A Study of Readiness for the Integration of 21st Century Practices in the Mathematics Classrooms

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This poster explores the complex process of integration of 21st Century (21C) teaching and learning practices into mathematics classrooms, reporting on mathematics teachers' perceptions of the predictors for, and barriers to, their integration in European post-primary schools. Data are drawn from teachers' responses to a questionnaire for an Erasmus+ project that addresses readiness for the integration of 21C practices. Responses from 52 Irish, Swedish, Estonian and German practitioners listing mathematics as one of their teaching subjects are considered. For quantitative data, descriptive and inferential statistics were used; a directed content analysis approach was taken for qualitative data. Findings indicate that system restrictions and resources are major barriers, and that classroom management and teacher beliefs impact on confidence with and frequency of use of 21C practices. We propose that this work form the basis of a broader study.

Keywords: Teaching practices, 21st Century Learning, Mathematics Education.

The perceived importance of a '21st Century' (21C) approach to teaching and learning is well documented (Dede, 2010; Voogt & Roblin, 2012). In terms of mathematics pedagogy however, while there is considerable research into the use of technologies for teaching and learning (e.g., TWG15 and TWG16), the broader field of 21C practices in the classroom is less considered. This research explores responses to a survey instrument developed for an Erasmus+ project, Teaching for Tomorrow (TfT). TfT is a partnership between institutions in four countries (Ireland, Sweden, Estonia and Germany) that are working to develop a model of 21C teaching and learning across subject areas. The poster reports on the responses of 52 teachers who name mathematics as one of their teaching subjects. The aim is to identify what they see as the predictors for and barriers to usage of 21C practices in the classroom, with a view to larger-scale research.

The theoretical framework underpinning the model for 21C practices being developed by TfT draws on the work of Ravitz, Hixson, English, and Mergendoller (2012), which emphasises a project-based, collaborative, and student-led pedagogic approach. "Readiness for integration" is taken as involving *confidence* in using and encouraging, and *frequency* of using, the 21C practices of: Critical thinking, Collaboration, Communication, Creativity & Innovation, Use of Technology, Self-direction, Global and Local Connections.

The questionnaire used to gather data was developed by the Irish partners, with items drawn from the validated instruments of Euler and Maaß (2011), Ravitz et al. (2012), and the OECD (2010). It involved 4 main sections: (1) *Background information*; (2) *Teachers' beliefs about the nature of teaching and learning (direct transmission versus constructivist)*; (3) *Orientation towards, usage of, and barriers to 21C teaching and learning*; and (4) *Confidence with and frequency of integration of 21st skills in practice*. Apart from section 1 and an open-ended item in the Barriers section, all items used 5-point Likert-type scoring system.

Multiple regressions were performed to identify whether the categories of *beliefs*, *opinions and usage*, and *barriers* had a significant bearing on teachers' *confidence* with, and *frequency* of, integration of 21CL practices in the mathematics classroom. Also, *t*-tests and one-way ANOVAs were used to compare the mean ratings across the four participating countries. Directed content analysis was undertaken for the qualitative data.

Results indicate that teachers' mean *orientation* towards 21C practices is quite high, with respondents tending to agree that 21C teaching and learning has a positive impact on student motivation. However mean levels of *confidence* are less positive, and mean *frequency of usage* is rather low, pointing to a lack of readiness for integration. Respondents' mean scores for self-reported direct transmission beliefs are lower than those for constructivist beliefs, the latter being predictors of confidence in 21C practices.

In the qualitative analysis, students' and teachers' direct transmission beliefs are reported by respondents as barriers to the integration of 21C practices, with "*teacher inertia and general reluctance to move from traditional methods*" emerging as a common issue. Barriers at the system level, particularly those associated with time, and curriculum and assessment, also appear important. In addition, both quantitative and qualitative analysis reflects that classroom management issues act as barriers to teachers' implementation of 21C practices: "*Students are not used to 21CL, because most of the time they do not have to do it, so at first it takes a lot of time.*"

In order to encourage teachers to integrate 21C practices in the mathematics classroom, it is essential to address some of the barriers identified. The features of the TfT model, outlined above, are intended to provide guidance for teachers and students, a structured approach to the development of 21C activities, and relevant assessment practices.

It should be noted that although the samples from each country are small and not representative, and that there were variations in the criteria for participant selection, the results across counties show surprising commonality. Thus, we propose to conduct a larger study, involving representative groups, uniformly selected in each country, to see if such trends arise outside the confines of TfT.

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