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Colloquia: MPTL14

Inspire: Challenging the lack of interest in physics among students

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Summary. — The Inspire project tested and analyzed the use of digital learning resources (LR) in the field of Maths, Science and Technology (MST) in 63 schools in Austria, Germany, Italy, Lithuania and Spain. MST teachers used the LR from a pool of 60 resources (12 for Physics) in class and the effects on teachers and 5–18+ year old students were measured. We found the use of LR increases the understanding of students of MST and allows for differentiated learning within a class. LR have a larger impact on boys than girls, and it decreases with age. Overall, it appears the use of LR has a positive impact on MST education but special attention has to be placed on technical requirements and localization of the LR.

PACS 01.50.-i – Educational aids.
PACS 01.50.F- – Audio and visual aids.

1. – Introduction

It is believed that the use of learning resources (LR) increases students' motivation in Math, Science and Technology (MST) by providing them with visual, and usually interactive, representations of the topics discussed. Although their benefits are widely assumed or even accepted, little research exists on actual proof of an increase in interest from students and teachers specifically as a direct result of the use of LR in class (Kay & Knaack 2008).

To address this issue, the Inspire (Innovative Science Pedagogy in Research and Education) project (Inspire 2007), set up a validation observatory where 63 schools in Europe used, tested and analyzed the use of LR in the field of MST during a defined period of time. Through this experimentation, special attention was given to the impact of these

LR at the level of pupils and their motivation, the analysis of the pre-requisites to be defined for enabling the teachers to integrate them in their pedagogy and the critical success factors to be mastered at the level of the teacher and the school for the generalization of such practices (Kearney C., Gras-Velázquez, À & Joyce A., 2009).

The testing was carried out in 63 schools in Austria (24), Germany (19), Lithuania (10), Italy (5) and Spain (5). More than 200 teachers used a selection of Learning Resources (LR) in their classes. Over 4100 students were surveyed before and after the pilot tests to measure the LR's impact on students' motivation. Additionally, teachers provided input on the characteristics and formats LR must have for their integration in the normal class lessons. Aspects like languages, LR technical formats and other issues were analyzed. Results were also analyzed taking into account the subject in which the LR was integrated, in particular in Physics classes.

2. – The protocol of experimentation

The experimentation consisted of two aspects: a well-defined selection of LR to be used for the testing in all five countries and a set of questionnaires to be to be filled in at the different stages of the Inspire activities: the preparation, the implementation, the follow-up and monitoring, the evaluation, documenting the activities, the dissemination or valorization.

2˙1. *The Inspire questionnaires.* – 26 questionnaires were designed to be filled by the different actors: the school coordinator, the MST teachers, the pupils and the national coordinator. They were all provided both as downloadable pdfs and either Google forms or spreadsheets, depending on the format of the questionnaire([1]) and were designed mainly as closed questions (multi-choice/rating questions).

The questionnaires provided information on: 1. The schools characteristics and policies (according to the school coordinator/head master); 2. The teachers' views and uses of the Inspire LR and ICT in general (filled in by the participating teachers); 3. The impact of the use of LR on the pupils (both from the teachers' point of view and the students'); and 4. The organization of the piloting (filled in by the national coordinators). More specifically, a form on the use of each LR by the teachers had to be filled in before and after using it, and both teachers and pupils were asked to fill in questionnaires on the expected impact or interest in MST before the use of the Inspire LR and after the actual impact and interest once they were used (teachers on the impact on both themselves and their pupils and students only on themselves).

2˙2. *Physics Learning Resources.* – To be able to compare the effect of using LR in science classes on the interest of students in MST across 5 different countries, it was important to have all schools use the same resources. To allow at the same time some freedom for teachers to choose the LR that best fitted their curricula and personal teaching style, there had to be a few resources per subject to choose from. 60 resources were selected according 3 main criteria. The selected LR had to be scientifically correct; appropriate for students between 5 to 21 years old and that would travel well, ie usable by teachers with different curricula and languages (Gras-Velázquez, À. & Joyce, A. 2008a).

([1]) All the Inspire questionnaires can be found at `http://inspire.eun.org/index.php/All_Forms`

TABLE I. – *Inspire Physics Learning Resources*([2]).

LR ID	Subcategory	Title	Author	en	ca	de	es	it	lt
P1-5-1	Kinematics	Distance-displacement	David Harrison	√	√		√		
P2-5-2	Kinematics	Motion with constant acceleration	Walter Fendt	√		√	√	√	
P3-5-3	Sound	Changing sounds	National Council of Teachers of Mathematics, USA	√					
P4-5-4	Dynamics	Conservation of Energy	B. Surendranath Reddy	√					
P1-13-5	Electricity	Ohm's law	Walter Fendt	√		√	√	√	
P2-13-6	Optics	Reflection-refraction	David Harrison	√	√		√		
P3-13-7	Mechanics	Galilean relativity	Physics@UNSW	√					
P4-13-8	Nuclear Physics	Radioactive decay	David Rea	√					
P1-17-9	Oscillations	Beats	Walter Fendt	√					
P2-17-10	Dynamics	Forces on a pendulum	David Harrison	√	√		√		
P3-17-11	Relativity	Time dilation	Joakim Linde	√					
P4-17-12	Optics	Young's Double Slit Experiment	B. Surendranath Reddy	√					

12 resources were selected per subject and categorized under: Physics, Chemistry, Biology, Mathematics and Informatics (IT). The topics covered by the Physics resources can be found in table I.

When available, links to the resources in the different languages of the pilot schools were provided. In table I, we indicate the languages the resources were available in. All resources were available in English (en), while some also in Catalan (ca), German (de), Spanish (es) and Italian (it). None were available in Lithuanian (lt). To facilitate the use of the LR in non-local languages, a list of the basic vocabulary used by each LR and its translation to all the Inspire languages was provided (Gras-Velázquez, À. & Joyce, A. 2008b).

3. – The participating schools, teachers and pupils

A few characteristics of the 63 pilot schools:

– 74% of them were Secondary schools (13–21 years old), 11% Primary schools, 11% Vocational schools and 5% Pre-educational schools (3-6 years old).

([2]) The URLs of the Physics LR can be found at `http://inspire.eun.org/index.php/Learning_Objects`.

– 72% were particularly interested in ICT, having a specific strategy to promote ICT in as many subjects as possible.

– Especially Lithuanian and Austrian schools had a lot of expertise as far as ICT is concerned while Spanish schools were fairly inexperienced. Nevertheless, all Spanish teachers involved in the project had experience in ICT, even if their schools did not.

– A total of 220 teachers filled in the questionnaires before the use of the LR, while 190 teachers completed the piloting. The drop-out of participation among teachers was due in general to difficulties in the use of the LR in classes, language issues and miss match of experience and resources available. The ratios per country (start/finish) were: 75/59 (AT), 63/52 (DE), 52/52 (LT), 21/16 (IT) and 11/11 (ES).

– A total of 4051 students filled in the initial questionnaire on their interest in MST while 3411 students responded to the questionnaire on Impact of the LR on the MST lessons and interest after the tests. The ratios per country (start/finish) in the case of students were: 1897/1641 (AT), 1599/1254 (DE), 182/182 (LT), 260/182 (IT) and 113/152 (ES).

– Out of the 4049 valid student responses, 2059 were male students and 1990 female students.

– The majority of pupils worked on their own (40%), while 33% in pairs and 12% in large groups. The remaining pupils worked partially in each of the previous distributions.

4. – Results

All the data obtained has been analyzed and will be published in a series of reports: Kirsch & Beernaert (2009a), Kirsch & Beernaert (2009b) and Gras-Velázquez, *et al.* (2009). The main results are discussed in the following subsections.

4˙1. *Assessment of the Physics learning resources.* – The LR were used 904 times. All the LR from the Inspire selection were assessed and used at least ten times by the Lithuanian teachers. The use of the LR per category was practically equally split, teachers using the Physics resources 183 times. The most popular Physics LR were P4-5-4 and P2-17-10, used 22 and 21 times respectively. Also P2-13-6 (used 19 times) and P3-5-3 (used 18 times) were very popular. The least popular LR were P1-17-9, P3-13-7 and P4-13-8 only used 11 times. If the Lithuanian entries are removed, the differences in use are even more striking, with P4-5-4 and P2-17-10, being chosen by the teachers for their classes 19% and 17% of the times correspondingly, compared to the one use of the least liked LR.

As seen in fig. 1, the main criterion for choosing the particular Physics LR was the fact that the topic was part of the normal curriculum. This result matches the results for all subjects, where 79% chose a LR because it concerns a topic that is part of the normal curriculum in MST. Around three quarters of the teachers also selected LR because it took into account the ICT expertise of the teachers (75%) and of the pupils (74%) and because it clearly combines MST with ICT.

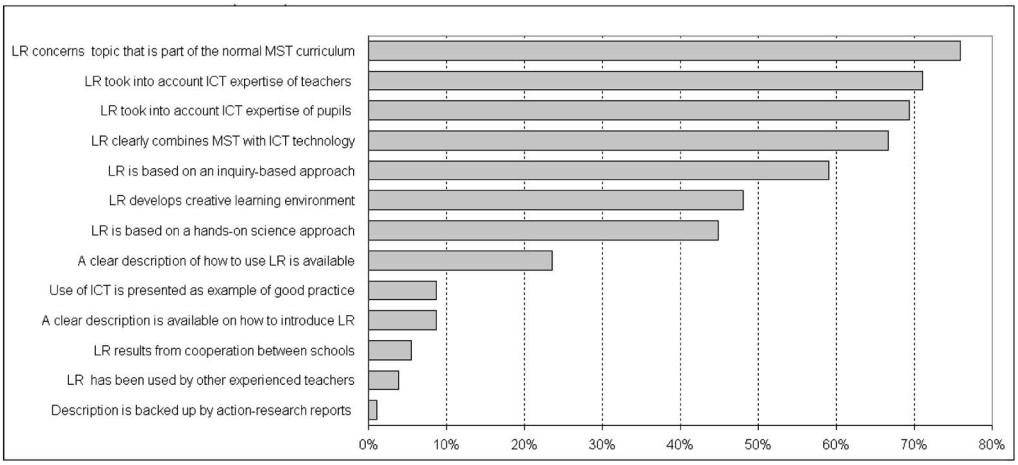

Fig. 1. – Selection criteria for the Physics resources. Bars represent percentage of teachers who took into account each criteria for selecting a resource to use in class.

4˙2. *Assessment of the impact of the use of learning resources in class according to teachers.* – When the teachers assessed the impact of the LR after having used them, they stated that they noticed the LR had the highest impact on the autonomous learning of the pupils. Additionally,

- Nearly three quarters of the teachers found that the LR stimulated their own interest and motivation for teaching MST.
- 70% said the LR increased the pupils' understanding and use of ICT in general.
- Around two thirds of the teachers noticed that the LR stimulated pupils' interest and motivation for learning MST (67%).
- They also experienced that thanks to the LR their own interest for teaching MST using LR increased (66%) and that the LR facilitated differentiated teaching of sciences in the classroom (64%).
- 54% of the teachers experienced that the LR helped link science to everyday life more easily.
- 52% that they made the pupils better understand tests and experiments carried out in labs or develop pupils' ability to use scientific methods.

Teachers from all countries, except Lithuania, felt it difficult to integrate LR in their classes which were not in their local language. Teachers from Spain and Italy, specially, also found the technical constraints to be against the use of the LR (lack of access to computer labs or Internet).

4˙3. *Assessment of the impact of the use of learning resources in class among pupils.* – The final survey on the appreciation of the impact on MST after the use of the LR by the students was filled out by 3403 pupils, 1740 boys and 1663 girls. In fig. 2 we show the answers of students who agreed with the statements versus the responses of the pupils

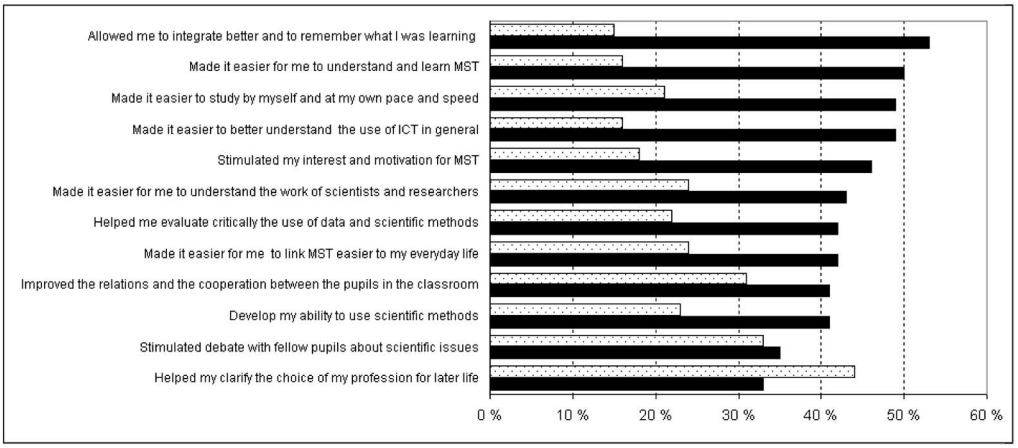

Fig. 2. – Impact of using LR on the students. Bars represent percentage of students who said yes/no to each statement. Dotted bars represent "no" answers. Filled bars represent positive answers.

who stated that there was no impact at all. The missing answers which correspond to "undecided" are not included.

The results shown in fig. 2 were also analyzed according to gender, age, country and amount of LR used during the piloting. The main results found are:

- LR had a major impact in pupils regarding better understanding and learning MST and making it easier to integrate and remember what pupils have learned;
- LR seemed to have a greater impact on boys than on girls;
- The impact of the learning objects decreases with the age, specially among female students;
- For virtually all items surveyed the impact perceived by the Lithuanian and Spanish pupils, followed by the Italian students, is considerably higher than the impact perceived by the Austrian and German students;
- No real impact could be noticed as far as the number of LR that were used.

5. – Conclusions

We have found the use of LR in MST classes increases the understanding of students of MST. Additionally, it allows for differentiated learning with a class. The use of LR has a larger impact among boys than girls, and decreases with age. The drop off is more acute among girls perhaps due to increased pressure of gender stereotypes (Gras-Velázquez, Joyce & Debry, 2009). Overall, it appears the use of LR has a positive impact on MST education but special attention has to be placed on technical requirements and localization of the LR.

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