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Spaced learning and innovative teaching: school time, pedagogy of attention and learning awareness

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Abstract

Currently, the 'time' variable has taken on the function of instructional and pedagogical innovation catalyst, after representing—over the years—a symbol of democratisation, learning opportunity and instruction quality, able to incorporate themes such as school dropout, personalisation and vocation into learning. Spaced Learning is a teaching methodology useful to quickly seize information in long-term memory based on a particular arrangement of the lesson time that comprises three input sessions and two intervals. Herein we refer to a teachers' training initiative on Spaced Learning within the programme 'DocentiInFormAzione' in the EDOC@WORK3.0 Project in Apulia region in 2015. The training experience aimed at increasing teachers' competencies in the Spaced Learning method implemented in a context of collaborative reflection and reciprocal enrichment. The intent of the article is to show how a process of rooting of the same culture of innovation, which opens to the discovery (or rediscovery) of effective teaching practices sustained by scientific evidences, can be successfully implemented and to understand how or whether this innovation—based on the particular organisation of instructional time—links learning awareness to learning outcomes.

Keywords*: spaced learning, innovative teaching practices, school time, learning awareness*

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1. Time as a variable for instructional innovation

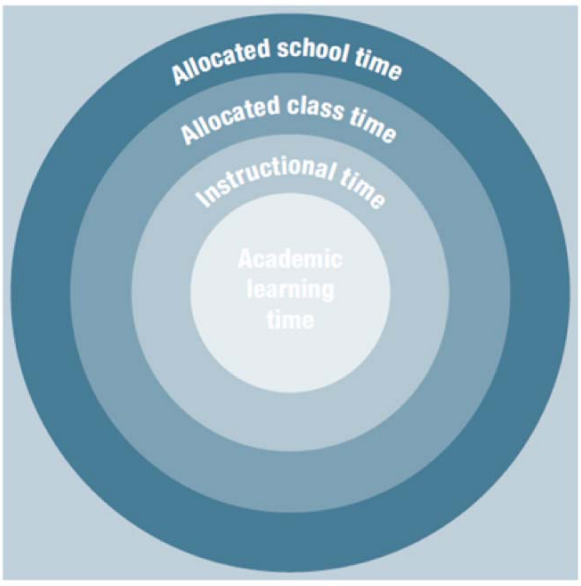
Currently, the 'time' variable has taken on the function of a catalyst for instructional and pedagogical innovation, after representing—over the years—a symbol of democratisation, learning opportunity and instruction quality, able to incorporate themes such as school dropout, personalisation and vocation into learning.

The need to specify the distinction between instructional time and instructional content allowed the temporal dimension to gain a significant position in the international debate on the most effective learning experiences, which resulted in it having a central role in the schooling process (Smith, 2000).

The concept of instructional time has been the subject of several studies that have tried to define and to identify it through different empirical research activities (Baker et al., 2004). As part of the so-called 'within school time' (to distinguish it from 'out of school time'), is it possible to recognise (Silva, 2007) the allocated learning time (estimated time for teaching in a specific classroom session), the procedural time (e.g., time spent on keeping order in the classroom), the instructional time (i.e., actual time of a lesson on a topic) and, finally, the time on task (percentage of teaching time during which behaviours and activities related to a specific task actually occur) (Figure 1). These articulations can be positioned along an axis the ends of which depict the so-called 'gross' and 'net' conditions.

The 'school time,' organised as hours per subject, is intended as 'allocated time' and should be seen as a gross measure. The time that a school autonomously decides to reorganise, by reducing it from or adding it to a variety of subjects, is then called 'net' or 'exposed' time (Clark and Linn, 2003). For example, the allocated time refers to the total time deemed as mandatory in education according to state or local regulations. What portion of the total time is then assigned to an activity and how individual schools autonomously organise that time within their daily teaching programmes can have an impact on students' learning. The amount of minutes and hours during which students are 'exposed' to a lesson (exposed time) has often been used to assess both goal attainment and student achievement. Along with the time exposed (which encompasses both procedural time and instructional time, strictly speaking) is the percentage of extra time remaining out of the lesson after subtracting the time necessary for the organisation of classroom activities and their proper management. This residual net is precisely called 'net teaching time' and coincides with the actual instructional time. This latter term corresponds to the following conditions of a student's involvement: interactive activity with the teacher, preparatory activity for a task, focus on student's reasoning on cognitive strategies and motivational attitudes, immediate feedback, encouragement and reinforcement, listening and discussion, review and practical activities (Scheerens and Hendriks, 2014).

Fig. 1 Types of School Time (from Silva, 2007)



The 'time on task' is another temporal construct that supports the analysis of educational progress (Stallings, 1980). This concept refers to the amount of time that students spend actively participating in a learning task, such as drawing up a paper or participating in a group work. It is often referred to as 'academic learning time'—or simply 'instructional time'—and is so large as to encompass different ways of exploiting this time to engage students during the lesson. The instructional time can also be understood as an 'engaged' time during which students in a classroom, while listening to a teacher, are also committed to working on different tasks offering appropriate levels of difficulty, to attain high academic achievements (Bloom, 1976; Caldwell et al., 1982; Scheerens and Hendriks, 2014). This excludes the time spent on too easy or too difficult activities to be performed.

Sorenson and Hallinan (1977) were the first who introduced the concepts of 'opportunity to learn' and an investigative approach whose key component is precisely the 'amount' of 'time spent teaching.' Since then, many studies have examined the impact of this school effect on student achievement and on its more effective management (Fuller and Clarke, 1994). Most of the studies resulting from educational research on 'time' have provided a significant contribution to the understanding of the relationship between use of time and academic achievements. This 'corpus' of educational research studies resumes the assumption underlying the Time Clock paradigm: (a) time is a limited resource, and (b) a special distribution of time can influence learning outcomes.

The consideration of time as a limited resource, vital to the learning process, has guided early studies on educational psychology, which tried to associate particular allocations of time to variations in learning outcomes. Research on the theme (Walberg, 1988) showed a considerable and positive influence of time on learning and rested on the adaptive dimension of teaching (Wang, 1984). As the authors highlight (Walberg et al., 1994) 'along with effective teaching, productive time engenders learning. Time should be a central concept in curriculum theory and practice' (p. 86).

Despite researchers having stressed the importance of meaningful learning activities and high-quality teaching, the 'amount' of time allocated to specific teaching objectives has long been perceived as the only construct through which to view and analyse results and performance in the classroom. The time spent on study and homework has been associated with better learning results. The literature has fostered the growth of (a) a specific need related to the development of students' time-management skills and (b) personal techniques that would allow monitoring, regulating and structuring study time (Claessens et al., 2007).

The cliché of time being an 'empty vessel' brought the thought that only by changing the amount of exposure time would there be an impact on the learning of a specific instructional theme.

Many studies have described, over a long period, the 'exposure time' as an intrinsic characteristic of the opportunity to learn: 'Clock time undergirds the majority of time research in education, enabling scholars to identify correlations between particular time allocations and educational outcomes, but also overlooking potential nuances in the reasons for and quality of time use choices' (Duncheon and Tierney, 2013, p. 256).

The theme of time optimisation with respect to intervals that are possibly useful to the long-term memory, as well as time customisation for accomplishing complex tasks and study of particular subjects, has been the object of numerous research activities. Especially, after the work by Leonard on instructional time (Leonard, 1999) and research conducted by Lasley concerning the 'time on task' (Lasley and Walker, 1986), new research themes began to emerge, at the base of which is an enquiry about the influence of the individual dimension on the relationship between time spent in learning (TSL) vs time needed for learning (TTL) and the impact of this relationship on students' 'achievements' (Gettinger, 1984); this trend supported the theory of time as a predictor of 'educational productivity.' The quantitative approach to teaching time has meant that, apart from limited experimentations including the most known initiatives such as block scheduling, year-round schooling, four-day school weeks or school-to-work, the organisational structure of the school time (teaching hours, school week and single-hour teaching structure) remained largely unchanged, not receptive to the changes that studies on learning customisation and others specifically related to the cognitive science required of institutions responsible for the formative process.

With the spread of constructivist-based approaches oriented toward a paradigm that enhances the quality of school time, research (Silva, 2007) highlights the need for schools to rethink the way resources are utilised, including time. While research within the Clock Time paradigm have focussed on the amount of time to be engaged in learning, further investigations dwell on the need to understand the relationship between time and quality of learning, as well as the definition of new instructional settings, which also make use of the information on students' behaviours outside the traditional classroom.

Time should be reviewed by the school, which could intercept the attention of students, even rethinking the academic time by using innovative logics such as those related to 'extended time' and reorganisation of lesson timing, with intervals aimed at supporting the conscious acquisition of knowledge outside the classroom space.

Research shows that the re-articulation of the time devoted to a specific subject is positively correlated with student achievements (Coates, 2003; Connor et al., 2005; Smith, 2000). Time, however, is intertwined with both content and concept of quality of classroom practices and returns to be at the centre of studies on school effectiveness (Yair, 2000).

The reflection on the efficient use of time and its dimensions ('amount,' 'dispersion' and 'intensity') in educational innovation (Millot & Lane, 2002), the experimentation with compacted school calendars (Patall et al., 2010) and the attention to micro-management of time and experience based on spacing (Kelley & Whatson, 2013) lead to situations of having to cope with 'erosion of teaching time' (Leonard, 2009) and students' dropout, setting new and effective pedagogical patterns that can be easily used by teachers in processes of instructional design, customisation and inclusion.

A research line able to reflect and amplify the values of constructivist and cognitive science approaches may involve the instructional pace, distinguishing for instance, 'spaced' from 'continued' teaching practices. These studies emphasise the concepts of 'spacing time' and 'wait time' considering the potential that mobile and immersive technologies offer today to improve the learning experiences (Kelley, 2008).

Such studies underpin the most modern learning theories that reassess time as an element for an alternate learning action in the classroom and that recognise, in the Spaced Learning approach, a model that will improve the learning processes through an active involvement of students, also producing enhancement in their attention span.

2. From Pedagogy of attention to Learning School: Spaced Learning and innovative teaching

Many students, at all levels of education, show marked difficulty in listening and concentrating in general. When asking a teacher what is currently the biggest obstacle to learning, most probably they will start talking about the poor attentional abilities of students. It is essential to define and disseminate a 'pedagogy of the attentional function' (Bellingreri, 2011)—based on research, studies and positive experiences of teachers—encouraging, with adequate guidance, both the schools and the families to promote attention and concentration in children and teenagers.

Whether the genesis of attention is explained by selective attention theories (bottom–up) or by motor theories (top–down) (Hochstein and Ahissar, 2002), there is no doubt that there are two major forms of attention—the involuntary (produced by an external stimulus, such as a flash of lightning) and the voluntary (depending on the value that is given to external stimuli, which are otherwise ignored, such as road signs while driving, but which need alertness because they are connected to the task that is being performed). The first type plays an important role especially in implicit memory, while the second type acts in explicit memory. 'Attention and memory are processes directly related to what we learn about the world and that we need to trigger appropriate behaviors and to make decisions' (Rivoltella, 2012, p. 64).

When we learn about the world, we actually learn from it. 'Learning' derives from the Latin term 'apprehèndere,' comprising the particle 'ad' (to, towards) and the verb 'prehèndere,' which in turn is derived from 'prehendo,' whose meaning is to grasp, to take, to seize and to capture. 'In Italian, it assumes the meaning of learning, understanding, comprehending, becoming aware of, grasping with the intellect, receiving and holding in mind' (Amenta, 2013, p. 39). The verb 'to learn' etymologically stretches back to the proto-Germanic *liznojan, which means 'to follow or to find a track.' To learn means building new knowledge or transforming existing knowledge; this produces modifications of the cognitive structures and their processes for the interpretation of reality. To phrase it as Endelman states (1992, p. 157), there is learning when behaviour produces synaptic modifications in the global maps so as to satisfy these values. 'The creation of long-term memory is the heart of education' (Cicatelli, 2013, p. 5), provided that this is the long-term memory wherein meaningful learning occurs.

The Spaced Learning concept is a teaching methodology useful to quickly seize information in long-term memory (Fields, 2005) based on a particular arrangement of the lesson time that comprises three input sessions and two intervals. In the first input session, the teacher provides information that students need to learn during the lesson. It is important to present the essential information in a technical language that characterises the subject to be treated. The input length is not predetermined, although retaining students' attention for more than 10–15 minutes is notoriously difficult. In this session, the neural pathways begin to create memory. This first session is followed by a 10-minute interval, which must not have any relevance to the content of the lesson. During this and subsequent interruptions, it is important to avoid stimulating the paths of memory being formed. Therefore, the activity must not have anything to do with what the students are learning, to increase the chances for the neural pathway to have 'rest' and to form stronger connections. Asking students what they would like to do can be a trump card here. In the second input session, the teacher revises the content of the first session, recalling key issues, arousing memories and changing the manner of presenting the content (e.g., using a variety of examples that are characterised by high interactivity level). The stimulation will affect the same neural pathways as the first input, informing the brain of their importance. To find out which content of the first input students are able to remember, several further examples of the same topic could be used through videos, or key pieces of the information may be omitted. For example, if, in the first input, students were asked to view a slide presentation, in the second input, they may be subjected to similar slides, showing white spaces to be filled with the key information that is missing. It is important that the pieces of information removed are exactly those that students are asked to know, because their attention will be focussed on the same information once they are prompted to remember. In the second interval, the same principles as the first are applied, leaving a rest/relaxation period of about 10 minutes. In this pause, the activity can be a variation of the previous one; what matters is that it has no connection with the content of the lesson. In the third input, the teacher remains on the content of the first session but proposes activities centred on the student: the learners will have to demonstrate that they have acquired and understood the content shared in the first two inputs, applying their new knowledge in drilling activities or problem-situation contexts. At this stage, the teacher simply stays among the students and, eventually, verifies their actual understanding of the lesson content.

The effectiveness of this pattern is also demonstrated by international studies. Kelley himself (2008), by experiencing it during a full school year while teaching physics and biology, evidenced a greater efficiency of such teaching methodology than traditional teaching in terms of the learning speed of his students. The results of this research show that replacing 1 hour of spaced teaching by 4 months of traditional teaching (a total of 23 hours) is an optimal choice to improve students' learning. The verification of authentic performances allows us to recognise and assess the achievement of deeper understanding, while also preserving Spaced Learning from the danger of being reduced to a mere mnemonic, a not-so-student-centred technique.

3. Training experience: *DocentiInFormAzione*

The idea of an innovative didactic rethinking of the time dimension that characterizes educational practice and to adapt the concept of 'instructional time' in order to facilitate a differentiation from disciplinary teaching was one of the main goals of the EDOC@WORK3.0[2] Project. As part of the framework of EDOC@WORK3.0 Project, INDIRE—the Italian National Institute for Educational Research and Innovation—is committed to accelerating the conditions that enable didactic innovation in Apulia region through training of teachers in innovative didactic models.

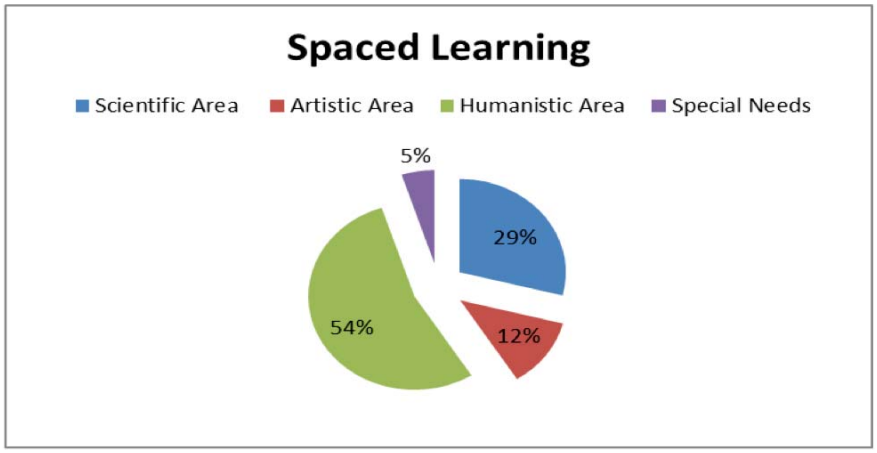
One of the methods through which innovation has been propagated in EDOC@WORK3.0 is a teachers' training initiative that, between April 2015 and November 2015, involved 368 teachers working on four themes selected as relevant didactic methodological innovations: Coding, Digital Learning Content, Spaced Learning and Laboratory Didactics.

The teachers' training activity on Spaced Learning method was one of the training initiatives offered to primary, lower secondary and upper secondary school teachers within the wider programme 'DocentiInFormAzione' (literary meaning TeachersInTraining) in Apulia region in 2015. The teacher training model is based on laboratory didactics, centred on practice and reflection with a subject matter expert, and aimed at supporting the modeling process and actions useful for experimentation of such a method with students in the classroom.

The course was conducted by an expert teacher capable of adapting the methodology to different didactic contexts and levels 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 implementation of the Spaced Learning method through collaborative reflection and reciprocal enrichment (Garzia et al., 2015; Mangione et al., 2016, in press).

The course was developed in four 'face-to-face' meetings (15 hours) and involved teachers in 'autonomous distance work' (25 hours). During the first face-to-face meeting, the expert teacher described the added value of Spaced Learning and illustrated a 'pedagogical template,' namely, an 'organisational 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 (Figure 2). Overall, 26 classes of Mathematics and Science teachers, 8 classes of Arts teachers and 28 classes of Humanities teachers followed the Spaced Learning course; 8 experimentations have been conducted for teachers with special educational needs (SEN), confirming the value of this method in inclusion and personalisation too.

Fig. 2 Disciplines involved in the Spaced Learning experience



The expert teacher supports the cooperative learning dynamics since this phase. In the second meeting, the first input of the Spaced Learning module 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 of completing a multimedia presentation highlighting the main content of the topic to be dealt with, through the definition of keywords, relying on the possibility of using an interactive white board or projector in the classroom.

During the third meeting, the teachers, individually but within their scaffolding group, were required to complete the second input of the Spaced Learning programme. 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

[2] PON Ricerca e Competitività 2007–2013 Smart Cities and Communities and Social Innovation Asse II – Integrated actions for sustainable development; 'Education and work on Cloud' (EDOC) is a research project funded by PON MIUR [AU: Please provide expansion for "PON MIUR" if applicable.]'Smart Cities and Communities and Social Innovation.' The project aims at innovating the educational value at all levels, from primary education to vocational training, bringing in technology into the heart of didactics. (http://www.edocwork.it/home) [AU: Please check and confirm whether the edits to footnote 2 convey the intended meaning.]

Educanon, Teachem or Knowmia, specific environments that let him build and share interactive video lessons), guiding the learners-teachers in the development of skills, allowing a dialogued lecture.

In order to respond effectively to the paradigm changes, it is necessary to rethink the traditional training courses by introducing training patterns that provide action–reflection recursion. Training for the different levels must accompany the teacher in a process of discovery of such procedures, inviting him/her to experiment them and to place them in comparison with his/her own way of 'thinking teaching' (Vanhulle, Merhan & Ronveaux, 2007). For this reason, between the third and the fourth meetings, all the teachers were involved in the design and implementation of a lesson based on Spaced Learning in their classrooms. During the fourth meeting, the expert showed how to build a virtual classroom. This is a fundamental activity because documents, products and interactive tests shared in the cloud related to the experiments conducted by each teacher in his/her class were analysed and reviewed in collaborative activities, with a focus on designing tools, to assess students' learning.

The training experience raised interest and enthusiasm from the 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 aware and responsible, as well as interested in studying. Teachers also engaged in social discussions and collaborative reflections to promote schools' exchange through a new time conceptualisation, also finding the opportunity to follow a professional development programme with a more aware use of the technological dimension within an environment of possibly great impact, namely, that of a self-regulated teacher development programme, alone or within a community.

4. Pilot Research: steps, objectives and methodologies

During the training experience, 49 teachers with their 49 classes were involved in Spaced Learning practices. The analysis focussed on two voluntary classes, called 'experimental sites': a second year class of a 'scuola secondaria di primo grado' (lower secondary school) and a first year class of a 'scuola secondaria di secondo grado' (upper secondary school). The former class consisted of 23 students (13 females and 10 males), whereas the latter was composed of 17 students (nine females and eight males).

The research goal was to analyse how innovation is received in teaching processes. In particular, on the one hand, we wanted to observe and go back to the effective teaching practices implemented in Spaced Learning—based on the particular organisation of instructional time—and to understand whether there are links between students' learning awareness and their learning outcomes (Mangione et al., 2016, *in press*).

The research group favoured the adoption of combination of qualitative and quantitative approaches based on the integration of specific methodologies and tools.

In the first case, data analysis is mainly based on 'interpretative principles that consider the multidimensionality of survey objects and make the analysis of research results emerge from them.' In the second case, there is 'a predetermination in the justification of working hypotheses, which tends to bring out from the investigated phenomena only those aspects that can lead to data which are generalisable and, in some way, objectively structurable according to standard measurement criteria' (Semeraro, 2014, p. 100).

From a qualitative point of view, the chosen method is educative practice observation using multiple approaches and techniques in a sort of triangulation among observation grids, interviews and video recordings.

From a quantitative perspective, the analysis tools used for the Spaced Learning didactic model were an evaluation questionnaire of the metacognitive competence of the students—namely, the Awareness Learning Metacognitive (ALM) questionnaire (La Marca, 2014), and assessment tests designed by the teachers in terms of a learning outcome grid.

4.1 Classroom observation: methodology and tools

The observation of teachers' classroom practice took place in the month of May 2015 and in the month of October 2015 in accordance with the calendar of both training courses.

The goal of the idiographic approach is to learn about daily events (education), in particular situations (integration of an innovative method), with the identification of categories or assumptions that underlie the interpretative analysis of processes and facilitate an in-depth reading of experiences (Coggi & Ricchiardi, 2005). By considering this perspective, we can affirm that multiple interpretive paths allow in-depth investigations that enable multiple possible interpretations, as well as legitimise the need to use multiple techniques (Trinchero, 2004).

Classroom observation uses a structured grid, video recordings and interviews with teachers.

Regarding the first instrument, if it is true that in the narration/diary-type descriptions—the so-called 'open' methods ('paper-and-pencil' descriptive observation and videotaped observation)—it is necessary to perform selections and determine what to observe, when we have to build a grid, the choice of what is relevant to record has to be even more explicit. 'The categories of behavior that compose a grid represent the "lenses" that filter the observer/researcher

sight and therefore must enable the sharpest vision of the phenomenon to be observed' (Gattico & Mantovani, 1998, p. 151).

In this case, the exploratory nature of the experience did not allow the definition of an 'assertive hypothesis,' yet an 'implicit hypothesis' emerged, allowing the identification of factors, on which we built the guiding questions and the observation grid. This hypothesis thus guided the construction of the observation grid and indicated the design sections (predefined and shared with the tools capable of capturing, in a narrative modality, the way in which innovation is brought about in the class) to either confirm or question what emerged from the content recording (Table 1).

Table 1. Hypotheses, factors and observed elements.

Implicit hypothesis	Factors	Elements to observe
Classroom time revisiting favours the design of lessons supporting memorization and participation	Modification in the lesson time management	Classroom time articulation according to the SL model
Intervals and pauses allow an increase memorization of key concepts	Good participation in response to the stimuli	Impact on pauses on participation and comprehension
Integration of technologies favours inclusion, material research and peer learning processes	Technology integration in the lesson structure and digital competencies	Teachers capability to integrate technologies in the lesson plan and peer-working improvement
The teacher is the key figure in the sharing and evaluation moments	Management of classroom time, feedback and reinforcement moments	Teacher's pauses and appropriate inputs management capacity

To avoid loss of any information, grid filling has been integrated with the video recording of the situation under study. 'It is a very trusted and reliable detection tool, as it allows not only a very accurate, almost "live," description of the observed behaviors, but also, in the case of automatic recording, it is not conditioned by the possible stress of the observer' (Mantovani, 1998, p.99).

This strategy allows the retrieval of microevents or aspects not covered by the grid indicators, which might escape the eye and the pen of the observer. Besides, it gives other experts the possibility to grasp—from their own point of view—additional aspects, allowing a systemic and very detailed analysis that reduces the risk of subjectivity in the interpretation. The use of videotaping also serves as a study and evaluation item for classroom settings, a key aspect for successful teaching in multiclasses or in networked small classes (extended classes).

Furthermore, the mere compilation of the grid fields would not allow reconstructing the time sequence of events. Video recording instead allows the complete unveiling of such a sequence, namely, the description of the situation in its dynamics, respecting its temporal structure.

After the observation phase assisted by videotaping, a shared viewing of the resulting recordings occurred, in order to expand the compilation of the grid. Finally, face-to-face interviews with the two teachers of the experimental sites were conducted. They were free interviews, in which the interest of the researcher—resulting from the collection of i) the material in the classroom observation and ii) spontaneous material by the teacher—is to solicit very general questions designed to enrich the understanding of the classroom event. The data (verbal transcripts) collected through free interviews were analysed according to qualitative criteria (explanation modes, selection of facts and their interpretation, used by respondents) and integrated with data interpretation (Section 5.1).

4.2 Learning and student awareness: methodology and tools

The teachers of the experimental sites, at the end of their innovative classroom practice, were involved in a process of quantitative measurement of results. In June 2015 and November 2015, the two teachers of the experimental classes collaborated in defining appropriate evaluation tests for innovative methodology and in administering a questionnaire to test the degree of students' awareness and self-regulation. Metacognition proved to be a useful strategy, particularly for those settings that involve awareness and regulation of cognitive processes. Promoting the development of

metacognitive skills encourages students to anticipate, monitor and reflect upon their own cognition and can lead to a better engagement with learning materials. It can support students in developing metacognitive skills in their learning or performance situations and in monitoring the activity that takes place during critical performance events.

The proposal was accepted by all the teachers involved as an opportunity to understand to what extent their work influenced students' awareness as well as having an impact on learning results.

In the context of learning assessment, the research methodology envisaged that the assessment tests be built by teachers to assess the effects of the Spaced Learning method on four cognitive aspects of learning, defined by the following indicators: Know facts and phenomena, Understand processes and concepts, Use knowledge and learnt procedures, and Express a judgement based on a criterion or a standard (Table 2). The choice to assess knowledge instead of competencies stems from the short duration of the experimentation, which would not have allowed the development of competencies with respect to the applied model. Each teacher evaluated his/her students' tests, assigning a score on a scale of 1–10 points for each student/indicator.

Table 2. Learning outcomes indicators.

INDICATORS	DESCRIPTORS
Know facts and phenomena	Know specific information units (discipline-specific lexicon, specific facts related to a given domain), modes and ways to treat them (conventions, rules, processes, temporal sequences, classification and categories, discipline-specific inquiry methods), abstraction schemes (generalization principles, theories and models)
Understand processes and concepts	Knowledge transposition and translation, interpretation, extrapolation, inference
Use knowledge and learned procedures	Knowledge application in the resolution of specific problems
Express a judgment based on a criteria or on a standard	Judgments formulation with respect to internal and external evidence criteria

The authenticity of a performance is judged by the mobilisation of resources and by the ability to use, effectively and efficiently, knowledge and skills appropriately selected according to the task to be accomplished, reprocessing and reorganising, in a problem-situation context, what has been learnt. In creating, a final test to be administered during the third input of the Spaced Learning, the teacher chooses the path of authenticity.

Recent research indicates that metacognitively aware learners are strategic and perform better than unaware learners, allowing individuals to plan, sequence and monitor their learning in a way that directly improves performance.

In our experiment, we used the ALM questionnaire, a tool able to facilitate comprehension about the level of awareness of mental operations implemented, as well as knowledge and skills used, during the Spaced Learning lessons. The ALM consists of four scales: motivated commitment (16 items), responsible learning (17 items), knowledge of cognitive processes (13 items) and autoregulation (18 items) (La Marca, 2014). All items can be used in a cooperative form.

The items help to reflect on the importance of completing the study commitments with perseverance. Students can understand the importance of persistence in the face of difficulties, find out why and how to complete the work allocated to them, even when there is no desire to engage and, in the end, to reflect on the importance of overcoming moments of fatigue or unwillingness. In some items, students are asked to identify similarities between note situations, for which we now possess defined concepts, and new situations. Others, however, offer loads to use conceptual and imaginative thinking, to generalise the knowledge learnt by applying them to a new and not very defined situation, to check the autonomous capacity to use the rule and knowledge acquired in the course of the entire unit work, and to develop hypotheses and effective action strategies.

Teachers can check whether students acquire the skills provided by observing them while they carry out the proposed activities and by listening to their comments. In particular, it should be noted whether the student recognises the demands of the task, has awareness about the knowledge and skills that can be exploited to address it, formulates plans and action strategies, is flexible enough in the application of these strategies, identifies goals to reach and can monitor the effectiveness of his/her own learning (La Marca, 2015).

The ALM questionnaire was administered to two classes that underwent Spaced Learning sessions: a second year class of a secondary school first degree and a first year class of the secondary school classroom. The design used can be described as 'almost experimental' because it was not possible to monitor all potential threats to the internal validity of the study design. This type of design is the best solution when forming groups of natural entities that must be kept intact in order to study their characteristics. It was therefore not possible to evaluate the effect of treatment by comparing the initial situation and the final one.

5. Analysis of results and discussion

In this section, we present the results of the qualitative and quantitative analyses and show some possible correlations among teaching practices, awareness levels and learning results in the two experimental classes.

5.1 Qualitative analysis: discussion of the observed teaching practices

We observed two classrooms, selected among those who volunteered during the project experimentation. In both classes of secondary level (a lower secondary and upper secondary class each), the method was experimented in the Arts curriculum. For both observations, we can synthesise what emerged from the implicit hypothesis that guided the observation.

The classes were organised according to a traditional setting. One of them had an interactive white board, tablet for group works with configurable desks and chairs. The other classroom had a more traditional setting, and mobile devices such as smart boards for videogames were brought directly by the students.

Regarding the 'type of student participation,' there are interesting elements that show how time management and technology integrated into the instructional design favoured an active and collaborative role by the student. In particular, the student interviews highlight a surprising effect resulting from the introduction of deliberate pauses devoid of references to the topic under study.

Concerning 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 method of reviewing the unit of time, which is specified in a form suitable for long-term memory development, without the cognitive load that the timing of traditional lectures generates. In this context, 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 classes were organised in a circle, each with his own tablet or iPad, engaged in recreational activities based on video games (Figure 3).

Passing from the first to the second input facilitated moments of increased students' participation, supported by the teacher's mobility and peer-based discussions. As one of the teachers observed, 'students were eager to collaborative after the first break and easily concentrated again actively participating to the second productive moment' (citation of interview).

Fig. 3 Intervals in the Spaced Learning programme for secondary school.

During the 'assessment,' students, with the permission of the teacher used search engines to disambiguate some useful concepts to carry out the test. The teacher invited the students to pay attention to the assessment test modality, to concentrate on what the questions were focussed on and to answer succinctly. This occurred particularly after the second break, when the students were most emotionally excited. The assessment test was administered both individually and collectively through a group discussion.

In one case (upper secondary level), the teacher first presented the test using the interactive white board. Students were requested to work on a graphic digital representation, putting the right names on represented architectures (Figure 4).

Fig. 4 Assessment phase during Spaced Learning experience in technology-enhanced setting.

In the other class (lower secondary level), the teachers used the interactive white board to introduce the test and distributed paper forms on which the students were requested to work individually (Figure 5).

Fig. 5. The role of technology: teaching organizer and educational mediator.

Finally, students used online repository environments or specific applications (e.g., Dropbox) to share the final examination file with the teacher.

Time management also influenced the manner and the effectiveness of the assessment, as highlighted by the students themselves during the video analysis: '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 the supplied device enabled a better supervision of the class action and a responsive scaffolding for specific requests of students, including in-depth clarification and interaction with less-performing and introverted students. The teacher showed particular ability in the management of time and technological equipment, articulating her action between a general level and a more dedicated and customised one. After the interval, the teachers reinforced the presented contents illustrated in the first input through the screening of two videos, pausing the performance at specific moments to pose questions to verify students' comprehension.

Owing to the availability of Internet connection, teacher and students shared materials, documents and tests. The teacher reinforced the content presentation, continuously posing questions to assess the comprehension and to solicit connections with related topics. Both teachers used the peer learning method through dialogue and discussion, thus maintaining the levels of motivation and sharing high. Teachers valued students providing positive answers to specific questions and stimulated less-interactive students.

'Technology' was fully integrated into the design and practice of teaching and in the lesson timing. The devices were used to activate the student–teacher relation and student content and activity organisation.

The ability to use mobile devices and the white board encouraged participation and accelerated learning to the extent that students were able to associate teacher's explanation with concrete images, videos and content from the Web and also dedicate more time to the exercises. In this regard, a teacher said: '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.' In the lesson phases in which technology was used, increased production was observed as well as an increased frequency of communication studies.

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

technology allowed better regulation of the classroom climate and of the alternation of productive and relaxing moments. Pauses seem to psychologically reduce the concentration burden in the times dedicated to the learning process, intended as "storing" phase of new knowledge' (citation of interview).

In this model, the different articulation of time seems to have really disrupted the lectures and facilitated both the concentration of the students as well as the moments of exchange and dialogue.

Teachers used activity logs to trace their opinions on this new method and on how it influences the design of and activity in a didactics classroom. With respect to the development of competences related to the didactic methodology, teachers observed, 'the strengths are implicit in the methodology that arouses students' curiosity, who like to make new experiences. Viewing of videos had a considerable impact on visual memory, since they helped to more quickly and meaningfully consolidate complex contents. Another strength is certainly the extreme rationalisation of the content administered, which the teacher is required to calibrate according to the final product (of learning assessment) that she gives to the students each time. Each lesson needs a target and objective and take a step forward. This represents a continuous monitoring, allowing teachers to intervene and iteratively modify the objective definition or the modality of deepening and/or content clarification' (cit. interview).

Another improvement is also observed in the digital competencies: 'the path contributed to stimulation of a greater interest with respect to the technology-enhanced didactics and promoted a greater interest for the technological competencies and for an integrated didactics' (cit. interview). Regarding the didactic time, according to teachers, 'the break allows mitigating the tensions and improving learning but needs to be closely controlled because exceeding distraction could require specific intervention to bring students back to the needed attention levels to continue with the lesson.' On the other side, 'the breaks help to set confidence, shortening the student–teacher distance. This contributes to increase in reciprocal trust that predisposes to peaceful learning' (cit. interview).

5.2 Quantitative analysis: discussion of the data collected with respect to awareness and learning

At the end of the experiment, to find whether the breakthrough experimental work had changed the attitudes and metacognitive skills of the students, the answers given by the students in the experimental group were analysed for secondary school degree, and for the experimental group of secondary school first degree, the same test was administered at the end of their trial. It also sought to take account of the changes eventually produced by the action of random factors or of traditional school.

Table 3. Frequencies of some items on the 'motivated commitment' scale at the secondary school first degree level.

In the classroom I am able to use the technological tools and resources in the best way	**Percentage (%)**
Strongly agree or agree	95,65
Disagree or strongly disagree	4,35
Total	**100**

I think that what I learn by studying could be useful for others one day.	**Percentage (%)**
Strongly agree or agree	69,57
Disagree or strongly disagree	30,43
Total	**100**

I seriously try to understand what the teacher says even if I do not like the subject.	**Percentage (%)**
Strongly agree or agree	65.22
Disagree or strongly disagree	34.78
Total	**100**

When, for some reason, I fall behind with class work, I try to catch up without the teacher forcing me to do so.	**Percentage (%)**
Strongly agree or agree	60.87
Disagree or strongly disagree	39.13
Total	**100**

Even if a task is tedious, I continue to do it until I have finished.	**Percentage (%)**
Strongly agree or agree	69.57
Disagree or strongly disagree	30.43
Total	**100**

For the construction of class profiles, the collected data were analysed; this analysis has made it possible to gather the changes that occurred in the students; evaluative moments are also served as opportunities to structure adjustments and programmatic reorganisation. In the following tables, the frequency of response presented to the items related to the 'motivated commitment' scale, reported by the students of the experimental class of the secondary school first degree who experienced the Spaced Learning methodology, is shown.

Table 3 shows the main results obtained from the questionnaire gathered from students.

From analysis of the answers given by the students of the class of the secondary school first degree, with whom was experimented the Spaced Learning methodology, it was possible to detect the best results with regard to the 'motivated commitment' scale, probably because the activities carried out had a strong impact on motivated commitment.

From the preceding table, it is clear that 95.65% of the students claimed to be able to use technology in the classroom in the best way; 69.57% of the students thought that what they learnt by studying will be useful to others; 65.22% of the students reported that sustained efforts are needed to understand what the teacher says even when they do not like the materials; 60.87% of the students said that when, for some reason, they fell behind in school work, they sought to recover without the teacher forcing them to do so; 69.57% responded that they continued to perform a tedious task until they had finished; 60.87% of the students said that when they faced a difficulty, they tried to overcome it by increasing their commitment; and 65.22% said they continued to work uninterruptedly even when that study was boring and not interesting.

Regarding the experimental class of the second degree secondary school, results were generally positive both for the 'motivated commitment' scale and for the 'responsible learning' scale.

Tables 4 and 5 show the main results obtained from the questionnaire gathered from students.

Table 4. Frequencies of some items on the 'motivated commitment' scale at the secondary school level

I pledge even when a task requires a lot of time and effort	**Percentage (%)**
Agree strongly or agree moderately	100
Agree a little or disagree strongly	0
Total	**100**
One of the most important reasons that drives me is the desire and curiosity to learn new things	**Percentage (%)**
Agree strongly or agree moderately	93.75
Agree a little or disagree strongly	6.25
Total	**100**
I try to relate the study and what I learn in school with my daily life	**Percentage (%)**
Agree strongly or agree moderately	93.75
Agree a little or disagree strongly	6.25
Total	**100**
When, for some reason, I fall behind with class work, I try to catch up without the teacher forcing me to do so.	**Percentage (%)**
Agree strongly or agree moderately	100
Agree a little or disagree strongly	0
Total	**100**
Even if a task is tedious, I continue to do it until I have finished.	**Percentage (%)**
Agree strongly or agree moderately	100
Agree a little or disagree strongly	0
Total	**100**

From the analysis of the responses to the questions related to 'motivated commitment' given by the students in the experimental class of secondary school degree, it is found that: 100% of the students have good motivation to learn,

they perform the assigned tasks with pleasure even when a task requires a lot of time and effort; in fact, they report that they want to persevere even when they face difficulties. Moreover, 93.75% of the students are intrinsically motivated to complete an already started job; students study voluntarily, having the curiosity to learn new things; 93.75% of the students try to relate the study and what they do at school with their daily lives.

Table 5. Frequencies of some items on the 'responsible learning' scale at the secondary school level

When I study, I pose this question because it helps me focus	**Percentage (%)**
Agree strongly or agree moderately	87.5
Agree a little or disagree strongly	12.5
Total	**100**
Do I need to change my way of studying, adjusting it to the various materials	**Percentage (%)**
Agree strongly or agree moderately	93.75
Agree a little or disagree strongly	6.25
Total	**100**

Regarding the 'responsible learning' scale, it is found that: most of the students (87.5%) ask themselves questions while studying because this helps them focus and try to connect what they studied in various disciplines; 93.75% of the students also agree to having changed their way of studying the various disciplines, when needed. The questionnaire used is therefore useful for students to reflect on their own learning process and for teachers to understand the importance of promoting self-assessment in the classroom.

At the end of the experiment, for a triangulation of learning outcomes, teachers were asked to use a special assessment grid, taking into account a number of indicators (about facts and phenomena used to understand processes and concepts; to use the knowledge and procedures that they learnt; to express an opinion on the basis of a criterion or standard).

The data emerging from the questionnaires for the secondary school second degree do not seem to be confirmed by the learning outcomes identified by the teachers.

In the analysis of the learning outcomes of the class that experienced the Spaced Learning methodology in the secondary school first degree (Figure 6), the best results have been achieved in the 'to understand processes and concepts' part: in fact, 63.63% achieved a positive evaluation ranging from eight to ten in the learning levels. This seems to be confirmed by the students who claimed in the ALM questionnaire that they try to connect what they learn to other already studied topics (60.87%) and to change the method of studying if they faced difficulties in understanding what they studied (52.17%).

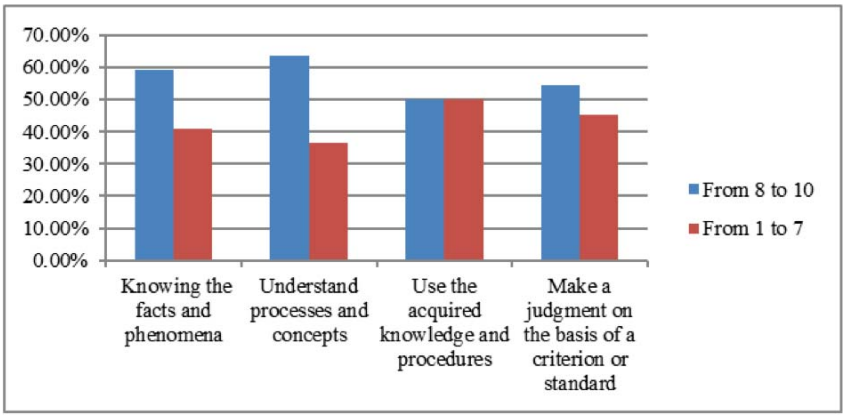


Fig. 6 Learning outcomes of the class of the secondary school first degree.

The graph in Figure 7 shows the breakup of the learning achievements of students of secondary school first degree involved in the experimentation. Thus, 59.09% of the students had a rating from eight to ten in the 'knowing facts and phenomena' area; in terms of the answers to the questionnaire in this area, 47.83% said that they tried to see that what

they study can be applied to everyday life, trying to learn patterns to generalise what they learn. Instead, not entirely positive feedback—in terms of learning—was obtained from the secondary school second grade class that participated in the experiment (Figure 7).

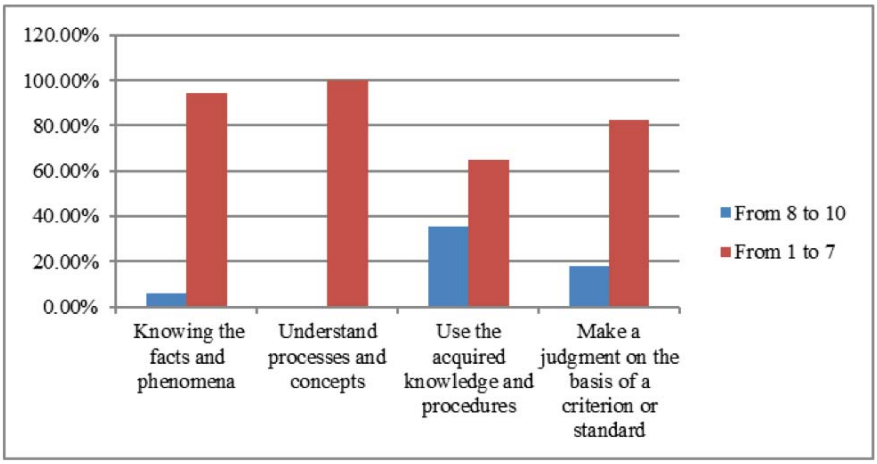


Fig. 7 Learning outcomes of the class of the secondary school.

As seen in the chart, we did not achieve positive learning outcomes in any of the four areas. In fact, the percentages of those who obtained scores ranging from eight to ten are low: only 5.8% gave a rating from eight to ten in the 'Knowing the facts and phenomena' area; only 17.34% in 'Expressing an opinion on the basis of a criterion or a standard' area; the highest percentage (35%) was the one that referred to the 'Use the knowledge and learnt procedures.' At the end of the research, it can be said that, despite the limitations identified in the small sample, the results that emerged from the questionnaire used to investigate students' metacognitive awareness appear significant.

Conclusions

The literature findings in terms of the use of time and its dimensions helped in setting new and effective pedagogical patterns, also integrated with information and communications technology, which can be easily used by teachers in processes of instructional design, customisation and inclusion. Time is nowadays recognised as an element for an alternate learning action in the classroom and Spaced Learning as a model that will improve the learning processes through an active involvement of students, also producing enhancement in their attention span.

The EDOC@Work3-0 Project was meant to tackle the theme of instructional innovation, experimenting with a methodology useful to students' attentional processes. Such methodology, based on the concept of Spaced Learning has been at the centre of both training and then instructional practice of teachers in the Apulia classrooms. The teachers' training and involvement has allowed the grasping of elements characterising this innovative didactic model and the conditions of integration of such an innovation within school processes, with particular reference to teaching, organisational and technological processes.

In this study, we have documented the educational practices that support the integration of an innovative method in class and investigated the relation between awareness and learning outcomes in two experimental classes.

Moreover, our findings show that, despite the weaknesses recognisable in the limited study sample, results related to students' metacognitive awareness and learning outcomes emerging from the questionnaires appear to be relevant. This study could represent a starting point for future explorations aimed at understanding the relationship among the use of the Spaced Learning methodology, students' metacognitive awareness and performances based on authentic tasks.

Teachers who experienced Spaced Learning have pointed out a few weaknesses: risk of engendering confusion during breaks in large classes, cutting of distracting activities in primary school classes (which did not occur in secondary school classes), little time given to students for asking questions, need for longer time for preparing lesson and equipment, and space and materials not being always available. In addition, several teachers have also highlighted the importance of letting students manage intervals individually, because whether involved in group activities, or during the moments of relaxation that teachers had to use as a distraction time from the input sessions, students tended to discuss about the lesson content, invalidating the effectiveness of this methodology.

Finally, it would be also interesting to investigate if and how this teachers' training path aimed at introducing an innovative educational model is stabilised, reinforced and strengthened in the teacher professional practice and if and how the use of the practice is further propagated as a consequence of this training experience.

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