

Testing the Vygotskian Model of Double Stimulation in a Formative Intervention.

The contribution of educational research

Verifica del modello vygotkijano della doppia stimolazione negli interventi formativi. Il contributo della ricerca educativa

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ABSTRACT

Double stimulation is currently acknowledged as a foundational issue in contemporary studies, commentaries and interpretations of Vygotsky's work. This paper sheds light on how double stimulation works outside experimental settings. While many authors have advocated for double stimulation as one of the epistemic principles characterising formative intervention, no scholar has tried so far to interrogate this relationship with a detailed analysis of the transcripts of the workshops. This paper applies Sannino's model of double stimulation to formative interventions and tests it to a specific Change Laboratory with in-service teachers. The analyses of the transcripts at the level of the workshops shows the presence of all the four phases of the double stimulation model. Moreover, the findings support the theory of expansive learning that formative interventions are based on.

Il principio della doppia stimolazione è riconosciuto come una questione fondante negli studi e nelle interpretazioni odierne del pensiero di Vygotskij. Questo contributo si propone di chiarire il funzionamento della doppia stimolazione al di fuori di contesti sperimentali. Anche se diversi autori hanno affermato che la doppia stimolazione è un principio epistemico che caratterizza gli interventi formativi, nessuno finora ha basato quest'affermazione su un'analisi dettagliata delle trascrizioni. Questo contributo applica il modello della doppia stimolazione di Sannino agli interventi formativi, e verifica il modello testandolo su uno specifico Laboratorio di Cambiamento effettuato con insegnanti. L'analisi delle trascrizioni dei laboratori mostra le tracce di tutte le quattro fasi del modello della doppia stimolazione. I risultati sembrano supportare la teoria dell'apprendimento espansivo su cui gli interventi formativi sono basati.

KEYWORDS

Teacher Training, Formative Interventions, Cultural Historical Activity Theory, Double Stimulation, Vygotsky, Collective Transformative Agency. Formazione Insegnanti, Interventi Formativi, Teoria Storico Culturale Dell'attività, Doppia Stimolazione, Vygotskij, Agentività Collettiva Trasformativa.

Introduction

It is now acknowledged that agency is a mediating element in educational change (Kumpulainen, Kajamaa, & Rajala, 2018); it is considered important to address active learning in relation to the diverse levels that exist in each school, later in work life, as well as in teacher education (Juutilainen, Metsäpelto, & Poikkeus, 2018; Tao & Gao, 2017). Students ready for the future need to exert agency to act responsibly in the world and influence individuals, events and circumstances with good intentions (OECD, 2018). In these circumstances, the practitioners' agency to search for alternative solutions and set the most promising innovative path is key (Haapasaari, Engeström, & Kerosuo, 2018). Agentic teachers go beyond the mere delivery of the curriculum to support their professional growth and the learners' competencies, to inspire lifelong learning (Lipponen & Kumpulainen, 2011). Moreover, teachers need to develop a relational agency to collaborate with colleagues and other professionals as they increasingly cross professional boundaries, use the support given by colleagues and become themselves a resource for others to draw from (Edwards 2011). In this context, training the practitioners results key to develop their agency (Hökkä, Vähäsantanen, & Mahlakaarto, 2017; Lipponen & Kumpulainen, 2011; Tao & Gao, 2017). Double stimulation is therefore vital to understand how individuals agentively transform their circumstances, and is acknowledged to be as a foundational issue in contemporary studies, commentaries and interpretations of Vygotsky's work (Sannino 2016). It aims at stimulating aims at eliciting expansive forms of agency in the individuals to make subjects masters of their lives (Engeström, 2007). Contemporary literature, however, has seldom gone beyond brief accounts of it (Sannino & Laitinen, 2015).

Double stimulation is key within the interventionist legacy of Cultural Historical Activity Theory. Change Laboratory is based on such principle as a means to trigger collective transformative agency (Haapasaari & Kerosuo, 2015), which is defined as breaking away from the given frame of action and taking an initiative to transform it (Virkkunen, 2006). Englund and Price (2018), for example, have used the Change Laboratory in higher education as a specific instrument to build the participants' agency for collaborative sustainable development. While many authors advocated for double stimulation as one of the epistemic principles characterising formative interventions (Engeström, 2011; Engeström & Sannino, 2010; Haapasaari & Kerosuo, 2015; Virkkunen & Newnham, 2013), no scholar has tried so far to trace the process of double stimulation in the transcripts of formative interventions. This paper aims to contribute to this scholarship by shedding light on how double stimulation unfolds outside experimental settings and operationalises the model for formative interventions. A group of teachers in an Italian vocational high school engaged in a Change Laboratory as in-service training, to find ways of increasing the number of students enrolled.

1. Literature Review

For Sannino and Laitinen (2015) Vygotsky's principle of double stimulation is key to understand how individuals make volitional actions in situations of uncertainty and cognitive conflict. A task is never just the task that the experimenter designed. Instead, each subject interprets and reconstructs creatively the tasks they are set, and this process can be hardly controlled externally (Sannino, 2015). Vygotsky (1978) describes a situation entailing this principle:

«The task facing the child in the experimental context is, as a rule, beyond his present capabilities and cannot be solved by existing skills. In such cases, a neutral object is placed near the child, and frequently we are able to observe how the neutral stimulus is drawn into the situation and takes on the function of a sign. Thus, the child actively incorporates these neutral objects into the task of problem solving» (p. 74).

In relation to this principle, Vygotsky refers to an experiment called waiting experiment or meaningless situation (Vygotsky 1987; 1997). A subject is invited to take part to an experiment but is simply left alone in a room with no task and no instruction. Research has shown that the individual tends to hesitate until he or she finds an object in the room such as a clock, which is used to make a decision. When the hands of the clock will move to an established position, the subject will leave the room. In Vygotsky's explanation, the wait in the empty room represents the first stimulus while the clock becomes the second stimulus. In so doing, the clock is transformed into a meaningful sign, and characterises the individual's will to break from the ambiguous situation. Vygotsky (1978) comments:

«Tying a knot as a reminder, in both children and adults, is but one example of a pervasive regulatory principle of human behaviour, that of signification, wherein people create temporary links and give significance to previously neutral stimuli in the context of their problem-solving efforts. We regard our method as important because it helps to objectify inner psychological processes» (pp. 74–75).

Double stimulation is therefore key to understand how individuals agentively transform their circumstances (Sannino 2015). It includes a conflict of motives, which constitutes a clash between opposite aspirations or tendencies, which occur in situations involving uncertainty. Together with the problematic situation, a conflict of motives represents the starting point with which individuals intentionally enact their behaviour and influence the world around them. This form of conflict is evident in subjects asking for the courage to make a deliberate choice: an action is volitional only when there are obstacles to carry it out (Leont'ev 2005).

Contemporary literature, however, has seldom gone beyond brief accounts of double stimulation, as most experiments are designed to focus on two stimuli that are tested by variables across a few domains of investigation (Sannino, 2015). An exception was Sannino and Laitinen (2015) who tested the model in an experimental setting with both single individuals, and Sannino (2016) with small groups. Figure 1 illustrates the model of Double Stimulation that Sannino (2015) hypothesised drawing from (Vygotsky, 1978; 1997).

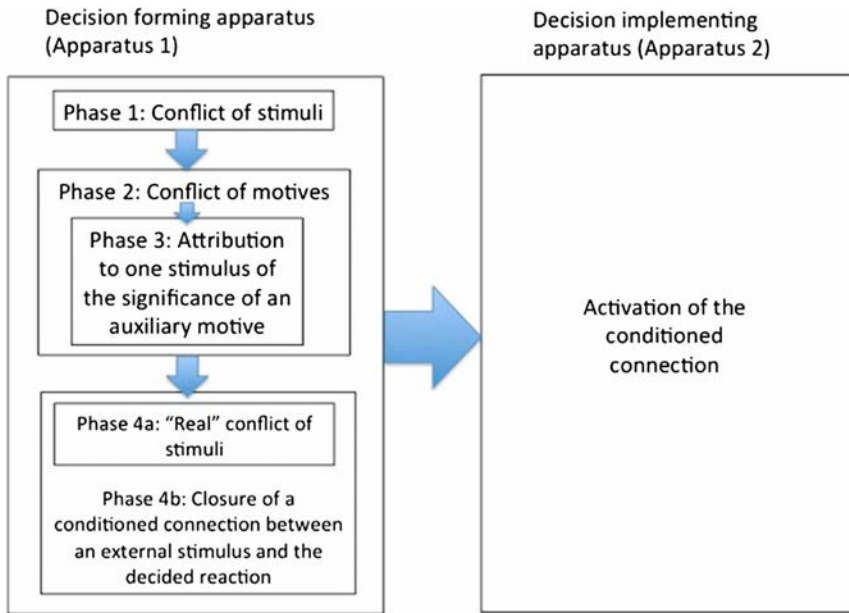


Figure 1. The double stimulation model of the emergence of volitional action (Sannino, 2015).

Apparatus 1 consists of the formation of a decision to act in a certain way by means of an auxiliary motive. Apparatus 2 consists of the implementation of the decision formed in the Apparatus 1. Apparatus 1 is made of 4 phases. In Phase 1 the individual is confronted with conflicting stimuli. In the case of the waiting experiment, for instance, the conflict of stimuli is to wait in a room with no reason. In Phase 2, conflicting stimuli activate a conflict of motives. In the case of the waiting experiment, the conflict of motives is represented by staying in the room and wanting to leave it. Phase 3 involves the selection of one stimulus and its conversion into an auxiliary motive; in the case of the waiting experiment, this action can be embodied in how the clock is treated. Phase 4 consists in establishing a connection between the decided reaction and the direct appearance of the auxiliary stimulus. In the case of the waiting experiment, the subject decides to take action and to leave the room when hands of the clock reach a certain position. Figure 1 illustrates Sannino's model of double stimulation.

1.1 The theory of expansive learning

Within the Vygotskian legacy, Activity theory has developed tools to study networks of interacting activity systems, dialectics and multiple perspectives Engeström (2015). The focus is on communities seen as learners, hybridisation and horizontal movement, creation and transformation of culture, in addition to the development of theoretical concepts (Engeström & Sannino, 2010). The theory of expansive learning accounts for innovation and change of practices: when the contradictions of an activity system worsen, some of its members start questioning and disagreeing with the established norms. As a result, they engage in a collective and meaningful effort to change and innovate. This behaviour can result in an ex-

pansive transformation when the practitioners reconceptualise the motive and the object of their activity. Ideally, a cycle of expansive learning is composed of seven learning actions, as shown by Figure 2 (Engeström, 2015).

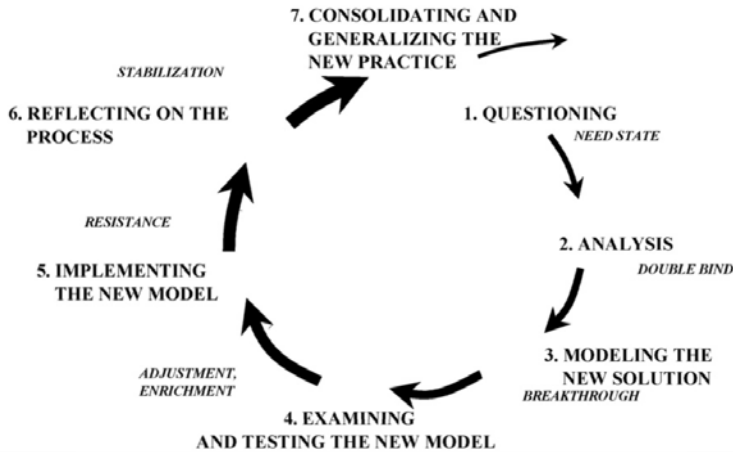


Figure 2. The ideal type cycle of expansive learning.

The phases logically follow from one another, and are described as following (Engeström & Sannino, 2010; Virkkunen & Newnham, 2013):

1. Questioning, criticising or rejecting aspects of the present wisdom or current practices.
2. Analysing the situation with ‘why’ questions. The participants find the internal contradictions of the activity system through a double analysis: an historical investigation of the changes occurred in the structure of the activity; and an actual investigation of the manifestations of contradictions.
3. Modelling the new explanatory relationship in a way that can be shared with the other members of the activity system. This part of the cycle entails presenting a clear-cut model of the idea.
4. Examining the new model and experiment with it to evaluate its limitations, potentials and functioning.
5. Applying the model and enhancing it during the application.
6. Reflecting on the model and assessing the learning process. The goal is summarising the learning that has taken place during the process and finding further learning needs.
7. Consolidating the model to make it an established practice, by generalising it to other working units within the same organization or other organisations.

1.2 Formative interventions

Within the Vygotskian legacy, which owns an activist and interventionist history, formative interventions were developed to break away from linear interventions. These include design experiments typical of the ‘gold standard’ thinking in educational research (Engeström, 2011). Linear interventions tend to suffer from the following weaknesses: the unit of analysis is left vague; the research process is

depicted as linear (with the researchers designing, the teachers implementing, and the students learning better); the issue of causality is often unquestioned. By way of contrast, formative interventions are based on Vygotsky's process of double stimulation. The result is the participants face a contradictory object embedded in their life activity, and the contents of interventions are subject to negotiation. A key outcome of these interventions is the development of their agency; the researcher is actively involved by backing the expansive learning process.

The Change Laboratory is a type of formative intervention designed to trigger cycles of expansive learning (Engeström, 2007; Engeström, Virkkunen, Helle, Pihlaja, & Poikela, 1996). Typically, it involves 15 to 20 practitioners who meet once a week for a couple of hours for roughly eight to twelve intensive workshops plus follow-up. Helped by a researcher who acts as a process facilitator, the participants deal with a contradictory and problematic object concerning their activity, which they analyse and develop by designing a new concept (Engeström, 2011). The main instrument is a 3x3 set of writing surfaces (such as flipcharts) to display work activity. The writing surfaces are used according to a horizontal and a vertical dimension. The vertical dimension accounts for different levels of abstraction and generalisation, while the horizontal dimension represents the historical perspective. The Change Laboratory has been applied in various type of organisations (Virkkunen & Newnham, 2013) such as libraries (Sannino, Engeström, & Lahikainen, 2016), service companies (Haapasaari et al. 2018), as well as in universities (Englund & Price, 2018) and schools (Botha, 2017; Teräs, Lasonen, & learning, 2013).

A diverse body of authors (Engeström, 2011; Engeström & Sannino, 2010; Haapasaari & Kerosuo, 2015; Virkkunen & Newnham, 2013) have claimed double stimulation to be a foundational principle in formative interventions to trigger expansive learning. While Vygotsky (1999) experimented with double stimulation at the individual level, the design of formative interventions brings about change in collectives. When used in a joined activity, the process of double stimulation operates distributed between individuals and time (Virkkunen, 2006). Virkkunen and Newnham (2013, p. 48) suggests that double stimulation operates on several levels, and describes the level of presenting the participants with problematic aspects of the current practices (first stimuli) and using the general model of activity as a possible mediation for the second stimulus. In longstanding collaborative activities such as in Change Laboratory workshops, double stimulation is composed of long chains of first and second stimuli. Similarly, Engeström (2011) finds that that double stimulation is a longitudinal and layered process, in which both first stimulus (the initial problematic situation) and the second stimulus (the mediating conceptual tool) undergo different reformulations.

For Engeström, Sannino, and Virkkunen (2014) double stimulation is used systematically in formative interventions to find personally experienced conflicts of motives and to identify potential second stimuli. Engeström (2011) explains that problems and critical incidents in the work practice serve as first stimuli to trigger conflict of motives, and for Penuel (2014) the first stimulus can be a challenging situation or obstacles in the accomplishment of a certain objective in work practice. In trying to cope with the problem, an individual or a collective may employ external artefacts and a concept, that is second stimuli, which could be turned into meaningful signs to gain control of the problematic situation (Engeström 2011). In the intervention, the researcher facilitates the analysis of the problems by introducing conceptual tools as a second stimulus, such as the cycle of expansive learning (showed above) or the triangular model of activity

(Engeström 2015, p.63). During the process, however, the participants tend to construct their own second stimulus. They acquire agency by taking the lead of the workshops and by inventing or reshaping their second stimulus, a sketchy artefact that is step-by-step filled with content.

2. Methodology

This paper seeks to operationalise the model of double stimulation (Figure 1) as developed by Sannino for formative interventions. As such, it searches for instances of double stimulation at the level of conversations in a fully transcribed Change Laboratory made of 11 workshops fully recorded and transcribed. It adopts a similar methodology to Engeström, Rantavuori, and Kerosuo (2013), who searched for occurrences of expansive learning actions, and Haapasaari and Kerosuo (2015) as well as Englund and Price (2018), who looked for instances of transformative agency. In doing so, it makes use of mixed methods as it combines quantitative and qualitative methods as part of the research, with an explorative design that makes use of sequential phases, first qualitative and then quantitative (Ponce & Pagán-Maldonado, 2015).

The first methodological step was, with the help of the literature review above, to apply the model of double stimulation to formative interventions. Apparatus 1 corresponds to the design of a new idea, concept or practice that tackles the important challenge that can only be solved by collective action. Apparatus 2 corresponds to the implementation of this idea, concept, or practice. Apparatus 1 can be traced within a formative intervention, while Apparatus 2 corresponds to the implementation of the new concept or idea in between and after the workshops. The analysis coded the four different phases of Apparatus 1 applied to the conversation analysis of a formative intervention as following:

1. Conflict of stimuli, when a participant or the researcher expresses a problematic issue related to the organisation taken as activity system. The triangular model of activity (Engeström 2015) finds different elements composing an activity system: a community, rules, division of labour, tools and object, and each of these or their relationship can represent a source of conflict.
2. Conflict of motives, which is defined by a participant or the experimenter pointing out a conflict between opposite aspirations or tendencies, ranging from dilemmas to double binds that require action (Engeström 2011).
3. Possible auxiliary motives, where a participant or the researcher proposes a solution or concept that could potentially mediate the problematic situation towards a solution.
4. Closure, which eventuates when a participant details the implementation of the new idea, concept or practice that was developed during the formative intervention.

The intervention upon which the analysis was made is a Change Laboratory organised as in-service teacher training in an Italian secondary state technical institute. It was carried out at the beginning of 2016 with eight workshops and one follow-up workshop; another two follow-up workshops were organised the following school year to support the implementation of the new practice. The participants were 22 teachers and workshop assistants of a surveying course. The important challenge that the teaching body tackled was the constant and dramatic decrease of their students' enrolments from 104 students in 2008 to 26 students

in 2016. The surveying course was bound to close on this trajectory; The teaching staff knew that something had to be done do deal with such a catastrophic decline and decided to engage in a formative intervention.

The concept collectively developed during the workshops was that in the two Grade 5 classes, 6 technical teachers (3 for each class) helped by the workshop assistants taught around a common interdisciplinary project. This project would be used to advertise the surveying course outside the school through open days and word of mouth, thus possibly attracting more enrolments. The multidisciplinary project was delivered in school year 2016/2017, and an improved version was planned and executed the following school year. So far it has contributed to raise the number of enrolments to 37 in students for the school year 2018/19 from 26 of 2016.

At the level of the overall intervention, this study identified the first stimulus as the dramatic fall of enrolments in surveying over 10 years. The second stimulus developed over the workshops was an interdisciplinary project involving vocational subjects that was used to promote the surveying course in the open days (see Morselli 2019). At the level of the double stimulation model applied to formative interventions, Apparatus 1 corresponds to workshops, while Apparatus 2 corresponds to the implementation of the multidisciplinary project the following school years. The analysis of double stimulation therefore concentrated on Apparatus 1, that is, the goal was to look for instances of the 4 phases of Apparatus 1 within the transcripts of the intervention.

The second methodological step was to apply the general model of the first phase to the specific Change Laboratory. The analysis identified the following four phases of Apparatus 1 in the transcript:

1. A problem related to the school taken as activity system.
2. A conflict of motives expressed by a participant or the researcher and dealing with the school taken as activity system.
3. An idea, a concept, a proposal of solution of the problems evidenced in phase 1.
4. Details on the implementation of the multidisciplinary project: approvals of school councils, coordination of the project who starts first, who to involve, the role of each individual and group.

Phase	Quote	Workshop	Line
1	We come from a tradition where we used to have four Grade 1 classes, sometimes even five. From five Grade 1 classes we have arrived at a situation where we'll have perhaps two Grade 1 classes next year, while this year and the year before we had only one. As such, there has been a dramatic drop of enrolments.	1	7
	The objective would be to find a balance of students within our school, if we have three courses of Graphics and 1 of Surveying this is not our balance.	5	97
	That's what I just said: we can't proceed in a scattered order.	7	875
2	Our problem was what do we do now and what is our role? What type of students do we train? What will they do after the end of their study? They can't do anything, they can't do this, they can't do that. I think that these dilemmas have conditioned us in a negative way.	1	78
	We are aware that our students will find a job, and we knew already the things that the experts of the industry told us. (My wonder is) how can we have make the world understand that, even though there is a crisis in the building sector, the technician that we train is still essential (for the industry)?	5	69
	It is clear that the students' group work is useful only when each component does their job and then shares with the other components, so they all share responsibilities. This has been done, and I don't know how I could have done it differently (better).	11	83
3	In practice the first four ideas can be summarised, we always end up there, isn't it? The technician is not known about, therefore the broader public don't know it exists, which is why people don't know what such professionals can do.	1	181
	I would do this exercise: who are the students that could be entrepreneurs in the future? And who are the students that could only be employees? Can we find them?	5	20
	Yes, but know that what I can understand from the outside world is the surveyor does not design tower houses anymore. S/he carries out small interventions of various types and various types of certifications. We should therefore train students to become flexible consultants.	9	330
4	We (the teachers) organise the timeline of the project so that it starts with topography, then design, and then land valuation, and you (the workshop technicians) will manage it. Since you guys are temporary, during the summer we (the teachers) will plan a project that you will deliver during the school year, for three hours each week.	6	225
	If we want to start straight away (at the beginning of the school year) perhaps it is better that we make decisions today.	8	120
	The topography teacher will pass me the material so that my class can start working on the multidisciplinary project.	9	11

Table 1. shows three examples for each phase translated into English.

The entire body of data (available on Zenodo at <https://zenodo.org/record/838015#.XHf1loj0mM8>) consists of 6967 speaking turns, which were analysed according to the four phases of Apparatus 1 described above. From the methodological point of view, following that of Sannino and Laitinen (2015), the transcripts were read and annotated several times, with the aim of detecting the model phases and to reflect on their possible relationship with the double stimulation model. Following these steps, the analysis coded the data and calculated the occurrences of the model phases.

Concerning the validity of this explorative study (Ravitch and Carl, 2015), the person that analysed the data was the same that facilitated the formative intervention, and therefore was intimately acquainted with the data and the outcomes. The four phases and examples of coding in the transcripts were discussed with two major experts in qualitative research in Cultural Historical Activity Theory, one of which also supervised the intervention's workshops. Moreover, the data coding followed the guidelines for analysing qualitative data suggested by Ravitch and Carl.

3. Results

Table 2 illustrates the occurrences of the four phases of Double Stimulation across the 11 workshops. While the first column illustrates the number of the workshop, the second column shows the expansive learning actions that characterised each workshop. Although the analysis identified the main learning phase triggered for each workshop, diverse expansive learning actions can be present in the same workshop, as found in the analysis of Rantavuori, Engeström, and Lipponen (2016).

Workshop	Expansive learning action	1ph	2ph	3ph	4ph	Total Occurrences Double Stimulation	Speaking Turns Total
1	Question	92	31	34	0	157	616
2	Historical Analysis	33	25	12	0	70	869
3	Empirical Analysis	117	8	83	0	208	1105
4	Question	43	2	44	0	89	365
5	Question	106	17	64	0	187	596
6	Model the new practice	35	19	108	31	193	705
7	Examine the model	67	3	169	36	275	949
8	Reflect on the process	23	1	35	5	64	305
9	Reflect on the process	19	7	83	11	120	487
10	Examine the model	23	4	60	6	93	504
11	Reflect on the process	35	9	64	5	113	466
Total		593	126	756	94	1569	6967
Total %		8	2	11	1	22	
% only double stimulation		38	8	48	6	100	

Table 2. Occurrences of the four phases of Double Stimulation in the corpus of data.

The criteria to select whether a speaking turn belonged to a phase of double stimulation was restrictive, and only 22.5% of the whole corpus matched the conditions of the categorisation of Apparatus 1, which converts to 1569 turns out of 6967. The four phases of Apparatus 1, however, are evenly distributed across the whole body of data, in 1569 speaking turns. In total, the data display occurrences of all the 4 phases, as displayed in Figure 3. However, the fourth phase only appears after the sixth workshop, and this phenomenon is because the participants only start shaping their second stimulus, the interdisciplinary project, later in the workshop sequence.

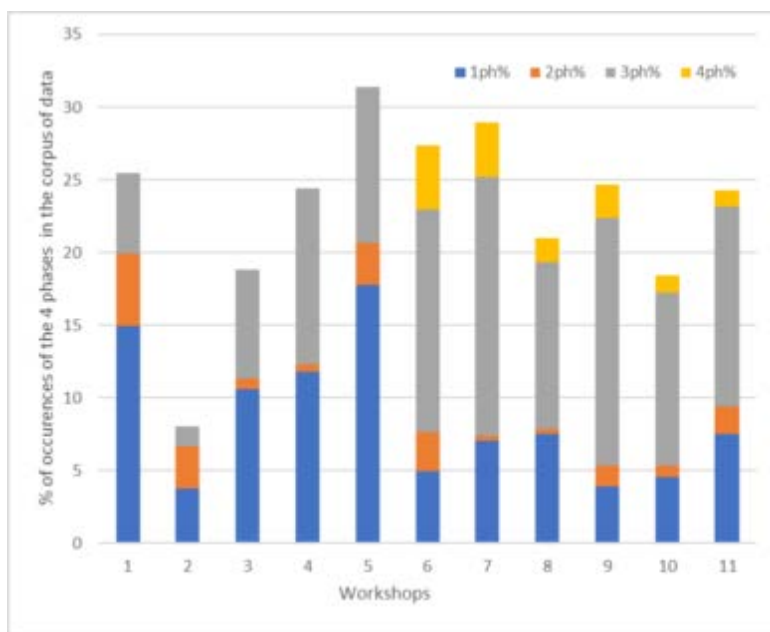


Figure 3. Occurrences (in %) of Double Stimulation in the whole corpus of data.

When only the 1569 instances of double stimulation are considered, almost half of the mentions concern the third phase (48%), the possible auxiliary stimuli with ideas and solutions. The second most represented phase is the conflict of stimuli (38%), with problems connected to the challenge the teachers want to tackle. Only few occurrences of conflict of motives (8%) and the closure of action (6%) could be found in the transcript.

Figure 4 focuses only on the 4 phases (in %) to look for possible trends of double stimulation.

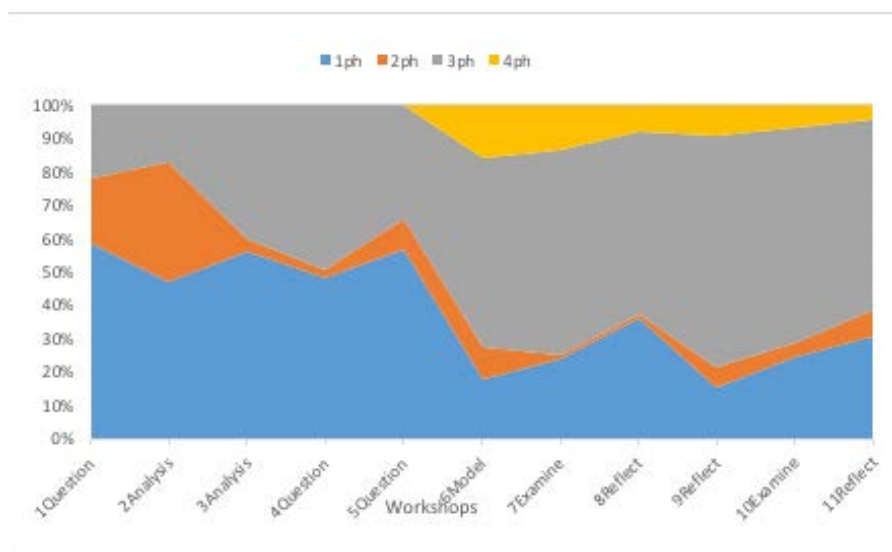


Figure 4. Occurrences (in %) of the four phases throughout the workshops.

When making a descriptive analysis of Figure 4, it appears that the first five workshops are characterised by the first phase, with the participants talking about problems and the challenge they are confronted to with. The first phase tends to decrease throughout the workshops, but never disappears. A similar trend characterises the second phase, the conflict of motives. An opposite trend can be observed for the third phase, possible auxiliary stimuli, with ideas, proposals and concepts increasing throughout the formative intervention. Concerning the fourth phase of closure, this phenomenon only appears starting from the sixth workshop, when the participants start designing the multidisciplinary project and decide what the steps are to have it running the following school year: who does what, and when. The participants discuss further implementation details (fourth phase) even when the project is already ongoing (workshops 10 and 11).

Discussion and Conclusions

The results can be interpreted globally according to the theory of expansive learning. The four phases of the apparatus 1 of double stimulation characterise the workshops to a different extent. The first phase of apparatus 1 characterises the first five workshops with participants discussing problems relevant to the challenge or the school. This first phase, however, never disappears throughout the workshops; Rather, from the sixth to the eleventh workshop the participants discuss the problems that the design and implementation of the new idea/model brings, and this trend aligns well with the hypothesis made by Engeström (2011), that second stimuli are progressively filled with content, but are open ended and therefore never fully stabilised. Similar to the first phase, the second phase is always present throughout the workshops, although in limited figures. This evidence could be compatible with Sannino (2015), who found that conflict of motives are the energising force of double stimulation. The third phase indicates possible auxiliary stimuli, including proposals of solutions and new ideas, and accounts for almost half of the instances where double stimulation is found in the transcripts. This regularity demonstrates that formative interventions (Sannino, Engeström, & Lemos, 2016) are places where new ideas are generated, discussed, and turned into collective action. Finally, the fourth phase characterises the second half of the workshops, with discussion on how to implement collectively the idea (the interdisciplinary project): who does what, when and how. The fourth phase bridges the occurrence of Apparatus 1 in the workshops, with Apparatus 2 being situated between and after the workshops with the implementation of the new idea or model. Most importantly, the finding that first and third phase are always massively present seem to align with the hypothesis made by Virkkunen and Newnham (2013) and Engeström (2011) that the Change Laboratory is characterised by chains of first and second stimuli.

The results can be further analysed by looking for connections between the phases of Apparatus 1 and the expansive learning actions characterizing the 11 workshops. The questioning and analysing expansive learning actions characterise the first 5 workshops with a conflict of stimuli (first phase), while the participants point out and discuss the many problems that affect the school course and look for the main cause of it – the main contradiction (Virkkunen and Newnham, 2013). The fourth phase of double stimulation concerning the new model/idea characterises expansive learning phases such as modelling, examining, implementing and reflecting.

This paper has tested the practice Sannino's model of double stimulation outside experimental environments in collaborative settings. While many authors posited that double stimulation is a foundational principle of formative interventions, for the first time this paper sought to trace empirical instances of double stimulation in a specific Change Laboratory delivered as in-service teacher training. This explorative analysis focused on Apparatus 1 of double stimulation concerning the formation of will to act in a certain way (Sannino 2015), and start to shed light on how collectives agentively transform their situation. Overall, the results seem to back the presence of double stimulation as being the trigger of formative interventions.

Developing a personal agency to influence people and events for the good is becoming more and more important in education as witnessed by OECD (2018), which in a position paper called *OECD Learning Framework 2030* developed a new competence framework, where developing a personal agency is key for students. Moreover, teachers "should be empowered to use their professional knowledge, skills and expertise to deliver the curriculum effectively. This requires interdisciplinary and collaborative learning alongside mastery of discipline-based knowledge" (p. 7). The study of agency from a pedagogical point of view has a longstanding contribution stemming from Sens and Nussbaum's capability approach, with authors such as Costa (2014).

Testing the model of double stimulation in collaborative settings, however, is important beyond the bounds of the Vygotskian studies. While previous international study of agency have been merely descriptive¹, the principle of double stimulation is a triggering mechanism for agency. Through double stimulation in educational research, researchers can now promote agency in professional contexts such as teacher training, and study how agency develops from resistance to collaboration and committing to change and innovation. As principle, double stimulation shows the generativity (Margiotta, 2017) of formative interventions. The generativity comes from the possibility to work together to envision new solutions, to turn them into action and to create value for their communities.

The main limitation of this study is that the analysis has been explorative and based on one particular case. Future analysis will have to prove to what extent the dynamics of double stimulation found in this study can be retrieved in other formative interventions.

Acknowledgements

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1 For a literature review on agency and professional identity, see Eteläpelto, Vähäsantanen, Hökkä, and Paloniemi (2013).

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