other new technologies is higher than the older population, but there are significant differences in how and why young people use these new technologies and how effectively they use them.

While for Prensky the differences between digital natives and digital immigrants seem to be explained by age, for other authors the characteristics of a digital native are determined by exposure, experience or expertise with new technologies, thus the difference is between users and non-users.

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Annex 3 - Adult Education and Andragogy

The term andragogy, originally formulated in 1833 by Alexander Kapp, a German teacher, refers to the discipline of studying the adult education process or the science of adult education (Nottingham Andragogy Group, 1983), but it was Malcolm Knowles who developed the paradigm of andragogy, as we know it today.

Knowles defines andragogy as “the art and science of helping adults learn” (Knowles, 1980) and he uses this term to build a comprehensive model to offer a 'framework for thinking about what and how adults learn', contrasting the pedagogical approach, useful for children or young people (Knowles, Holton & Swanson 2005).

ANDRAGOGY VS PEDAGOGY

According to Knowles, the characteristics of adult learning are different from the assumptions about young learners, because adults are self-directed and expect to take responsibility for their decisions; therefore adult educational programs must accommodate this aspect.

	Pedagogy	**Andragogy**
Learner	He is dependent. Teacher directs what, when, how a subject is learned and tests that it has been learned.	He moves towards independence. He is self-directing. Teacher has to encourage this movement.
The learner's experience	Of little worth.	A rich resource. Hence teaching methods must include discussion, problem-solving etc.
Readiness to learn	People learn what society expects them to and the curriculum is standardized.	People learn what they need to know, so that learning programmes organised around life application.
Orientation to learning	Acquisition of subject matter. Curriculum organized by subjects.	Learning experiences should be based around experiences, since people are performance centred in their learning.

Table - Differences between pedagogy and andragogy according Knowles model, 1977 (Jarvis, 1985).

PRINCIPLES OF ANDRAGOGY

The Knowles Andragogy theory is based on certain principles, that are not mutually exclusive, but they are part of a system of learning theory.

> LEARNER AS SELF-DIRECTED

Because adults regard education as a lifetime activity, they are able to learn more effectively through self-directed learning, which is quite different from traditional teaching. They need to be seen by others and treated by others as being capable of self-direction; otherwise they can react with resentment and resistance.

The flexibility of learners and their self-governance result in the most effective learning. Accordingly, adult learners should be dynamically involved in planning their learning process (Cervero & Wilson, 2001). They

- need to know why they need to learn something before undertaking to learn it;
- should be motivated through intrinsic motivation (internal motivators as the desire for increased job satisfaction, self-esteem, quality of life and the like) rather than extrinsic motivation (external motivators as better jobs, promotions, higher salaries) (Reed, 1993).

This is particularly important in lifelong learning programs, because while "basic training - usually taken once in a lifetime - even if addressed to young adults (e.g. university courses) requires a psychological contract in which the subject takes an hetero-directed, a less active role, only in view of the many future advantages expected", "this contract is not acceptable in the continuing professional development", and "adults are not surprisingly unwilling to participate to basic training initiatives"(Bruscaglioni, 2004).

> LEARNER AS RESOURCE

Adults accumulate a growing reservoir of experience that can be a resource for their own learning and the others' learning; collaboration is a key ingredient for successful adult learning methodologies (Galbraith, 1990). Teachers should value adult students' life experiences and self-awareness (Uehling, 1996).

> LEARNING AS DEVELOPMENTAL OF LEARNER'S GOALS

Adults are willing to learn only the things they need to know and be able to do in order to cope effectively with their real-life situation, so teachers must choose strategies that will enable adults to achieve their learning goals. "The driving force in lifelong learning is not the acquisition of knowledge per se as it is amongst youngsters, but rather the self-actualization of individuals of themselves and through the organizations where they work and live" (Prestoungrange, 2002).

Adults also need assessment not just for evaluation, but also for motivation and feedback (Beaman, 1998). They may develop skills and self-awareness through feedback and evaluation of others' behaviour in the classroom (Saunders, 1991).

> LEARNING AS APPLICATION TO REAL WORLD

In contrast to children's and youths' subject-centred orientation to learning (at least in school), adults are life-centred, task-centred or problem-centred; they need an immediate application of theory to practice. Therefore, learning strategies should be less involved with content or theory, and more focused on real problems and practical applications of knowledge relevant to the real world (Patterson & Pegg, 1999).

Ultimately,

- Adult learning is problem-centred rather than content-oriented.

- Adults are most interested in subjects that have immediate relevance to their job or personal life.
- They need to be involved in the planning and evaluation of their training.
- Experience (including mistakes) provides the basis for their learning activities.

CRITICISM OF KNOWLES' ANDRAGOGY PRINCIPLES

There are authors that are not fully in agreement with the Knowles Andragogy theory and who believe that some observations are imprecise and the principles are poorly formulated.

First, about the self-directed learning, pedagogists note that children are not dependent learners for much of the time, "quite the contrary, learning for them is an activity which is natural and spontaneous" (Tennant, 1988).

It is also not correct to say that children's and young people's experiences are any less real or less rich than those of adults: "they may not have the accumulation of so many years, but the experiences they have are no less consuming, and still have to be returned to, entertained, and made sense of" (Smith, 1996; 1999).

Although the Knowles' work might be considered "dated," most of the studies about the adult learning cited at least one article by this author and they do not refute his claims, but only supports them with additional arguments (Thompson & Deis, 2004).

In addition, many of the Knowles' claims about the adult learning (about the intrinsic motivation or the need to know why one needs to learn something), actually also apply to the children and young people learning.

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Annex 4-- Teaching Methods[7]

Teaching methods comprise the principles and the methods used for instruction. They are paths activated by the teacher and designed to facilitate the students' learning.

The choice of a method depends largely on the information or skill that is being taught, on the aim (where we want to go), on the determination of the potential of learning (learners' characteristics), and on the teachers' beliefs about learning and learners. Teachers can also use multiple methods in the same class.

LECTURE

The lecture is the most common teaching method, because it allows the transmission of knowledge that would be expensive to provide with more interactive or active methods, but it also has a number of disadvantages. It is a teacher-centred method, an intended to teach or present information about a particular subject, basically supported by oral communication. The teacher tells the students critical information, history, background, theories and so on. This method predominantly favours one-way communication that does not involve significant audience participation and interaction.

During a class, a brief introductory lecture can give direction and purpose to a demonstration or prepare students for a discussion or for cooperative work.

ADVANTAGES

- The lecture is one of the most efficient methods for presenting much information in a relatively short time to many students. However, this requires logically organized contents.
- It is useful to introduce a subject, ensuring that students with varied backgrounds have the necessary information to understand and learn it.
- In subject areas where information changes frequently or is available in widely scattered places (textbooks, journals, web, etc.), the lecture allows teachers to summarize and emphasize pertinent material and give students the most up-to-date information.
- The lecture is often the most effective way of communicating the interest and enthusiasm of a teacher about a subject or a person who has actual experience in a field, thus motivating students.

DISADVANTAGES

- The lecture does not lead to maximum achievement in learning of certain types of skills, such as speech skills, metacognitive thinking, and motor skills, for example. Moreover, this method alone is generally not appropriate for presenting material above the comprehension level of the cognitive domain or topic.

[7] For the purposes of the SmartVET project, in this annex we consider main teaching methods in common use, such as the lecture and active learning methods, but we don't consider the Computer-Based Training Method. A review on cooperative or group learning is included in following Annex 5.

- The lecture method tends to foster passiveness and dependence on the teacher: because the lecture makes no provision for participation by the students, too often, many students willingly allow teacher to do all the work.
- Within a single class period, teachers may unwittingly present more information than students can absorb and the lecture does not provide teachers with an opportunity to estimate student progress (before an examination).
- It is difficult to hold the attention of students for an entire class period. To use the lecture method effectively, teachers need considerable skill in speaking.
- Too often, the lecture becomes a simple repetition of content already contained in textbooks or other teaching aids.
- Finally, teachers may have to spend much time preparing for the lectures.

To limit these disadvantages, the teacher can make the lesson more interactive by including group discussions, questions and answers, active learning methods or the use of interactive tools such as the IWB.

ACTIVE LEARNING METHODS

These methods are based on the principle that effective learning depends largely on experience. They involve students through participation and investment of energy in all the phases of the learning process, therefore they are more useful for stimulating higher cognitive processes and critical thinking. They are student-centred methods.

ADVANTAGES

- May increase critical thinking skills in students.
- Enables students to show initiative.
- Involves students by stimulating them to talk more.
- Incorporates more student input and ideas.
- Easier to assess student learning.
- Better meets the needs of students with varying learning styles...

DISADVANTAGES

- Teachers need to be expert in the content area and in teaching methods too.
- It may be difficult to organize active learning experiences.
- These methods require more time and energy and it may be stressful for teachers and students.

The main methods of active learning are:

- Didactic Laboratory
- Case method
- Problem Based Learning
- Project Based Learning

DIDACTIC LABORATORY

Generally, the concept of the didactic laboratory is associated to a place where various kinds of experiments (chemical, biological, physical...) are conducted. However, in the last few

years, a new idea of a didactic practice based on a laboratory approach has been asserted. It does not necessarily coincide with the common conception of a laboratory but it takes the form of a research and learning environment.

This method improves the motivation of the students in learning within a cooperative and research environment.

The laboratory is work organized into projects, from the formulation of the project idea (on what we intend to work) to the definition of the objectives to achieve; to the analysis of the available resources and those to be gathered; to the planning of the work stages and of the deadlines; to the organization of the activities to research, collecting and ultimately processing the data; to the final evaluation of what has been obtained.

Within a laboratory a variety of techniques can be used, typically demonstrations and exercises.

DEMONSTRATION-PERFORMANCE AND EXERCISES

With these techniques, students learn physical or mental skills by actually performing those skills under supervision: they learn to write by writing, weld by welding, etc. They are techniques of learning by imitation, involving two typical complementary aspects: demonstration ("look as I do") and exercise ("try it yourself").

PHASES

Generally, this technique provides the following phases:

- *Explanation* - Teacher gives instructions that must be clear, pertinent to the objectives of the particular lesson and based on the known experience and knowledge of the students. Teacher also conveys to the students the precise actions they are to perform and describes the result of these procedures.
- *Demonstration* - Teacher shows students the actions necessary to perform a skill.
- *Student Performance* and *Teacher Supervision* - Students perform the task or actions shown. Through doing, they learn to follow correct procedures and to reach established standards. It is important that students have a chance to perform the skill as soon as possible after a demonstration. Teachers have to coach as necessary.
- Evaluation - Students work independently and the teacher judges each student's performance.

CASE METHOD

Case method consists in presenting the students with a case, putting them in the role of a decision maker facing a problem (Hammond, 1976). Students usually work in group.

This method is based on *case studies*, and is common in social and life sciences. As a teaching method, it provides for the written submission of complex situations (real or virtual but realistic), that students have to analyze. This situation is the subject of an inquiry, an instance or example of a class of real phenomena or situations. It should have enough information that students can understand the case, and, if necessary, can propose a solution.

To write the case study, the teacher has to:

- Describe the problem or case question, putting together the information to solve it.
- Organize the sections of the case, under topics like introduction to the problem, background, decisions taken by the actors, procedures adopted for the solution of problems, results caused by the actions and their strengths and weaknesses, etc.
- Write the conclusion, formulating questions to be answered.

Cases may be (AIF, 1988):

- About **decision** - the text provides all the information about the situation and the aim (a decision to be taken). Students must find a solution or more solutions, (i.e. the best decision), deriving it from the available data.
- About **problems** - the initial situation is not defined in any detail and students must first select the information and complete the data collection, redefining the scope of the solution.
- About **problem definition** - similar to the previous, the text presents a real situation but without evidence of the problem. Students must then identify precisely the type of problem.
- **Case study** - the text describes all the significant aspects of a real situation (and problem), which has not been resolved satisfactorily. Based on the actual data, students must assume other solutions.

PROBLEM BASED LEARNING

PBL is a student-centred method in which students learn about a subject in the context of complex, multifaceted, and realistic problems. In this approach, students can work individually or in groups, and the teacher is a facilitator of learning who provides appropriate scaffolding and support of the process, modelling of the process, and monitoring the learning. It can be used to enhance content knowledge while simultaneously fostering the development of communication, problem-solving, critical thinking, collaboration, and self-directed learning skills.

PBL starts from a problem in a simulated real context, which involves practices, policies, process, and ethical problems that will need to be understood and resolved. It is an *inquiry* method. The teacher should give enough information so that students can understand what the problem is, and, after thinking about it and analyzing the information, the students should be able to come up with a proposed activity or solution.

Problem-based learning includes seven steps (Schmidt, 1983):

- Clarifying and agreeing on terms and concepts that are unclear.
- Define the problem and review terms, which need more depth or explanation.
- Analyze, brainstorm and create potential hypothesis.
- Discuss, evaluate and organize possible explanations into potential hypothesis.
- Generate and prioritize learning objectives, divide research workload.
- Private study time to research objectives.
- Write an explanation and synthesize new information in relation to the problem.

PROJECT BASED LEARNING

Project Based Learning is a method based on activities aimed at producing complex, real-world projects. The project is therefore a product/service (or performances or presentations, and other tangibles) to be carried out, which force students to confront the reality and to apply their knowledge. During the project activities, students learn and they use their learning. This method also has an impact on metacognition and "life skills" (self-management, problem solving ...).

Usually the project is long-term (more than two class days and up to one semester or term), is central to curriculum, focuses on interdisciplinary topics or on the central concepts of a discipline, and is conducted by a collaborative working group.

PHASES

Generally, the method can be divided into three phases:

- Planning - learners choose the topic; search and organize the required resources into a usable form and organize the collaborative work.
- Creating - students develop the project idea, combine the contributions of the group, build the project and finally present the work to class members.
- Processing - learners share each group's or individual's project (artefacts) in a small group or with the entire class, exchange feedback, and reflect on the learning process and the project.

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Annex 5 - Cooperative Learning

Cooperative learning is an approach to organizing classroom activities that recognises students as active recipients of knowledge by discussing information and answers in groups, engaging in the learning process together rather than being passive receivers of information. Students must work in groups "structuring positive interdependence" to complete tasks collectively toward academic goals: they have to work towards a group goal or recognition and group success is reliant on each individual's learning.

Learning cooperatively, students capitalize on one another's resources and skills: everyone succeeds when the group succeeds.

In this approach, the teacher's role is not giving information but it is about facilitating students' learning.

Research demonstrated "overwhelmingly positive" results and confirmed that cooperative modes are cross-curricular (Johnson & Johnson, 1989; Brady & Tsay, 2010).

Cooperative learning methods are usually equally effective for all ability levels; they increase academic achievement, higher-level reasoning, generation of new ideas and solutions, transfer of learning between situations, self-esteem, and self-concept.

ELEMENTS

Five essential elements are identified for cooperative learning (Johnson & Johnson, 1994):

- Positive Interdependence - Students must fully participate and put forth effort within their group; each group member has a task/role/responsibility therefore must believe that they are responsible for their learning and that of their group.
- Face-to-Face Promotive Interaction - Members promote each other's success; students explain to one another what they have or are learning and assist one another with understanding and completion of assignments.
- Individual and Group Accountability - Each student must demonstrate mastery of the content being studied; each student is accountable for their learning and work, therefore eliminating "social loafing" (the phenomenon of people exerting less effort to achieve a goal when they work in a group than when they work alone).
- Social Skills - Social skills that must be taught in order for successful cooperative learning to occur include effective communication, interpersonal and group skills (such as Leadership, Decision-making, Trust-building, Communication, Conflict-management skills).
- Group Processing - Every so often groups must assess their effectiveness and decide how it can be improved.

For these reasons when the teacher designs cooperative learning tasks and reward structures, he or she has to identify individual responsibility and accountability. Students must know exactly what their responsibilities are and that they are accountable to the group in order to reach their goal; each group member must have a task that cannot be completed by any other group member.

TYPES

They are two main types of cooperative learning:

- Formal - is structured, facilitated, and monitored by the educator over time and is used to achieve group goals in task work. Groups can vary from 2-6 people with discussions lasting from a few minutes up to a longer period. Any course material or assignment can be adapted to this type of learning.
- Informal - incorporates group learning with expositive teaching by drawing attention to material through small groups throughout or at the end of a lesson. It typically involves groups of two (e.g. turn-to-your-partner discussions - dyads). These groups involve two-four learners and can change from lesson to lesson. This type of learning enables the student to process, consolidate, and retain more information learned.

COOPERATIVE LEARNING TECHNIQUES

There are a great number of cooperative learning techniques available (Schul, 2011; Kagan, 1994; Brown, 2001; Slavin, 1990):

JIGSAW

Students are members of two groups: home group and expert group. The home group is heterogeneous and students are each assigned a different topic. Once a topic has been identified, students leave the home group and group with the other students with their assigned topic. In the new group (expert group), students learn the material together before returning to their home group. Once back in their home group, students are accountable for teaching his or her assigned topic to the members of their home group.

JIGSAW II

Jigsaw II is a variation (Slavin, 1990) of Jigsaw in which members of the home group are assigned the same material, but focus on separate portions of the material. Each member must become an "expert" on his or her assigned portion and teach the other members of the home group, who must then become ‘expert’.

REVERSE JIGSAW

It differs from the original Jigsaw during the teaching portion of the activity (Hedeen, 2003), because students in the expert groups teach the whole class rather than return to their home groups to teach the content.

THINK PAIR SHARE

Students work in pairs, to solve and answer a posed question or problem. The teacher proposes the task-stimulus; each student may write down thoughts or simply brainstorm in his or her head, then, when prompted, he or she pairs up with a peer and discusses his or her idea(s) and then listens to the ideas of his or her partner. Following pair dialogue, the teacher solicits responses from the whole group (Lyman, 1981).

RECIPROCAL TEACHING

This is a cooperative technique that allows student pairs to participate in a dialogue about text. Partners take turns reading and asking questions of each other, receiving immediate feedback (Brown & Paliscar, 1984). Such a model allows students to use important metacognitive techniques such as clarifying, questioning, predicting, and summarizing.

STAD (OR STUDENT-TEAMS-ACHIEVEMENT DIVISIONS)

Students are placed in small teams; the class in its entirety is presented with a brief lesson; all the students after study in group and then they are subsequently tested. Although the tests are taken individually, students are graded on the team's performance, so they are encouraged to work together to improve the overall performance of the team.

LIMITATIONS

Although cooperative learning has many benefits and effective methods, it does have limitations that should be recognized.

Most of the limitations of cooperative learning come from failure to implement the cooperative structure carefully. If the teachers just put the students into groups to learn and didn't structure the positive interdependence and individual accountability, then it would not be unusual to find groups where one person did most (or all) of the work and the others signed off as if they had learned it or had done the work. Or it might be easy to have a "bossy" student who did not allow the others to take part; or other group problems that might come from not setting the ground rules for behaviour and carefully crafting the group dynamics (Kagan, 1994). Development of clear ground rules for social and democratic interaction is essential when establishing this form of learning.

Another limitation is the time: organizing and monitoring group work takes more time than independent work, and this can hinder the learning time in a classroom.

Another concern is that the educational rationale for cooperative learning techniques tends to develop more from socialization needs than from achievement needs: according to some researchers, some cooperative techniques seem to ignore the importance of individual education (Turco & Elliott, 1990).

Teachers often express uncertainty about how to evaluate the group work skills that students demonstrate during group work; it is not easy judging what happens during a group project or evaluating how the initiatives of some team members affect others.

Some teachers may also experience frustration and open hostility from their students. Students who do not like to work in groups, because they are shy or uncomfortable in groups and prefer to work by themselves, or they feel uncomfortable being judged by their peers; bright students complain about being held back by their slower teammates; weaker or less assertive students complain about being discounted or ignored in group sessions.

Thus, teachers often became discouraged and reverted to the traditional teacher-centred instructional paradigm (Kagan, 1991, Sapon-Shevin, 1991).

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Annex 6 - Mind Maps

Mind maps are a means of organizing information visually, proposed in the late 1960s by Tony Buzan. This technique is based on and develops students' visual and associative thinking. Mind maps are an overview and summary of a body of knowledge that fuses words and pictures together.

According to Buzan (1993, 2000), the use of mind maps naturally expands students' thinking capacity, because the human brain works by association and it likes to link two (or three, or more) things together. Therefore, when we connect the ideas, we will understand and remember a lot more easily. Therefore, mind maps improve problem solving ability, the concentration, the facility to remember complex information, the imagination and creativity and learning. They enable students to structure, organize, memorize, arrange, brainstorm and learn information, showing how big ideas are made of big pieces, which in turn are composed of smaller pieces.

A mind map is created around a single topic (represented by word or text or symbol or image), placed in the centre, to which associated ideas are added. Major categories radiate from a central node, and lesser categories are sub-branches of larger branches. Categories can represent concepts, ideas, tasks, or other items related to a central key word or idea.

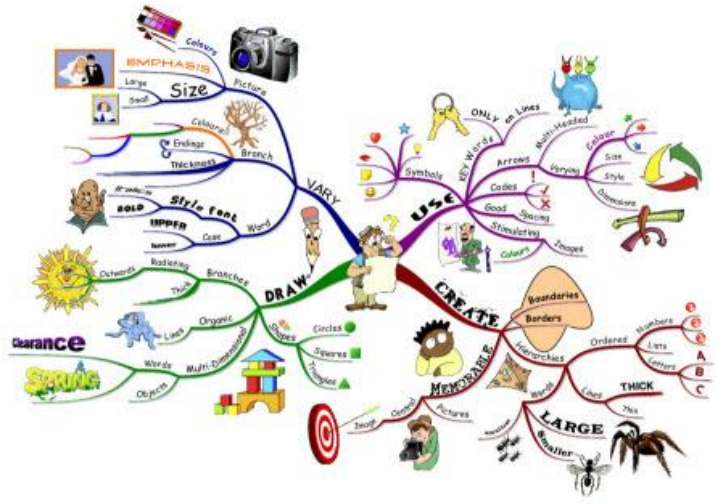

Figure 13. Mind map example (from http://blog.iqmatrix.com)

DRAWING MIND MAPS

Drawing a mind map is a rather simple process. Buzan (2001) proposes the following steps:

1. Start in the centre of a blank page turned sideways, to be free to spread out in all directions and to express itself more freely and naturally.
2. Use an image or picture for central idea, using at least three colours, because an image helps the imagination and the concentration and is more interesting.

3. Use colours throughout the map, because they add energy to creative thinking, and are fun.
4. Connect main branches to the central image and connect the second- and third-level branches to the first and second levels, etc., to develop the associative thinking.
5. Make the branches curved rather than straight-lined (that are *boring* to the brain).
6. Use one key word per line, because single key words give mind map more flexibility.
7. Use images throughout, because each image is worth a thousand words.

Drawing mind maps in this way helps to stimulate imagination while at the same time creating strong associations. Moreover, they are two factors that stimulate long-term memory, recall of information, greater flexibility and creative self-expression.

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Annex 7 - Concept Maps[8]

Concept maps are graphical tools for organizing and representing knowledge, developed by Novak in 1972 (Novak & Musonda, 1991). They represent a network of relations between concepts, in a tree structure which branches downwards, from father, super ordered and more "inclusive" concepts to subordinated son concepts.

The concepts are usually enclosed in circles or boxes of some type (identified as nodes), while the relationships between the nodes are indicated by a connecting line linking two concepts.

Words on the line (linking words or linking phrases) specify the connection - logical, argumentative, causal, chronological, predicative, or other, between the two concepts, to form propositions.

A proposition is a meaningful statement about some object or event in the universe, a semantic unit, or units of meaning.

Transversal relationships (crosslinks) are also present between distant branches of the tree. These are relationships or links between concepts in different segments or domains of the concept map. Cross-links help us see how a concept in one domain of knowledge represented on the map is related to a concept in another domain shown on the map. In the creation of new knowledge, cross-links often represent creative leaps on the part of the knowledge producer.

A final feature that may be added to concept maps is specific examples of events or objects that help to clarify the meaning of a given concept. Normally these are not included in ovals or boxes, since they are specific events or objects and do not represent concepts.

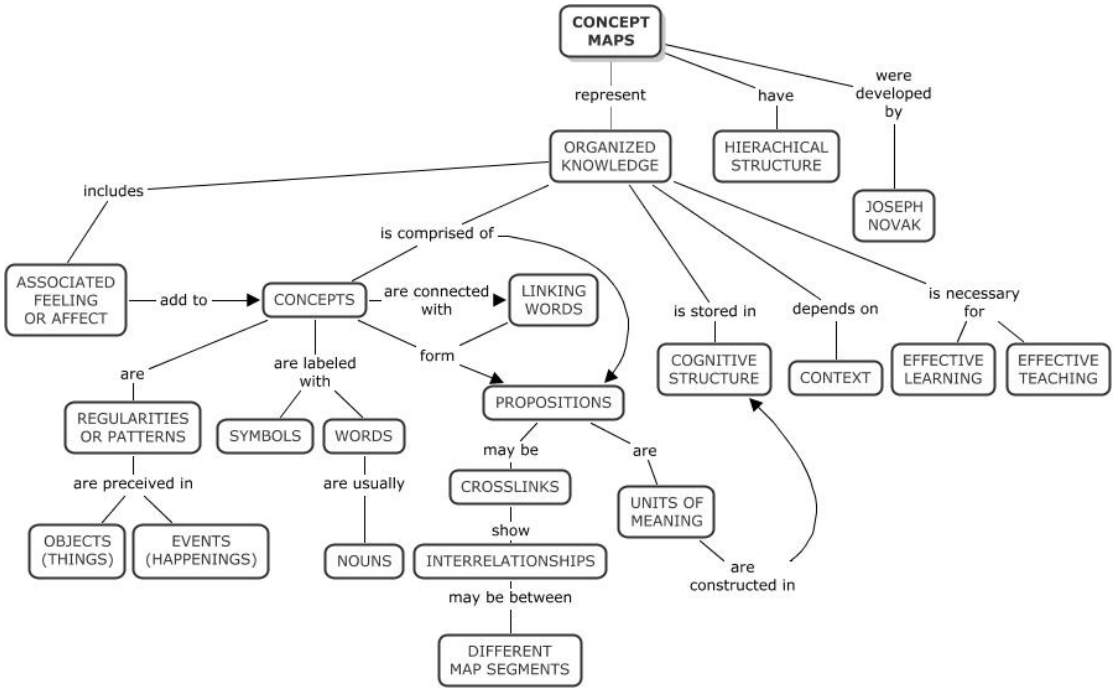

Figure 14. What are concept maps? Concept map from Cañas & Novak, 2008.

[8] From Novak, J. D. & Cañas, A. J. (2008). The Theory Underlying Concept Maps and How to Construct Them.

MEANINGFUL LEARNING

Concept maps are based on the learning psychology of Ausubel (Ausubel, 1963; 1968). The fundamental idea is that learning takes place by the assimilation of new concepts and propositions into existing concept and propositional frameworks held by the learner. This knowledge structure as held by a learner is also referred to as the individual's cognitive structure.

Ausubel made the distinction between rote and meaningful learning. Rote learning is the simply memorizing of information without relating it to previously learned knowledge. Meaningful learning is the opposite. It means ability to formalize our thought, to understand the relations between concepts, to give sense to what we learn, to rebuild our knowledge every time we learn something. The knowledge acquired is remembered longer, and further learning of similar topics becomes easier; the information learned can be applied to a wide variety of new problems or contexts, thereby stimulating the search for new meanings and a high generalisation of knowledge, together with the indispensable feature of problem solving and creative thinking. Meaningful learning also promotes metacognitive strategies (learning to learn, and thinking about knowledge). In other words, Meaningful Learning is the way to transform data in knowledge and knowledge in wisdom.

According to Ausubel (1968), the rote-meaningful distinction is not a simple dichotomy but rather a continuum.

Meaningful learning requires three conditions:

- *The learner must possess relevant prior knowledge*. Concept maps can be helpful to assess the learner's specific knowledge about a topic.
- *The material to be learned must be conceptually clear and presented with language and examples relatable to the learner's prior knowledge*. Concept maps can be helpful to meet this condition, both by identifying large general concepts held by the learner prior to instruction on more specific concepts, and by assisting in the sequencing of learning tasks though progressively more explicit knowledge that can be anchored into developing conceptual frameworks.
- *The learner must choose to learn meaningfully*. This is a condition over which the teacher has only indirect control, and this control is primarily in instructional and evaluation strategies used: teaching strategies and evaluation strategies that encourage learners to relate ideas they possess with new ideas, foster meaningful learning.

Concept maps are used as a learning tool but also as an evaluation tool, thus encouraging students to use meaningful-mode learning patterns (Mintzes et al., 2000; Novak, 1990; Novak & Gowin, 1984). They are also effective in identifying both valid and invalid ideas held by students, and the relevant knowledge a learner possesses before or after instruction.

CONSTRUCTING GOOD CONCEPT MAPS

The hierarchical structure for a particular domain of knowledge depends on the context in which that knowledge is being applied or considered. Therefore, to construct a concept map, it is important to begin with a domain of knowledge that is very familiar to the student. It is also helpful to select a limited domain of knowledge for the first concept maps.

To define a concept map it is best to construct a *Focus Question*, that is, a question that clearly specifies the problem or issue the concept map should help to resolve. Every concept

map responds to a focus question, and a good focus question can lead to a much richer concept map; in fact, the first step to learning about something is to ask the right questions.

Given a defined question, the next step is to identify the key concepts that apply to the domain (usually 15 to 25 concepts). These concepts could be listed, and then from this list a rank ordered list should be established from the most general, most inclusive concept at the top of the list, to the most specific, least general concept at the bottom of the list.

The next step is to construct a preliminary concept map, by linking the concepts. After a preliminary map is constructed, it is always necessary to revise this map, add other concepts if necessary. Good maps usually result from three to many revisions. For this reason, using a computer software, as IHMC CmapTools (Cañas et al., 2004, http://cmap.ihmc.us) is helpful, because it allows moving of concepts and links to restructure the map.

Finally, cross-links should be sought. They are important in order to show that the learner understands the relationships between the sub-domains in the map.

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Annex 8 - Project Plan Examples

EDUCATION SECTOR	SUBJECT(S)	THE LEARNING EXPERIENCE	ADDED VALUE FOR TEACHING
VET (Italy)	HISTORY The complete program carried out during the school year	**HISTORY OLYMPICS** • ***Students involved (number, age, characteristics…):*** 50 VET students, including 25 foreign students and 4 with cognitive delay. Age: 17-18 years 4 classes: 3 ^ mechanics - 3 ^ Panel beaters - 3 ^ Plumbers- 3 ^ Operators to Numerical Control Machine • ***Learning Objectives*** Review the History program Evaluate the learning acquired during the school year Prepare for the vocational qualification exams • ***Overall duration:*** 1 mouth - about 5 hours (+ time-study) • ***Temporal progression of activities*** The activity is organized as a championship between the classes based on students' ability to correctly answer a test of history on the IWB. 1) students in each class will divide the topics of the history program by reviewing 2) the teacher, by extraction, combined in pairs classes 3) qualifications (2 hours) on the IWB 4) semifinals (1 hour)on the IWB 5) the finals (test on the IWB) and awards ceremony (1 hour) • ***Expected outcomes and products*** Multiple-choice questionnaires covering the entire history program. Transforming the time of evaluation in cooperative learning experience. Cooperation and teamwork in each class Familiarize with the IWB **METHODOLOGY** Collaborative learning. Peer tutoring. The teacher will divide the history program into sections. The students in each class will divide the sections: each student is responsible for one section. The students then teach one another the sections they have worked on. The teacher prepares a multiple-choice test on the IWB with immediate feedback. The test contains about 150 questions and is constructed using materials from the Internet. During the matches are proposed only 50 questions, random. The teacher draws the classes that will face one another. During the matches, the teacher draws by lot at least 5 students per class, who must respond to the test on the IWB: in this way, all students must be prepared in the whole history program. The teacher on the IWB opens two pages: each page includes the same test version; the students of two classes will have to respond to the test.	The IWB can improve the learning process because: - Makes the activity more interesting, fun and engaging; - Provides information, images, materials for testing directly from the Internet, making them immediately usable by the students; - Allows the interaction of two students at once; - To take up the activities in front of all classes.

EDUCATION SECTOR	SUBJECT(S)	THE LEARNING EXPERIENCE	ADDED VALUE FOR TEACHING
HIGH school (Italy): Technical Institute	MATHEMATICS Polynomials	**PODCAST: POLYNOMIALS** • ***Students involved (number, age, characteristics…)*** 21 high school students, including 1 foreign student and 1 with dyslexia. Age: 15-16 years (first class) • ***Learning Objectives*** To acquire a correct terminology Knowing the rules of operations between polynomials Knowing polynomial products and functions Familiarize with the functions of the Garageband software (to realize podcast - Apple) • ***Overall duration:*** About 6 hours • ***Temporal progression of activities*** Students must produce a podcast on polynomials. The activity will include: 1) lecture (1 hour) to provide operational instructions about the activities 2) collaborative work: the students divided into pairs surf various sites proposed by the teacher to get the information and illustrations necessary, finally, preparing the material necessary to record the podcast (2 hours) 3) recording and editing audio podcast. The work is organized and shared on the IWB (1,5 hour) 4) adding a selection of images related to text. The work is organized and shared on the IWB with the whole class; students interact directly to the IWB, alternating (1,5 hours). • ***Expected outcomes and products*** A podcast about polynomials. Cooperation and teamwork Familiarize with the IWB and with a podcast software **METHODOLOGY** Lecture followed by group work with collaborative learning. The teacher on the IWB proposes a work plan, explains the use of software, selects the internet sites, organizes and supervises the work of students. Students work collaboratively to: - Get the information and illustrations - Select the materials and write the texts to recorder - Learn to use the Garageband software - Share a work plan - Create a podcast by selecting the most appropriate method and materials - testing the podcast - Assess the podcast - Assess the activities carried out	The IWB can improve attention, understanding, learning and exposure of the contents - make activities of cooperative learning easier The IWB will be used to compose together with the students an outline of work and then to follow all the phases of the assembly of an 'increased' podcast. The IWB allows to gather and present the results found in group activities, and to share the work that will be carried out with the whole class. This allows a metacognitive reflection on the work.

EDUCATION SECTOR	SUBJECT(S)	THE LEARNING EXPERIENCE	ADDED VALUE FOR TEACHING
HIGH school (Italy): Technical Institute for surveyors	PHYSICS Ohm's Law	**SIMULATION: OHM'S LAW** • ***Students involved (number, age, characteristics…)*** 40 high school students. Age: 16-17 years (second classes) • ***Learning Objectives*** Promote understanding of Ohm's Law Check the knowledge gained in the laboratory Develop presentation skills • ***Overall duration:*** About 4 hours • ***Temporal progression of activities*** The activity will include: 1) simulation on the IWB (1 hour) 2) individual work in the physics laboratory (2 hours) 3) writing the report on the activities (group work - 1 hour) 4) sharing the reports on the IWB (1 hour). • ***Expected outcomes and products*** Select and save simulations about physics available online Students' reports Reflections on laboratory procedures Familiarize with the IWB **METHODOLOGY** Multimedia lecture followed by interaction on the IWB, laboratory experience and group work with collaborative learning. The teacher on IWB shows the simulation on Ohm's law from the PHET site: http://phet.colorado.edu/en/simulation/ohms-law and asks students to use the simulation. Then he prepares and makes performing the same activities in the physics laboratory. Students interact with the simulation on the IWB, then work individually in the laboratory in an Ohm' law activity. The teacher divides the students in little groups (3-4 students): each group have to write a report on the activities, listing the data collection and evaluating the differences and similarities between the simulated and the real situation. Each group shows their data and observations on the IWB. The teacher, with the help of the whole class, identifies common conclusions and points put them on the IWB.	The IWB can improve - attention, understanding, learning, preparation by the students - the ability of exposure of the teacher The use of simulation to the LIM, combined with the laboratory, can enable students to better understand the activities that take place in the laboratory and view the difference in the levels of reality. The IWB will be used to gather and present the results found in students activities, and to share the groups' reflections with the whole class.

EDUCATION SECTOR	SUBJECT(S)	THE LEARNING EXPERIENCE	ADDED VALUE FOR TEACHING
ADULT EDUCATION: Course for graduation (working students)	ITALIAN The poetry of G. Pascoli	**GIOVANNI PASCOLI POETRY** • ***Students involved (number, age, characteristics…)*** 12 working students, including 3 students with *Italian* as a *Second Language* (ASILS). Age: 30-55. • ***Learning Objectives*** Acquire methodological skills for the study of the poetic text (paraphrase, metrical structures, keyword analysis, message) Recognize and analyze the characteristics and the leitmotiv of Pascoli's poetics Recognize and analyze characteristics of poetic language of Giovanni Pascoli Make connections between the author's biographical story and the main themes of his works • ***Overall duration*** 8 hours • ***Temporal progression of activities*** The activity will include: 1) lecture on the IWB (3 hours) 2) surfing the Internet resources on the IWB (2 hours) 3) crossword on the IWB to summarize the contents (1 hour) • ***Expected outcomes and products*** Select and save materials available from Internet Crosswords Smart Notebook lesson (Learning Object) Podcast WikiTeca Files- Texts and Poems performed: Il fanciullino - Lavandare - X Agosto (San Lorenzo) **METHODOLOGY** Lecture with audio files (podcast), followed by interaction on the IWB. The teacher prepares and gives a lesson on the IWB to explain the poetics of Pascoli. Students listen. After the lecture, the students take turns using the IWB and surfing the internet to visit the links and podcasts provided in the lecture. At the end, the teacher proposes a crossword puzzle on the IWB: students respond and complete the crossword.	The IWB allows the use of resources and materials available on the Web. The use of podcast audio on the IWB can improve - attention, understanding, and can enable students to better speaking in Italian.

EDUCATION SECTOR	SUBJECT(S)	THE LEARNING EXPERIENCE	ADDED VALUE FOR TEACHING
VET	ELECTROPHYSICS The lightning rod	**CONCEPT MAP: THE LIGHTNING ROD** • ***Students involved (number, age, characteristics…)*** 12 VET students, including 7 foreign students. Age: 17-18 years. • ***Learning Objectives*** Recognize and analyze the characteristics of a lightning rod Assess the learning about the lightning rod and the the acquisition of correct terminology Analyze and synthesize the main concepts about the lightning rod and the electrophysics principles. • ***Overall duration*** 5 hours • ***Temporal progression of activities*** The activity will include: 1) introduction to the activity (10 minutes) 2) individual construction of a concept map (paper and pen) lecture on the IWB (2 hours) 3) presentation on the IWB of cmaps produced (2 hours) 4) discussion and evaluation (50 minutes) • ***Expected outcomes and products*** Students' concept maps **METHODOLOGY** ***Indicate the teaching methodology and how you intend to use the IWB. Specify: What does the teacher? What do the students?*** Interactive lesson with concept mapping activities. The teacher introduces the activity, organizes and supports the construction of concept maps. He coordinates the discussion of cmaps and their evaluation. Students construct cmaps individually on a blank paper: each student can use books and notes. The concept maps produced will be collected and processed through a digital copier (or other means) and then projected onto the interactive whiteboard. Each student shows own map and explains the choices made. The whole class comments and assesses concept maps. The teacher intervenes with his assessments and gives reasons for the final evaluation.	The IWB allows - to show and reflect on the thought processes that led to the concept maps (metacognition) - to share cmaps, but also the method of evaluating them -to reflect on the evaluation processes.