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Consensual Cooperative-Learning: A New Method to Harmonize the Learning of Complex Knowledge

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Abstract A harmonized learning outcome is eagerly needed when it comes to teaching complex knowledge, particularly concepts that can be contingent on different perceptions and understanding. No teaching method is currently available, however, about achieving a harmonized learning outcome of puzzling knowledge. To fill this educational gap, we developed an incrementally innovative learning-centered method; the consensual cooperative-learning method (CCL) and tested it on a group of executives enrolled in an innovation management PhD program. This paper describes the CCL method and highlights the potential of combining and building upon self-learning methods in achieving harmonized acquisition of sophisticated knowledge.

Keywords: *learning method, self-learning, cooperative learning, complex knowledge, consensual learning*

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1. Introduction

The process by which humans learn and assimilate new knowledge is still largely unknown despite global and continuous efforts to unriddle it [1]. Nevertheless, the educational field is going through major changes as new learning paradigms are making their way into educational institutions [2,3] as well as non-educational institutions where the assimilation and use of new knowledge and concepts are crucial to sustain their activities.

Meanwhile, with the accumulation and deepening of knowledge and the sophistication of human organizations, issues that used to be compartmented became tightly linked and interdependent and thus more and more complex. As a consequence, the learning process becomes knotty when it comes to learning complex issues and particularly when the outcome of the learning process needs to be consensual and harmonized among the learners instead of being a polymorphic personal perception. Indeed, through the learning experience, the thinking, feeling and perception very often vary between individuals. Therefore, it is crucial that the learning method provides a common or harmonized learning outcome in terms of understanding and perception particularly when it comes to grasp complex issues. Common understanding of complex issues is of paramount importance for the academic spreading of this knowledge and/or to achieve specific management and business objectives. Nevertheless, any learning method that emphasizes harmonized learning outcomes should take into consideration the individual aspect of perception and should focus on the consensual aspect of the learning experience. To fulfill such an educational requirement, the self-directed learning and cooperative learning methods seem to be the most adapted. However, some modifications need to be made to introduce the consensual aspect in achieving common perception and understanding of complex issues.

As the long-lived method of stuffing or cramming of information in the minds turned out to be obsolete, the new learning paradigms are ultimately leading to learn how to learn. Therefore, self-learning which enables individuals or groups of people to obtain information and human knowledge on their own is becoming one of the most important methods for learning [4]. Indeed, driven by their own desire to learn, individuals will use the learning skills effectively, enabling them to learn at all times and helping them to develop their skills, abilities to suit their needs, interests and tendencies which are related to the cognitive and emotional aspects of it. Self-learning does not necessarily exclude teachers but does not depend on them as the only source of information or knowledge. There are multiple sources and varieties of self-learning [5,6] which can be envisaged individually or within a

group of people. The two approaches that are pre-dominantly discussed in literature are self-directed learning (SDL) and cooperative self-learning (CSL). Knowles [7] defined self-directed learning as an initiative to learn in a better environment without the assistance of others in accordance with the learning objective. In addition, various researches have addressed the importance of learning through different methods and various approaches [8,9]. The concept of cooperative learning is a self-learning method based on the learners' effective participation in the educational process [10,11,12]. It depends on the activation of the learners' mental abilities to discuss the effectiveness of their group and how they can improve their work continuously. In this method the role of the teacher consists of guiding and driving the students to augment their abilities and their knowledge using devices and specific educational methods to complete the educational learning process and achieve the learning outcomes [13,14].

In this paper we describe a new method we developed to harmonize the intellectual acquisition of complex knowledge among a group of learners. This method is based on individual as well as group cooperative self-learning that we applied to a group of students enrolled into a PhD program of innovation management to define the complex concept of technology transfer (TT).

Although the concept of technology transfer may seem semantically straightforward, it is the subject of a variety of understanding and perception as its boundaries cannot be easily defined. The complexity of TT arises from the knowledge embodied *sotto voce* in technology. This complexity was highlighted in the literature and various definitions of the concept that depend heavily on the users' perception and on the context in which TT occurs [15]. Furthermore, this complexity is delineated by the fact that the concept spills over business, economy, and technology to other fields such as anthropology and sociology [16].

Hence, reaching a consensual definition of the concept of TT was selected to be the learning objective of our new Consensual Cooperative-Learning (CCL) method. The aim was to provide a common understanding of the technology transfer concept on which subsequent chapters of the learning will be based.

2. Description of the Consensual Cooperative-Learning (CCL) Method

2.1. Conceptual Framework

The CCL method is a multilayered method built upon a three stages process. It starts with individual directed self-learning followed by group cooperative self-learning and completed by a consensual learning stage. The blending of these three learning approaches was used specifically to help achieving harmonized learning about complex subjects/concepts. Figure 1 shows the three stages of the CCL method and highlights the various inputs that feed this learning process such as the retrieval of information from various sources, the experiences on the subject matter of the learners and the active discussions among them.

2.2. Outline of the Method

The method is carried out in ten consecutive steps (Table 1) on a group averaging twenty learners. Steps one to three can be carried out independently of the remaining steps and step three involves individual work. Steps four to ten require the presence of all the learners at the same time in the same place. Therefore, the ten steps of the CCL method can be carried out either in one long continuous session lasting from 4 to 6 hours or into two sessions, the first one including steps 1 to 3 and the second one steps 4 to 10.

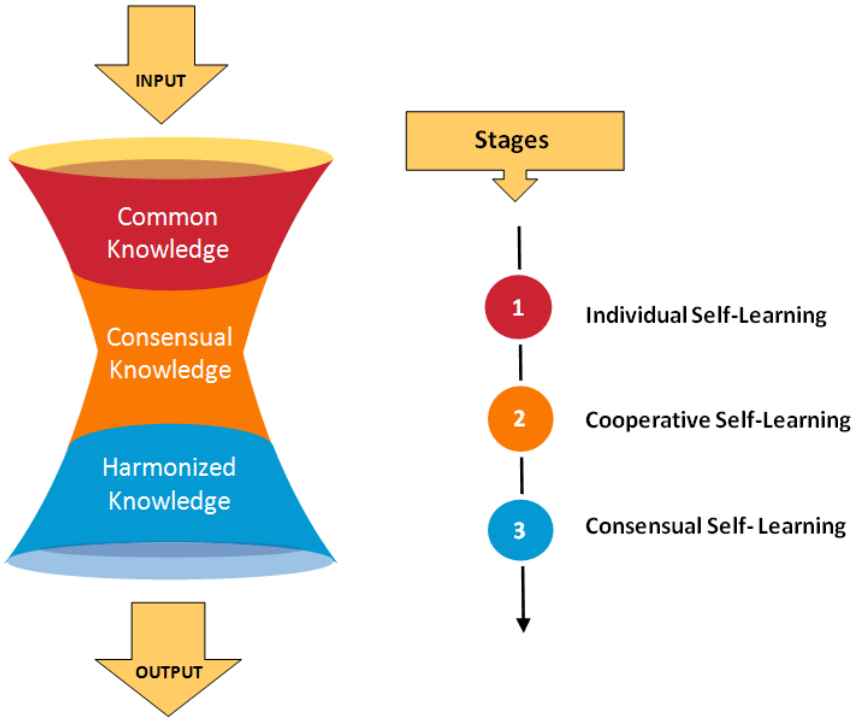

Figure 1. Consensual Cooperative Learning "CCL" method conceptual Framework

Table 1. Description of the ten steps process of the Consensual Cooperative Learning method

Step	Description
1	Enounce clearly the learning subject.
2	Split the group into small subgroups (4×5 people).*
3	Ask the learners to look through various sources for prior knowledge, information and data on the learning subject.
4	Ask each learner within a subgroup to orally present his personal definition of the subject matter to the members of all the subgroups.
5	Retrieve key words/phrases from the presentation of each of the subgroup member on a white board (first round of key words).
6	Using the selected key words/phrases ask each subgroup to develop a consensual definition of the subject matter.
7	Present each subgroups consensual definition to the other subgroups and grade the level of satisfaction with the definition by each of the group learners.
8	List the key words/phrases from each subgroup definition on a white board. (second round of key words)
9	Using these selected key words/phrases the group develops a consensual working definition of the subject matter.
10	Rating by each learner of his degree of satisfaction with the final result in a scale of 1 to 10.

*It is preferable at this step to constitute heterogeneous subgroup and not to mix individual with similar background. This will stimulate constructive discussions and anticipate consensual group self-learning.

2.3. The Teacher's Role

In this CCL method the teacher does not provide any knowledge on the subject matter. He does not interfere directly in knowledge acquisition but in the way knowledge is acquired. He is rather the guarantor of the quality control of the learning process particularly the success and efficiency of the collaborative phase. The roles he plays range from managing the time allocated to the different steps to making certain that each learner participates effectively to the stages of the method. Nevertheless, the main task carried out by the teacher is the stimulation of constructive discussions among the learners starting step 6. The teacher should put emphasis on collegiality in reaching consensual agreement when the group needs to validate knowledge. Finally, the teacher should work to make the learning experience enjoyable and should deal with any potential disillusionment and frustration the learners might face [17].

3. Results

3.1. Application of the Consensual Cooperative-Learning (CCL) Method to Learning the Concept of Technology Transfer

The process of CCL was initiated by announcing that the "Transfer of Technology", abbreviated here as TT, is the learning subject (step1). This was followed by splitting a group of 20 executives enrolled in a PhD program on innovation management into 4 subgroups of 5 learners (step 2). To cover various dimensions of the subject matter and enrich the understanding of the concept, each learner was assigned to review various sources and select up to 5 referenced definitions of TT and come up with a personal one (Step 3). Then, each individual learner provided the references for the definitions of TT he/she selected and presented orally to the audience the definition of TT he came up with from his personal research (step 4). Table 2 shows randomly selected individual definitions of TT from step 4. Forty key words (Table 3) were collectively retrieved from the individual presentations and posted on a white board (step 5).

Following intensive discussions, 30 out of the 40 selected key words were used and each subgroup reached a consensus and came up with and presented a common definition of TT (steps 6 and 7). Table 4 shows the definition of TT proposed by each subgroup.

Following that, the definitions proposed by the 4 subgroups were discussed by all the group members; a second round of key words selection was performed (step 8) and the following key words were selected. (Table 5)

These key words were used in conjunction with those selected from the first round to guide the group in proposing the consensual definition of TT shown below (step 9).

"TT is the process that organizes the dissemination of knowledge, skills, know-how and patents from a place of origination to a place of adoption in order to create added-value products or services through negotiation, licensing and agreement, within a given legal framework."

Finally each of the group's twenty learners graded the final consensual definition on a satisfaction scale of 0 to 10. The average grade obtained was 9.5/10.

Table 2. Examples of Technology Transfer definitions given by learners at the individual self-learning stage of the CCL method

The process of transferring by sharing and adapting knowledge, data, methods and technology among people or organization.
The process of transferring scientific findings from one organization to another for the purpose of further development and commercialization.
Movement of scientific methods of production or distribution from one enterprise, institution or country to another, as true falling investment, international trade, licensing of patent rights, technical assistant and training
The diffusion of practical knowledge from one enterprise, institution or country to another, transferred by commercial transaction or cross-national exchanges among components of multi-national enterprises that usually requires transfer of legal rights to use the technology.
Movement of knowledge, innovations and techniques from one country or organization to another by investment assistance, trade, licensing or training.

Table 3. Keywords retrieved from the definitions of TT given by each learner at the individual self-learning stage of the CCL method.

New market	Added value	Process	Problem	Solving	Invention	Connection	Ideas
Production	Method	Transform	Knowledge	Multidisciplinary	Usefulness	Solution	Intellectual property
New	Regulation	License	Vertical	Horizontal	Complex	Entrepreneur	Economic
Skill	Patent	Law	Exchange	Cost	Difficult	Creativity	Commercial
Organization	Leader	Technology	Diffusion	Vision	Gain	Know how	Data

Table 4. Consensual definitions of TT given by each of the four subgroups at mid-way of the CCL method process revealing their overall degree of satisfaction

Definition of Technology Transfer		**Subgroup Satisfaction Score 0/10**
Subgroup 1	A process of transfer of innovation, knowledge, methods, techniques, skills or data from one organization to another, for the purpose of further development, investments, licensing and commercialization of products and services.	6
Subgroup 2	The process of dissemination of knowledge, technology, skills, services and products that were developed in a particular place and for particular use to a new place and possibly for a new use by wide beneficiaries through or for commercial needs.	8
Subgroup 3	A process of transforming knowledge, data, information and patents into finding service or product with significant value through negotiation and agreement within a legal framework in order to achieve a certain impact.	7
Subgroup 4	It is the process of moving scientific and technical advances into marketplace as goods or services in an attempt to boost the economy.	6

Table 5.

process	origination	Products	agreement
dissemination	adoption	negotiation	Legal framework
patents	added-value	technology	data
services	Information	Economy	licensing

4. Discussion

This paper describes a new incrementally innovative learning method. The development of this Consensual Cooperative Learning "CCL" method stems from the observation that understanding of complex issues varies greatly among individuals and organizations. Indeed, complex issues are multifaceted and are generally at the crossroad of various fields, though contingent to different perception and understanding. To our best knowledge, no methods specifically dedicated to the learning of such issues are currently available. Therefore, we developed a consensual cooperative learning framework tailored to the need of achieving a harmonized learning outcome and understanding of a specific complex issue in a group of learners who are compelled to work together on the issue. The method is a three-staged model allowing for the vertical combination of two self-learning approaches with a consensual one. The three stages are as follows: Individual self-learning, Cooperative self-learning and Discussion-driven harmonized learning.

Individual directed self-learning [18] focuses on the capacity of each learner to retrieve existing knowledge on a complex subject and formulates it to express his own perception and understanding. In individual self-learning, the learning outcome is commonly influenced by the learner's personal background and this is when misconception or fragmentary understanding usually occurs. In our study, this aspect is reflected in the formulation of TT definitions provided by the learners individually (Table 2). Meanwhile, the cooperative learning stage [19] embedded in this method focuses on the mutual sharing of the knowledge acquired individually with a group of equally minded people. As a consequence of this interaction, the knowledge accumulated sums up and most of the aspects and dimensions contributing to the complexity of the subject can be equally grasped by each individual. This stage sets the ground to an enriched learning experience and deepens the understanding of the subject matter. The following stage of the CCL method consists in a discussion-driven harmonized learning process that focuses on the collegial compilation and integration of the previously accumulated knowledge about the subject matter into exhaustive, harmonized and shared knowledge. In this new learning method the individual participation stage yields effectiveness and responsiveness; while the collaboration stages help the learners exchange and discuss knowledge [20,22] to smoothly reach consensual validation of the acquired knowledge. The learners' engagement softens the lines between the complexity of the subject matter and the learning process, giving rise to a group-centered and seasoned learning process [22]. With regards to the technology transfer, Wahab and his coworkers attempted to cover the various dimensions of the subject matter and to enrich the understanding of the concept. To do so, they compiled definitions of TT through a review of relevant literature. However, almost all definitions were technically oriented and no consensual understanding of the concept of TT emerged. The implementation of the multi-layered "CCL" method which incorporates individual retrieval of relevant data, cooperative group discussion of referenced and consolidated definitions, helped in formulating a definition of technology transfer that can be used to

further academic study of the concept and/or to work on it in a corporate setting. Interestingly, the final definition of technology transfer was devised in its final form after the attribution by each learner of a personal satisfaction score using a 0 to 10 scale. The average score of 9.5/10 given by the group illustrates the high level of agreement reached in the understanding of the concept of TT and how the method is effective in achieving a harmonized learning outcome. It is also noteworthy that the method facilitated the communication and friendship among the group members, making the teaching method and learning style [24] more enjoyable, which is a feature of higher learning processes [11]. Furthermore, the results showed a compelling relationship between how the learners embraced information on the subject matter, and how successful the team was in collaborating and developing a valued consensual definition. [25]. The results from this study also indicated that all the ways of seeking out information, managing the data gathered and discussing different aspects of the subject matter need to be wisely geared toward agreement and consensual understanding. This depends heavily on the way the teacher structures the patterns of student-student interactions during the cooperative self-learning stage.

5. Conclusion

- This work illustrates how useful it could be to combine various learning processes, such as individual self-learning and cooperative self-learning in achieving a harmonized learning outcome of complex issue like technology transfer.
- The CCL method expands our arsenal of learning methods and fills an educational gap in achieving a consensual learning outcome of complex issues.
- Further research needs to be carried out to delineate the right combination of methods that matches best a given learning outcome such as the consensual learning outcome of complex issues.

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