Conditions for Successful *Learning-by-Teaching*: Lessons Learned in Training Prospective Science Teachers

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Abstract: Learning in the 21st century where knowledge is constantly changing, requires the use of strategies that create knowledge building communities (Bielaczyc, Paik & Ow, 2012). *Learning-by-teaching* is one such strategy. This entails forming students' groups of enquiry, who come to discuss their research findings with the whole class (learning forums), to encourage the building of shared knowledge. This poster uses quasi-experimental method to investigate the change in the performance of teacher-trainees when using *learning-by-teaching* strategy, after using non-*learning-by-teaching* strategies. The poster also explores students' perceptions on their use of the pedagogic strategy, in order to illuminate the conditions suitable for successful implementation of method. Three cohorts of students participate in the study over three years. Findings indicate that the strategy succeeds when students' motivation is high, resources are adequate, and timely corrective feedback is provided.

In classes where *Learning-by-teaching* is used, tutors divide students into groups consisting of about three to eight students. Each group is given its own specific learning task which they research about, discuss and make preparations to teach the rest of the class. These learning tasks may be given as home work or (in the case of lower classes) could be given during the lesson. Therefore, each group designs its own ways and pedagogic strategies of imparting the knowledge to other students(Skinner,2006). After each group has taught, a learning forum, where corrections, comments, additions and elaborations are made, is opened. The tutor (teacher) does not 'teach', but participates as a member of the forum, while also providing guidance and support to students as they teach each other (Martin, 2008). The support mainly comes through providing resources such as books, reference materials, and teaching-learning tools, including electronic and digital media tools.

The argument for the use of the strategy is that it recognises students' abilities and prior knowledge, which can become one of the most enabling and most powerful factors for motivation (Shor and Freire, 1987). It is also deemed to provide *collaborative-constructive* ways of knowing that tend to encourage self-management and self-monitoring, resulting in improved performance on educational objectives (Garrison, 1997; Kuusissari, 2013)). The promotion of 'talk' found in 'learning forums' and inquiry-group discussions, are viewed as ways of encouraging seamless knowledge creation in the communities of learning (Wenger,1998; Mitchell and Sackney, 2000) which could elevate interest, engagement and motivation to learn. This poster seeks to find if the *learning- by- teaching* can increase performance and, if so, under what conditions can this be possible.

Method

Participants were three cohorts of student-teachers. The first cohort were 23 prospective secondary biological-science teachers. They did not use *learning-by-teaching* in the 1st course done in their 2nd year, but they used *learning-by-teaching* in the course learned in their final/third year of study. The second cohort were 53(later 52) prospective primary science teachers. They did not use *learning-by-teaching* in the course done in their first year, but used *learning-by-teaching* in their final/third year of study. The last cohort were 84 (later77) prospective primary science teachers. They partially used *learning-by-teaching* in the course done in their first year of study and wholly used *learning-by-teaching* in the course done in their final/third year of study). The overall end-of term performance of all these students in the courses were recorded and compared.

Table 1: Descriptions of the Three Groups of Participants

Cohort	***Characteristics of each Cohort of students***
1st cohort	Prospective secondary biology teachers studying with fewer resources in 2nd year, but more resources in 3rd year. They had enough time for both courses and were 23 in both years.
2nd Cohort	Prospective primary science teachers that had fewer resources in first year (were53), but more resources in 3rd year (were 52). They had enough time for the courses in both years.
3rd Cohort	Prospective primary science teachers with extremely scarce resources in 1st year (were 84) and studied under severe time constraints. They studied with more resources in 3rd year (were 77) and had more time for the course.

Data was also collected from all the participants, using end-of-course evaluation questionnaires. The questionnaires were meant to find responses pertaining to the strengths and weaknesses of strategies and

resources used, as well as proposing improvements in the delivery of each course. The responses were coded and analysed qualitatively to find conditions leading to successful use of *learning-by-teaching* method.

Findings

The graphs below shows number of students and their overall course marks obtained, using *learning-by-teaching* & when not using *learning-by-teaching*.

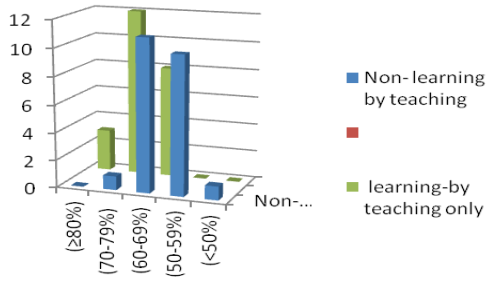

Figure 1. Marks obtained by 1st cohort

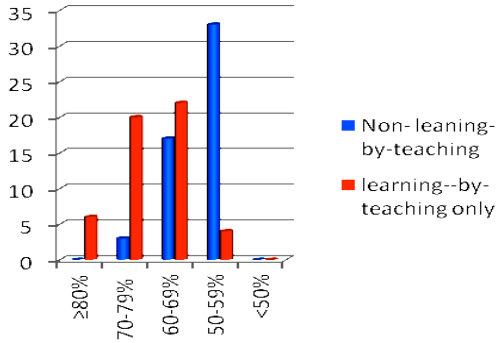

Figure 2. Marks obtained by 2nd cohort

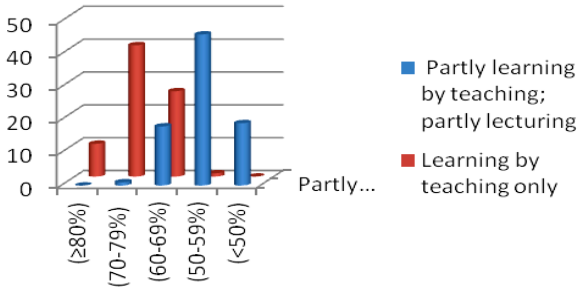

Figure 3. Markes obtained by 3rd cohort

Analysis and Discussion

The performance outcomes of all the three cohorts indicate that there was a general improvement when each group used *learning-by-teaching*. However, these results could not be very conclusive as there could be other factors that could have let to improved performance, such as the experience of learners and the content of the course. More controlled and stricter experiments are needed to draw more accurate conclusions. Nevertheless, *learning-by-teaching* appears to be a promising strategy and further investigation are needed. The findings emanating from the analysis of the questionnaires confirm *learning-by-teaching* as a worthy learning strategy which needs more exploration and could yield better results if students understood the justification for its use, were motivated to learn that way, adequate resources were provided, there was enough time for researching/preparations and discussions, and timely corrective feedback was always given.

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