Why Do Students Focus and Enjoy Carring out Tasks? Developing Procedural Scientific Knowledge of Preservice Primary School Teachers

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Abstract

When students are deeply focusing on a school task and enjoying it (experiencing flow), their willingness to perform similar tasks and the quality of the work done are higher. The objective of this study is to analyse the factors that favor the appearance of flow in tasks designed to develop procedural scientific knowledge in Preservice Primary School Teachers (PPST). For this purpose, preservice teachers were video-recorded while they were working in groups to solve volume and capacity measurement tasks. Collected data were analysed following an observation template which considers both, student's actions and the guidance of the teacher. Based on Flow Theory and Self-Determination Theory six main factors were analysed: feedback, clarity of the goal, the level of challenge and skills, perceived competence, autonomy and the relationship established with their work group and the teacher. The results of this analysis suggest that immediate and formative feedback and having positive relationship between the members of the group are essential factors to flow. Both factors make PPST participants to perceive that their contributions helped the group to accomplish the task, which increase their perception of the competence and that their skills match the challenge of the task. As soon as they feel both greater competence and challenges and skills balanced, students used to participated more often, which helped to increase concentration and enjoyment (flow).

Keywords: *Procedural scientific knowledge, experiences flow, preservice training*

1. Framework

Educational research has become an essential element for the improvement of educational quality. In recent years, Science Education research has focused on what knowledge is necessary to respond to situations in which science and technology are present (OECDa, 2016).

Traditionally, greater importance has been given to the knowledge of scientific content, that is, knowledge of facts, phenomena, concepts, theories and ideas related to science (Kind & Osborne, 2017; OECDb, 2016). However, several investigations show the existence of others (Howe, Tolmie, Duchak-Tanner, & Rattray, 2000; Montoro, Gil, & Moreno, 2017; OECDb, 2016), such as epistemic and procedural knowledge. Epistemic knowledge refers to the understanding of certain constructs related to science, as well as the characteristics that allow to build knowledge. In other words, epistemic knowledge favors the understanding of such relevant elements as questions, hypotheses, models, etc. Procedural knowledge refers to the necessary knowledge to carry out the practices on which science is based and allow us to verify scientific ideas (Montoro et al., 2017). Examples of this are: *distinguishing between dependent and independent variables, noting control variables, knowing the types of measures, errors and methods to minimize the error, identifying patterns within the data, etc*. (OECDb, 2016, p.23).

If we want everybody to be scientific competent, the three aforementioned kind of knowledge must be present in compulsory education. Another must for this concern is that Preservice Primary School Teachers (PPST) have to acquire scientific competence. According to the 2012 PISA Report (Ministry of Education, Culture and Sport, 2013), motivation and interest are considered to be the learning engine. However, the reality is that the rate of people who intend to dedicate themselves to areas related to science is getting smaller and many PPST are not interested on science topics. Considering factors causing motivation and interest would be appropriate in order to deal with this situation.

According to Self-Determination Theory, an individual might carry out an activity for pleasure or curiosity (intrinsic motivation), for getting a reward or avoid a punishment (extrinsic motivation) or not to be motivated at all (amotivation). It maintains that human behavior is driven by three basic needs:

autonomy, competence and relatedness. People make efforts to feel that they are the source of the actions they perform; they achieve the goals set in an effective way and to belong to a group (Deci and Ryan, 1985).
Flow Theory arose with the aim of explaining how people feel doing intrinsically motivated activities and what make the experience so rewarding. In these situations, people are so focused on their activity that they isolate themselves from what is happening around them and lose track of time (Cskiszentmihalyi, 2014). This experience, called *flow*, led to people to repeat the activity several times in order to feel the same again. Montoro and Gil (In press) affirm that the main factors used in previous literature to explain the appearance of flow are the necessity of setting clear goals, providing immediate and productive feedback and proposing challenges balanced with individual perceived skills. The interest and utility of the tasks were also taking in account in their research.

2. Metodology

The objective of this research is to analyze the aspects that facilitate flow experiences in PPST performing tasks that promote procedural knowledge, using both self-determination and flow theories.
In order to work out a first approach to this problem, three tasks used in a PPST training course of teaching and learning measurement were selected because of their capacity of promoting procedural knowledge. Task 1 asks to order different bottles according to their capacity (Figure 1), task 2 asks them to order two stones and an empty shaving foam bottle according to their volume (Figure 2) and task 3 asks them to measure the capacity of their handful, their drink and their lungs (Figure 3).

Figure 1. Group 1 solving capacity comparison task

Figure 2. Group 4 carrying out volume comparison task

Figure 3. Group 8 performing capacity measurement task

Several voluntary PPST were video-recorded working in groups of 4 or 5 students to solve these tasks. Groups 1 to 3 solved task 1, group 4 to 6 solved task 2 and groups 7 to 9 solved task 3. Observation template and atlas.ti software were used to analyze the videos.
Following the structure of Pazos, Micari and Light (2010) ´s template, two large areas were considered: one to analyze the actions of the lecturer and another for PPST. This template was adapted to include key factors of both Flow and Self-Determination Theories: feedback, clarity of the goal, the level of challenge and skills, perceived competence, autonomy and the relationship established with their work group and the teacher.

3. Discussion or results or conclusions

The most relevant results will be shown taking into account the space we have available. More than 80% of students who performed task 1 experienced flow (concentration and enjoyment), roughly a 70% of student who solved task 2 flew and just a 40% of student carrying out task 3 enjoyed it. Therefore, the question would be what have been the reasons why some have experienced flow and others have not.
One of the main characteristics of the three tasks is that all students understand what they were asked for and knew some knowledge which allowed them to start thinking about a way of solving them. They felt they could be successful. Both, having clear goals and feel the challenge is matched with perceived skills, are conditions for feeling flow.
However, big differences were found between their confidence with capacity and volume magnitudes. All students affirmed that the order of the bottles and the measure of the capacity of their handful and their drink (body measurements) were correct, although it could have been done it in a more accurate way. In contrast, half of the students were not sure about the suitability of their process in the volume comparison and just one of the three groups who made volume measurement task. That is, they needed the teacher´s approval to know if they succeed, since their previous knowledge is not enough to get feedback about their performance.
Since they were working in groups and shared the same vocabulary, peers provide positive feedback, discussing the best process to success or correcting mistakes. For example, in G4 a participant noted that their partners were doing the procedure to compare the volume wrong because they had immersed just a part of the shaving foam bottle in water. As soon as she told them, they agreed they were wrong and changed the procedure. The same happened in group 8, when students suggested measuring the capacity of the lungs by weigh the balloon or by the time they need to blow the air of their lungs in the balloon. However, in groups 7 and 9, the teacher had to make them to realize they were wrong, for example, by suggesting weighing an empty balloon or asking them about the units of capacity measurement.
Likewise, when feedback indicated that performance was not adequate on several occasions or team members did not support or helped each other, the perception of competence decreased, so they did not express their ideas or did not insist on performing the procedure suggested. That happened in groups 7 and 9 while measuring the capacity of the lungs. However, the members of group 8 listened and evaluated the ideas of their peers' without trying to impose their own view and understanding the perspective of the rest. For example, two of the members of the group affirmed that they need to know the volume of water before immersing the balloon, even though the rest of the group told that it is enough to fill the whole container and measure just the water displaced, which is faster. One of the members of the group, instead of imposing his idea, proposed to do both processes in order to realize that both were correct. Once the fastest method was carried out, the rest of the team agreed there was not necessary to do the alternative process.
In summary, the feedback provided to the students and a positive relationship between the different team members, where they feel that they contribute ideas to the group, favored an increase in their self-confidence. This increase causes a balance between the challenges presented by the tasks and the skills of the individual and an increase in students' participation, which helps boosting concentration and enjoyment. In contrast, when peers did not trusted on their mates´ ideas or when the teacher made them to realize their processes were wrong more than twice, the perceived skills decreased and became unbalanced with the challenge. To know more about the difficulties and mistakes made by students, see Montoro, Gil and Moreno (2017).

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