Chapter #14

TIME AND INNOVATION AT SCHOOL
The efficacy of Space Learning method in classroom

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ABSTRACT
The concept of *teaching competence* challenges today pedagogical research in the effort of finding new ways to organize the curriculum and to design learning activities in classrooms. EDOC@WORK3.0 project deals with the need to rethink the dimensions that characterize an educational practice, with specific regard to the dimension of "time", so as to adapt it in order to favor a differentiation in disciplinary teaching. This project supported teachers in acquiring competencies in new methodologies related to *time scheduling* and accompanied them in its design and application in their classroom. In this chapter we will present the didactic methodology known as *Spaced Learning*, inside the theoretical framework of adaptive teaching and allocated time. We will describe the results of the experimentation conducted by the teachers who attended the PON EDOC@WORK3.0 project and the training experience made in such an innovative educational method.

Keywords: teaching competence, spaced learning, allocated time, time scheduling, adaptive instruction, teaching practice, innovation, school, neuroscience.

1. INTRODUCTION

The concept of competence teaching challenges today pedagogical research in the effort of finding new ways to organize school curriculum and to design learning activities in classrooms. The idea of an innovative didactic rethinking the time dimension that characterize an educational practice and to adapt the *learning time* and *allocated time*[1] (Glaser,1977; Anderson, 1980) in order to favor a differentiation in disciplinary teaching, is gaining field (Boccanfuso, Walker, Princiotta, Knewstub, & Moore, 2012; Farbman, 2012; Ylimaki & Brunderman, 2014).

In the framework of EDOC@WORK3.0[2] Project (Research & Competitiveness National Operative Programme 2007-2013: Smart Cities and Communities and Social Innovation) INDIRE - the Italian National Institute for Educational Research and Innovation[3] - is committed to accelerate the conditions enabling didactic innovation in Apulia region. Through the monitoring and observation of the experimentation of education projects in the recent years, the institute got in touch with a number of didactic innovation examples thus detecting those that could foster a meaningful change in the school didactic and organizational praxis towards a systemic innovation horizon.

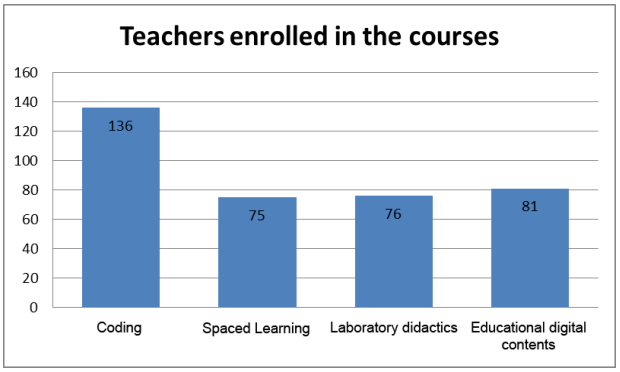
The Italian national movement of *Avanguardie Educative*[4] (literally, educational vanguards) allowed to set up a map of the most mature methodologies that already provided

[1]Allocated time is time during which students have an opportunity to learn some subject matter.
[2]Official home: http://www.edocwork.it/
[3]INDIRE is a public research institute whose main mission is to sustain the evolution of the Italian educational system through technology-enhanced teachers training, system actions for improvement and innovation: http://www.indire.it/
[4]http://avanguardieeducative.indire.it/

evidences as for the positive trends in increasing learning outcomes and reducing early school leaving in Italian schools. As a consequence the institute set up a specific training action on four didactic methods and set up their experimentation so as to investigate the condition under which innovation and effectiveness occur and can be widespread in the whole region of Apulia. The envisaged teachers training path was delivered in a blended mode (40 hours among hands on labs and online autonomous learning, peer discussion and project work production). 21 educational classes have been activated on the themes of *Coding*, *Spaced Learning*, *Laboratory didactics* and *Educational digital contents*.

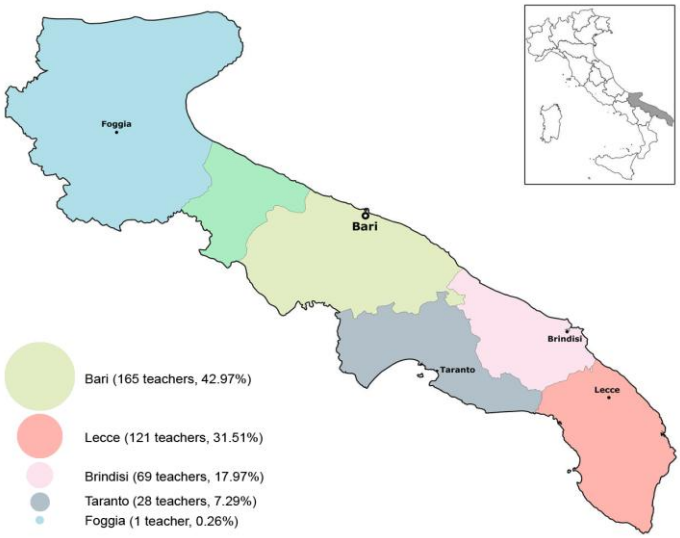
As shown in figure 1, the teachers enrolled in the course were about 400 split in four groups according to the innovative methodology they chose: 136 in Coding, 75 in Spaced Learning, 76 in Laboratory didactics, and 81 in Educational digital contents.

Figure 1. Teachers enrolled in the 4 courses offered by Docenti InFormAzione.



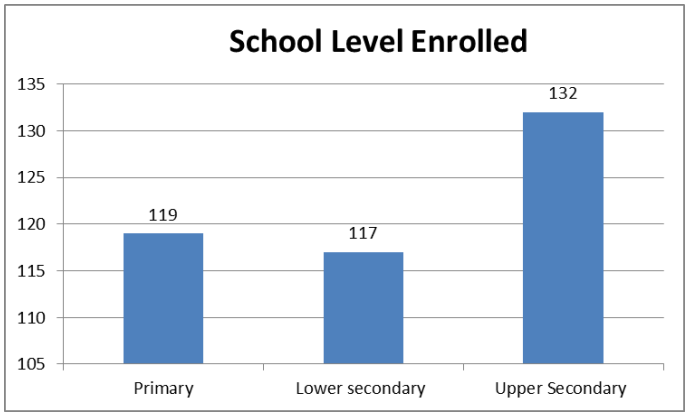
These teachers have been distributed according to the Apulia provinces as illustrated in Figure 2: 42.97% coming from the province of Bari (156 teachers), 31.51% from Lecce (121 teachers), 17.97% from Brindisi (69 teachers), 7.29% from Taranto (28 teachers), and 0.26% from Foggia (1 teacher).

Figure 2. Number of teachers enrolled in the training classes by geographical area.



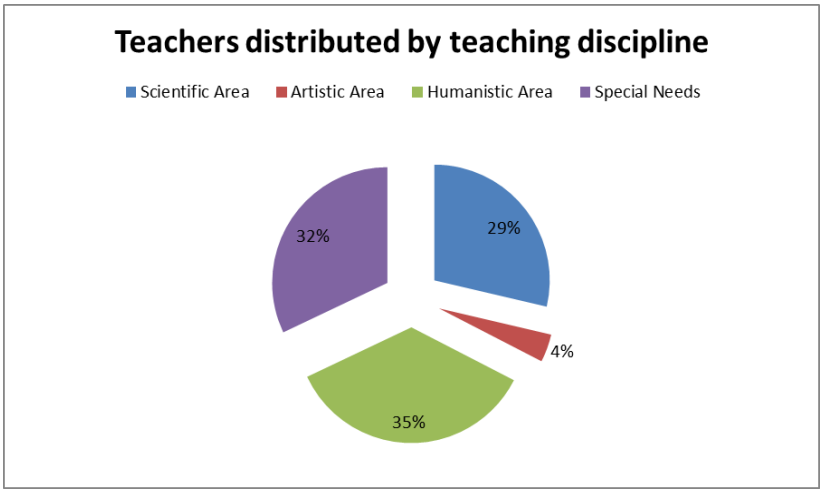
As shown in Figure 3, 119 teachers work in primary schools, 117 in lower secondary schools, and 132 in upper secondary schools.

Figure 3. Teachers enrolled in Docenti InFormazione according to school level: primary, lower secondary, upper secondary.



The training path conducted on the four methods thus involved 368 teachers from Apulia experimenting innovation in their respective teaching field: 35% humanities, 29% scientific, 4% arts, whereas a significant number of teachers (32%) were Special Need teachers. The implemented courses have been designed to be strongly focused on practice so as to sustain teachers in the development of professional skills also using technologies. The courses also aimed to stimulate teacher reflection on how to consolidate the new methodologies in their classroom improving their practice every day.

Figure 4. Teachers distributed by teaching discipline.



Being specifically focused on the dimension of "time", Spaced Learning proved to be a suitable methodology to increase students' involvement, attention and long-term memorization. *Pedagogical patterns* that refer to *time-based innovative models* and practices to be experimented in the context of teaching are therefore identified and formalized. In this chapter we first present the didactic model and the research in support of the didactic impact and then the results in terms of learning outcomes of a sample group of students coming from the experimentation classes in Apulia.

2. BACKGROUND

Time is a critical dimension of the curriculum and of learning (Duncheon & Tierney, 2013). The construct of time influences student learning inside and outside school and consequently pervades the educational discourse. In a recent report (Baker, Fabrega, Galindo, & Mishook, 2004) the authors examine the influence of time on learning outcomes worldwide. What they consider fundamental is not the linear relationship between time spent on lessons and learning outcomes, but rather the need to understand how time dimension – from an adaptive point of view and in the direction of personalizing the educational offer – can drive a review of curriculum, educational schedule and teachers' action.

Time dimension is one of the elements that can trigger the process of schools' adaptability among learners and guarantee opportunities for their individual success and development (Millot & Lane, 2002). The distinguishing feature is precisely based on teacher's ability to meet the specific individuality of each student. This ability is commonly referred to as *teaching adaptively* (Corno, 2008). We therefore need "to capture the adaptive strategies" to foster the manipulation of all elements able to drive practices of "adaptive teaching". As a concept, adaptive education can be actually defined as the use of alternative formal-or-non-formal educational strategies in the framework of a curriculum, that are able to meet students' needs (Mangione, 2013) The ability of adapting didactic conditions and situations is a required condition to build an effective learning environment, as stated also by Wang (1992) who suggests that "creating effective, practical school learning environments that are responsive to the diverse needs of students has been a continuing challenge in school reform efforts" (p. 1).

The connections between learning and time management are one of the most studied topics in psychology of education (Fredrick & Walberg, 1980). Several researches adopted the concept of time as the fundamental dimension to the learning process, linking particular time allocations with achievement variations (Duncheon & Tierney, 2013) and demonstrating a strong and positive influence of time on learning and *effective teaching* (Wang, 1984). According to Walberg, Niemiec, & Frederick (1994), "along with effective teaching productive time engenders learning". These authors also suggest that "time should be a central concept in curriculum theory and practice" (p. 86).

The theme of "time optimization" compared to interruptions that can be functional or not to long-term memory, as well as "time customization" for carrying out complex tasks and for the study of particular disciplines, have been the subjects of numerous studies and investigations (Duncheon & Tierney, 2013).

Particularly, Leonard's works on "instructional time" (Leonard, 1999), the one by Lasley on "time on task" (Lasley & Walker, 1986), and the one that start to questioning about the influence of individual dimension on the relationship between *time spent on learning* (TSL) and *time needed for learning* (TNL) and on the impact of this relationship on students' achievement[5] (Gettinger, 1984), have fostered a theory of time as a predictive factor of "educational productivity". These studies are the basis of modern theories that revalue time as an element for learning activities in the classroom.

Reflections on the efficient utilization of time in education and on time scheduling in the curriculum (Patall, Cooper, & Allen, 2010; Brucato & Gainey, 2014) on one side, and the attention to micro-management of time in experiences in order to support memorization (Kelley & Whatson, 2013) or on learning interruptions through the "erosion teaching time" (Leonard, 2009) on the other, bring us to ask about new educational models planned and managed on the base of a different utilization of time and space in teaching and learning activities.

In the context of the project EDOC@Work3.0, *Spaced Learning* method has been selected among many subjects for a widespread training in Apulia region. A blended approach has been employed to make teachers understand the method and its application in the classroom, albeit in a limited and experimental form.

We will point out how this process, ranging from training to experimentation, is the basis for identifying the conditions that allow us to bring innovation in the classroom and contribute to its management and customization with respect to the context.

3. SPACED LEARNING: THE METHOD

Spaced Learning is a particular approach, investigated in neuroscience (Fields, 2005), *characterized by a specific definition of the lesson timing,* (Fields, 2005), aimed at fostering the memory encoding by using its typical time pattern. *How can the genes of a single neuron know how to reinforce a synaptic path?*". Fields discovered that the creation process of long-term memory had "time" as key factor: the repletion of three stimulation, spaced by 10 minutes without stimulation, triggers a reaction that reinforces the permanent synaptic path (Barratt & Kelley, 2008). Brain cells are illuminated and linked depending on how they are stimulated: 10-minutes interval between stimulations leads to the long-term memory building (Kramár et al., 2012). As Kandel et al. (2014) and others have pointed out, human memory involves different mechanisms that encode, consolidate, reactivate and update explicit memory. Spaced Learning is an encoding technique for students.

Spaced Learning envisages structured repetition of contents separated by small intervals; this method supports storing learned information into the long-term memory (Cain & Willey, 1939). Kelley (2008), experimenting the method throughout one entire year during physics and biology teaching, demonstrated an increased effectiveness of this method as it regards the speed of learning, with respect to traditional teaching techniques.

[5]TNL refers to the number of learning trials, or exposures to a passage, needed to obtain 100% accuracy on a criterion test covering the passage content; TSL refers to the number of self-determined trials spent on an alternate task form.

A Spaced Learning lesson consists of three "inputs" of short duration (15-20 minutes), concerning the subject of the learning process and spaced by 10-minutes breaks. During the breaks students attain at simple activities, such as dribbling a basketball or playing with modeling clay, that should be unrelated to the content of the lesson. This aims to minimize the danger of disrupting the pathways being formed to record the information in the two inputs that are followed by breaks.

The first input given by the teachers provides the information that the students are required to learn during the lesson. Here it is important to provide the essential information with the technical language characterizing the topic. The duration of the input is not predetermined: 10-15 in order to keep students' attention. In this session the neuronal path start to create memory. This first moment is followed by a 10 minutes interval that must have nothing to do with the lesson's content. During this and the successive interruption it is important to avoid stimulating memories paths that are being formed so that they can find their consolidation in the rest[6]. Henceforth the activity must have nothing to do with what students are learning so as to increase the possibility that the neural path "rest "and form stronger connections.

Kelley envisages activities of equilibrium, movement, coordination to be developed in collaboration. Since student's school identity is strongly influenced by the cultural implicit shared by the related cultural context, we found that Italian students succeed in relaxing during individual activities and not in the group activities. Indeed in the latter case students tend to continue talking about the topics presented during the lecture during the input moments thus invalidating the method since they do not allow to the neural path to strengthen through resting. Asking to students what they want to do the day before the lecture can allow teachers to better organize the relax moments.

During the second input the teacher revisits the content of the first session recalling the key topics and changing the way to present its content (for instance using different examples and changing the interactivity modes). The same neural paths will thus be stimulated, strengthening their importance to the brain. Different key examples could be used or some key information could purposely be neglected to observe what students remember from the first input. It is important to specifically remove the information that students are required to know, since their attention should focus on this information only when they are required to recall it.

In the second interval the same principles of the first one are applied, providing a relax time of about 10 minutes. In this interval the activity can be a variation of the former one; again, the importance is that it is not related to the lesson's content.

During the third input the teacher stays on the first session's content, and proposes student-centred activities: students are required to demonstrate what they acquired about the content shared during the first input, applying their knowledge to exercises or problems. In this phase the teacher will monitor the students just to verify their actual comprehension of the content. The choice of the test used to check students' learning is up to the teachers. Given the limited time at our disposal in the experimentation phase, we decided to

[6]The lead neuroscientist recommended the two 10-minutes spaces were distractor activities, ideally physical activities to minimize possible interference in the synaptic tagging and capture processes putatively occurring (Fields, 2005).

administer a multiple choice questionnaire allowing partially-automated result processing. The use of student-centered authentic tests would have provided a more complete assessment method in case of a greater availability of time, since the student has to face situations/problems showing what he/she learned, minimizing the risk of mere content memorization.

As for the Spaced Learning technique, currently few research results are known. In recent scientific works (see Carpenter, Cepeda, Rohrer, Kang, & Pashler, 2012), students adopting only Spaced Learning produced remarkable results (see Kelley & Whatson, 2013). Three types of structured tests have been conducted for the study of this method in biology in UK: 1) a study with students aged 13-15 randomly divided into an experimental and a control group; 2) a study with students aged 14-15 homogeneously divided into groups by ability, randomly assigned to a control and an experimental group; 3) a study with students aged 14-15 to whom teachers administered Physics lessons with "traditional" rehearsal and final test and Biology lessons with spaced learning rehearsal and final test (Kelley & Whatson, 2013).

Nationally standardized results of the high-stakes test for all groups in the study were analyzed by the CEM Center, comparing individuals' predicted and achieved scores through linear regressions, and these data were used as the basis of results analysis. Both in case 1) and 2) one hour of instruction through Spaced Learning had an impact significantly greater than many hours of teaching. Experimental groups' scores were based on 60 minutes of instruction, and control groups' scores on teaching over four months with 23 hours of direct instruction. In case 3) the regression analysis of experimental group's scores in Physics and Biology organized by ability level produced a similar significance value.

Results show that long-term memory related to a whole school year can be rapidly reconstructed through Spaced Learning and that students seem to easily get used to the method. Even if there are substantial proofs that a number of communication systems in humans and in other species operate quickly, with exchanges occurring in milliseconds, this cannot explain the impact of Spaced Learning on the high speed of learning proven by test results. Evidences suggests that Spaced Learning is more efficient than traditional teaching. These results have evident parallels in Neuroscience, that show rapid memory storage in humans and indicate that time manipulation is a key variable for learning. Kelley's study is limited to Biology and Physics, and it does not directly explore the use of Spaced Learning in different subject matters and with students aged other than 13-15. The results of this study should be explored in different contexts with subjects of different age and other tests should be used to assess the learning outcomes.

Indeed, the use of authentic tasks and the TIC integration can ease the design and development of learning situation and they could function as an "antidote" to reduce this method to a mere memorization technique.

The model requires a micro-design effort that can be a detractor to its implementation. However, this limit is partly overcame by the awareness that teachers manifested, about the capacity that the method has to act on students' curiosity, motivation, interest, concentration and memorization (Xue et al., 2011; Carpenter et al., 2012). To present, remembering and understanding information are respectively the keywords associated to the three inputs of Spaced Learning patterns.

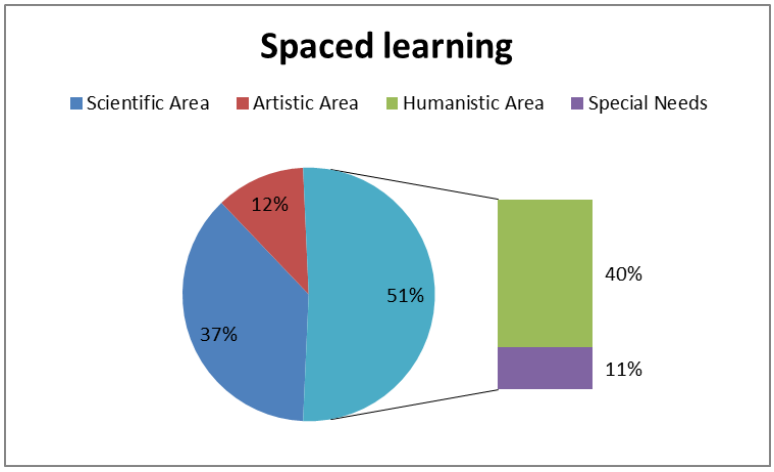
The teachers who are currently attending the training project are using this methodology to accelerate the mastering of advanced topics with their best students, or rapidly create long term memory for students who are inattentive. This methodology can be combined with other less common forms of learning, based on the investigation and retention of concepts (such as *Enquiry-based Learning* or *Flipped Learning*) (Deignan, 2009; Lewis & Kelly, 2014).

4. "DOCENTINFORMAZIONE": THE EXPERIENCE

The teachers' training activity on Spaced Learning method was one of the training initiatives offered to primary, lower and upper secondary school teachers within the wider program "Docenti InFormAzione" (lit. *TeachersInTraining*) in Apulia region.

Overall 26 classes of Math and Science teachers, 8 classes of Art teachers, 28 classes of Humanities teachers followed the Spaced Learning course; 8 experimentation have been conducted for Special Educational Needs (SEN) teachers, confirming the value of this method in inclusion and personalization (see Figure 6).

Figure 5. Disciplines involved in Spaced Learning experience.



The educational mode is based on laboratory didactics, centered on learning by doing and aimed to support the modeling process and practices useful to experiment such a method with the students in the classroom.

The course was conducted by an expert teacher, selected from a school leading the *Avanguardie Educative* movement, capable to adapt the methodology to the didactic contexts described by the teachers attending the course allowing wide margins of flexibility in the implementation of the solutions in class.

The training experience aimed at increasing teachers' competencies in the Spaced Learning method implementation in a context of collaborative reflection and reciprocal enrichment. During the first face-to-face meeting, the expert teacher described the added value of Spaced Learning and illustrated a "pedagogical template", namely an organizational pattern to guide the design of a Spaced Learning lesson plan in primary and

secondary school. Then teachers were grouped by discipline and school level, and they negotiated the topic on which to create the class (see Figure 6). Cooperative learning dynamics have been supported by the expert teacher since this phase. In the second meeting, a first input of the Spaced Learning was provided. During the first 15 minutes the expert teacher introduced simplified guidelines and provided key points. Each teacher, within his/her group, was assigned the task to realize a multimedia presentation highlighting the main content of the topic to be dealt through the definition of keywords, relying on the possibility to use an interactive whiteboard or projector in the classroom.

Figure 6. Captures of teacher training activities.

During the third meeting the teachers, individually but within their scaffolding group[7], were required to realize a second input for the Spaced Learning. The review of the topics of the first session was carried out through interactive contents and ideas, in a group activity setting. The expert indicated a series of multimedia tools (such as Educanon, Teachem or Knowmia, specific environments which let him build and share interactive video lessons), guiding the learners-teachers in the development of skills allowing a dialogued lecture.

During the fourth meeting, the expert showed how to build a virtual classroom. This is a fundamental activity, since documents, products and interactive-test sharing in the cloud is a specific need of the collaborative activity among teachers aimed at designing tools to assess students' learning.

The training experience raised interest and enthusiasm from involved teachers, who experienced it as an opportunity to renew their didactics. The novel aspect is a flexible model that allows each student to lead his/her learning process, to become more autonomous and responsible, as well as interested in studying.

Teachers have been engaged in social discussions and collaborative reflections on the link to *Flipped Classroom* and *Block scheduling* method which, together with the *Spaced Learning*, feed the galleries of the ideas of the cultural movement *Avanguardie Educative* originated by INDIRE to promote school's change through a new time conceptualization.

[7]We define as "scaffolding group" a set of teachers who teach the same subject in the same school level and help each other in bringing this innovation to their classes.

5. EFFICACY OF THE METHODOLOGY: OBSERVATIONS IN CLASSROOM AND EVALUATION OF LEARNING RESULTS

In order to analyze the modality of introduction of innovative practices in the context of traditional didactic situations, the research group privileged the adoption of an empirical interpretative research approach defined in the methodological literature (Semeraro, 2014).

This research type is grounded on the constructivist ontological approach: the theoretical framework in this case does not advance by hypothesis; instead explorative aims are pursued.

The same phenomenon is studied in specific cases (selected by spontaneous acceptance and not by selection of the best situations or projects) from multiple independent perspectives, using multiple approaches and techniques in a sort of *triangulation* (Cook & Reichardt, 1979) among class observations, interviews, reflections on learning objectives.

5.1. The observation of Spaced Learning in Apulia classroom

A specific "observation grid" has been designed for recording the class activity and the related logbook.

As for the type of student participation**,** there are interesting elements that show how time management and technology integrated in the instructional design favored a student active and collaborative role. In particular, it is clear from the interviews the surprise effect resulting from the introduction of pauses deliberately devoid of references to the topic under study. With regard to the question related to time management, a student says: *"I was very impressed when the teacher gave us the 10-minute break, when she said 'Do whatever you want' and especially struck me when she said 'Do something that is not connected to the lessons'. The breaks have certainly undermined the traditional classroom teaching, favoring students concentration."* In this regard, a second student said: *"At the beginning the teacher explained for about half an hour and then we were left free for few minutes and then during the lesson she asked us some questions on the subject. The novelty was the break. We liked this novelty. I had the impression of being more concentrated"*. What changed is not the amount of hours devoted to curricular matters, but the way to review the unit of time specified in a form suitable to support long-term memory development, without the cognitive load that the timing of traditional lectures generates. To this end, another student said: *"The distribution of time between the activities carried out by the teacher and those that we carry out remains the same, maybe we learn more because lesson breaks allow us not to get tired towards the end [...] With this new method the mind is even more refreshed... ".*

The lesson break encouraged the construction of moments of exchange and dialogue – *"In the pauses the communication exchanges between us students increased"* – although a difference in the articulation of space in the classroom setting was not registered: *"No, there was no change. We're always in that position in the classroom, we have traditional desks."*

During the first break, the boys of the class, organized in a circle, each with his own tablet or iPad, engaged in recreational activities based on video games. Girls spent time listening music via mobile devices, watching video clips on YouTube or reading e-books. None of the students exchanged information about the content of the lesson in progress (figure. 7).

Figure 7. Break in the Spaced Learning.

During the assessment students, with the permission of the teacher, used search engines to disambiguate some functional concepts to carry out the test. Themes have been the subject of sharing across the classroom using the interactive whiteboard. Finally, students used online repository environments or specific applications (e.g., Dropbox) to share the final exam file with the teacher. Time management also influenced the way and the effectiveness of the assessment, as highlighted by the students themselves: *"The new articulation of time changed the way we face the test because we checked if we had understood the lesson, while usually the teacher explained first and questioned us after [...] I experienced this change as a pleasant thing, because we had time to relax after the explanation and also to reflect on what we had done [...] better understanding concepts."*

The teaching practice thus influenced and supported the effectiveness of the method. Mobility granted by supplied device enabled a better supervision of the class action and a responsive scaffolding to specific requests of students, including in-depth clarification towards less performing and introverted students. The teacher showed a particular ability in the management of the technological equipment, articulating her action between a general and a more dedicated and customized level. She used the peer learning method through dialogue and discussion, thus keeping the levels of motivation and sharing high.

Technology has been fully integrated in the design and teaching practice and in the lesson timing. The ability to use mobile devices and the whiteboard encouraged participation and accelerated learning to the extent that students were able to associate teacher's explanation to concrete images, videos and content from the web and also dedicate more time to the exercises. In this regard, a student says: *"A very important thing was the use of the iPad as a tool of self-regulation by which it was possible to manage the exercising timing of each student with the general timing of the whole class".*

The dialogued lesson modes were often interspersed by critical questions posed by the teacher that appeared superimposed on the students' tablets, to encourage participation and peer support.

In this model the different articulation of time seems to have really disrupted the lectures and facilitated the concentration of the students as well as the moments of exchange and dialogue. On the other hand, a real integration of technologies in designing the lesson enabled the activation of collaborative knowledge building modes.

It is to be noted, however, that sometimes, even in the presence of a small and limited change of school time, the actors refer of a perceived benefit at a level of understanding and participation which does not have a real and symmetrical repercussion on the learning processes. Moreover, if the benefit is episodic, because it is linked to a "temporary experiment" that does not have a continuity in time and does not bind to a real implementation process of innovation, it is inevitable not to find benefits that invest the more purely cognitive processes involved in learning.

5.2. The learning results

The elements observed in Apulia classroom allow us to position ourselves critically with respect to what emerged from the data collected in the sample of 8 classes in which learning assessment tests were administered.

Do students involved in innovative educational models based on the new articulation of time envisaged in Spaced learning reach higher learning outcomes than those experimenting traditional teaching models?

The methodology envisaged that the assessment tests were designed by the teachers at their discretion so as to appraise the fallout of the educational models on four cognitive aspects of learning, declined in indicators freely adapted from Bloom's cognitive taxonomy[8] and Dublin descriptors.[9]

The choice of assessing knowledge/skills instead of competencies was dictated by the very short duration of the experimentation that could not allow the development of skills in relation to the innovative models applied.

Each teacher was required to assess his/her students tests, giving each student a score between 1 and 10 for each of the indicators. The analysis of student achievement is quantified on the basis of the following six groups of profit:

- Level 1: 1 to 3 (completely insufficient)
- Level 2: 4 (insufficient)
- Level 3: 5 (mediocre)
- Level 4: 6 (sufficient)
- Level 5: 7 to 8 (satisfactory)
- Level 6: 9 to 10 (excellent)

Once the student results were collected, based on assessment tests made ad hoc by the teachers themselves, we grouped the scores on scales of performance. The objective was to assess the repercussion that innovation brought in the classroom, resulting from the testing of innovative educational model, on the processes of learning declined in knowledge, understanding, contextualization and evaluation.

Table 1 shows the assessment results for each indicator registered by 8 experimental classes.

[8]Bloom's taxonomy is one of the ways to formalize the phases of acquisition and familiarization with sets of information or theories. It is a distinct taxonomy of educational objectives distinguished by *cognitive* (from which our *indicators), affective* and *psychomotor areas.*

[9]The "Dublin descriptors" are built on the following elements: knowledge and understanding (knowledge and understanding), application of knowledge and understanding (applying knowledge and understanding), ability to draw conclusions (making judgments), communication skills (communication skills), Learning skills (learning skills).

Table 1. Assessment results for all indicators.

Scho-ol	Knowing facts and phenomena					Understanding processes and concepts					Using learned knowledge and procedures					Expressing a judgment on the basis of a criterion or standard				
	1-5	6	7-8	9-10	Total	1-5	6	7-8	9-10	Total	1-5	6	7-8	9-10	Total	1-5	6	7-8	9-10	Total
1	14	3	11	3	31	4	12	12	3	31	14	3	11	3	31	8	9	14	0	31
2	0	1	21	7	29	0	0	22	7	29	0	0	4	25	29	0	2	2	25	29
3	0	4	9	2	15	0	0	15	0	15	0	0	3	12	15	0	3	12	0	15
4	12	3	10	3	28	4	11	11	3	29	12	3	10	3	28	6	9	13	0	28
5	0	9	14	1	24	0	9	14	1	24	0	9	14	1	24	0	10	13	0	23
6	11	9	8	0	28	11	9	8	0	28	15	9	4	0	28	28	0	0	0	28
7	12	9	7	0	28	12	8	8	0	28	14	9	5	0	28	26	0	0	0	26
8	11	9	8	0	28	11	9	8	0	28	15	9	4	0	28	28	0	0	0	28
Total	60	47	88	16	211	42	58	98	14	212	70	42	55	44	211	96	33	54	25	208
Total (%)	28,4%	22,3%	41,7%	7,6%	100%	19,8%	27,4%	46,2%	6,6%	100%	33,2%	19,9%	26,1%	20,9%	100%	46,2%	15,9%	26,0%	12,0%	100%

As shown in Figure 8, concerning the area *Knowing facts and phenomena* 22.3% of alumni scored 6, whereas 41.7% got a score between 7 and 8; 7.6% had an optimal result, since they got a score between 9 and 10; the remaining 28.4% did not reach sufficiency.

Figure 8. Results for the indicator Knowing facts and phenomena.

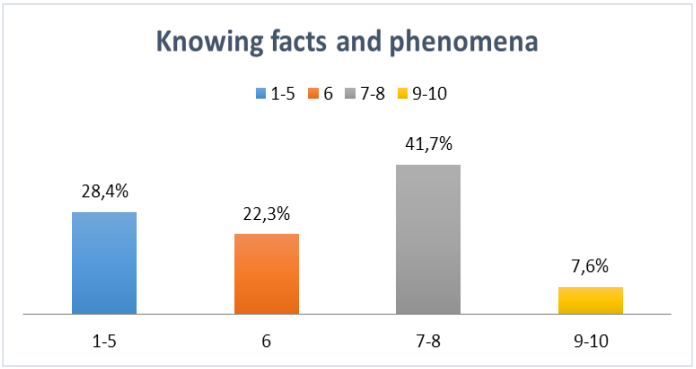
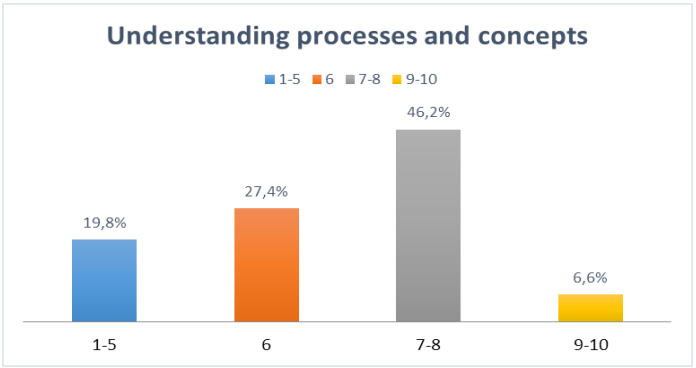


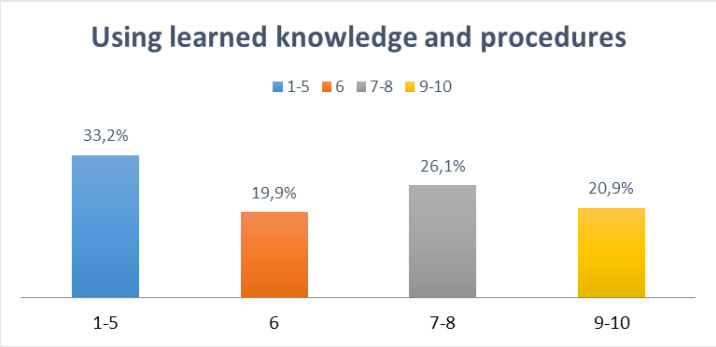
Figure 9 shows that in the area *Understanding processes and concepts* 27.4% of students scored 6, 46.2% reached a score between 7 and 8, while 6.6% obtained 9-10; 19.8% did not reach the sufficiency level.

Figure 9. Results for the indicator Understanding processes and concepts.



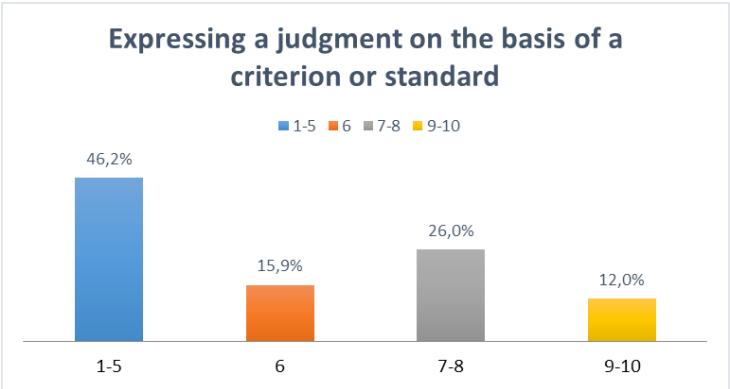
In the area *Using learned knowledge and procedures* (see Figure 10), the majority of the students obtained the sufficiency: 19.9% scored 6, 26.1% obtained between 7 and 8, while 20.9% reached the optimal score between 9 and 10; the remaining 33.2% obtained a score between 1 and 5.

Figure 10. Result for the indicator Using learned knowledge and procedures.



In the area *Expressing a judgment on the basis of a criterion or standard*, the majority of the students did not obtain the sufficiency: in fact 46.2% of students got a score between 1 and 5, 15.9% reached 6, 26.0% had a score between 7 and 8, while the remaining 12.0% reached the optimal result of 9-10 (Figure 11).

Figure 11. Results for the indicator Expressing a judgment on the basis of a criterion or standard.



Synthetically, success levels *deeply insufficient*, *insufficient* and *mediocre*, all aggregated in the 1-5 category, have been slightly predominant in the indicator *Expressing a judgment on the basis of a criterion or standard*; these data express that the didactic methodology had a scarce repercussion on the formulation of judgments in relationship to internal and external evidence criteria. This is likely to be attributed to the short time of the experimental phase. A satisfactory level was attained both in *Knowing facts and phenomena* and in *Understanding processes and concepts* areas; this finding shows that teachers probably used assessment tests such as authentic tests, allowing to assess such dimensions, thus avoiding the risk to incur in a mere mnemonic technique.

The excellence level had its major occurrence across the 4 areas in *Using learned knowledge and procedures*. In this sense, the method seems to have the ability to let students link previous knowledge to current learning and apply it to new contexts.

6. CONCLUSIONS

Comparing the international research results described above with the previous analysis developed on the design grids produced by teachers, a first picture of the method's strength and weakness can also be traced: this method is difficult to implement and its use is discouraged to introduce a new topic and in absence of technical assets, such as the interactive multimedia whiteboard.

Spaced Learning is interesting for its potential to help students in preparing exams. Besides, it is extremely useful to overcome learning gaps, related not only to information memorization but also to the comprehension and contextualization of those rules and procedures typical of a discipline.

Some weak points of the method, highlighted by the Italian teachers involved in this program, are: the risk of chaos during the pauses in crowded classes, the need to properly identify age-tailored distraction activities, the limited time for students to ask questions, the need of a significant amount of time for class preparation and technical assets setup, the identification of ad hoc spaces and dedicated materials.

Due to the shortness of the experimentation and the fact that the observation was conducted only once (specifically during a lesson in Spaced Learning mode in an Apulia school), the results obtained are more satisfactory, but more research actions would be required to validate the method's effectiveness. Moreover, this teaching technique requires the mastery of the method by teachers, whereas in Italy Spaced Learning is still at an early stage of adoption.

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