PROFESSIONAL DEVELOPMENT OF SCIENCE AND MATHEMATICS TEACHERS FOR BUILDING STUDENT DIGITAL COMPETENCE: EXPERIENCE OF LATVIA

Dr. phys. Inese Dudareva
Dr. paed. Dace Namsone

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REPUBLIC OF LATVIA

Capital and largest city
RIGA

Official language
Latvian

Area:
64 589 km²

Population (2016):
1 953 200
UNIVERSITY OF LATVIA

ANNO 1919
13 faculties
≈ 14 000 students

Studies and research in
- humanities
- pedagogy
- social sciences
- natural sciences
- health sciences

Over 20 research institutes and independent study centers
INTRODUCTION

• Digital competence: the set of knowledge, skills, attitudes that are required when using ICT and digital media to perform different tasks. (Ferrari, 2012)

• Teachers professional performance: using ICT with effective teaching strategies to expand learning opportunities and content knowledge for all students. (AITSL, 2011)
ESF DEVELOPMENT PROJECTS IN SCIENCE AND MATHEMATICS IN LATVIA

Science and math I
Upper secondary level
2005 – 2008

Science and math II
Lover secondary level
2008 – 2011

Developed the subject
• standards (goals and outcomes)
• curriculum and syllabi (methodological approaches and strategies)
• teacher support materials (adapted to the new curricula)

Supplied schools with:
• Equipment for science classrooms (included ICT)
• Methodological support materials

Organised professional development classes for teachers
Complete set of materials for grade 10 to 12

2005 - 2008
Complete set of materials for grade 7 to 9
ESF DEVELOPMENT PROJECT IN EDUCATION IN LATVIA

Implementation of competence-based education
2016 – 2020

Center for Science and Mathematics Education Research
2013 – 2016

• Gap between policy and actual teaching approaches
  (France, Namsone & Čakāne, 2015; Volkinsteine & Namsone, 2016)

• Direct impact on practices
RESEARCH QUESTIONS:

• What stages can be identified in teacher professional development on the focused area: building of student digital competence in Latvia over period of 10 years?

• What should the next stage CPD model of building student digital competence be like?
RESEARCH QUESTION 1

What stages can be identified in teacher professional development on the focused area: building of student digital competence in Latvia over period of 10 years?

Data collection and analysis:

• analysis of continuing professional development (CPD) programs (2006 – 2008; 2009 – 2011)
• 64 science lesson observations and analysis (2013 – 2014)
• analysis of expert feedback (2013 – 2014)

Professionally trained experts from the Center for Science and Mathematics Education (10 – 15 years experience)
## RESULTS AFTER ANALYSIS OF CPD PROGRAMS

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Stage I (15 h out of 72)</th>
<th>Stage II (6 h out of 36)</th>
</tr>
</thead>
</table>
| Usage of ICT tools and resources | To acquire the technical skills to use various ICT tools:  
- data loggers, sensors, interactive whiteboard, web camera, data camera etc.  
Teachers identify the resources available for the organization of the teaching/learning process in science and math:  
- videos, virtual labs, animations etc. | To use the developed teaching materials, ICT tools and resources in the teaching/learning process (mostly in Latvian):  
- lesson plans  
- Worksheet for virtual labs etc. animations  
To learn from other colleagues` ‘best practice' examples.  
Students identify the resources available for the learning process in science and math:  
- videos, virtual labs, animations etc. |
| Basic learning model | To use ICT in the teaching/learning process  
- for visualization  
- to demonstrate content to students  
- to deliver information | Support system model  
To develop and enhance ICT skills for organizing the teaching/learning process:  
- to plan according to the achievable outcomes  
- to engage students with content  
- to facilitate collaboration during and beyond lessons |
LESSON OBSERVATIONS AND ANALYSIS

• 2013 - 1014
• 10 schools from the same municipality
• 64 science subject lessons (physics, biology, chemistry; grades 7 – 12)
• Teachers have completed CPD classes offered by projects “Science and Math”

Data collection and analysis:
• Specially developed e-observation sheets for transcript and analysis
• Rubric: use of ICT for Learning
RESULTS AFTER LESSON OBSERVATIONS AND ANALYSIS

The use of ICT tools in science lessons
RESULTS AFTER LESSON OBSERVATIONS AND ANALYSIS

The correlation between the use of ICT and implemented teaching methods

0 – not present; 1 – minor presence; 2 – moderate presence; 3 – present
# RUBRIC: USE OF ICT FOR LEARNING

<table>
<thead>
<tr>
<th>Level</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Students do not have the opportunity to use ICT for this learning activity</td>
</tr>
<tr>
<td>2</td>
<td>Students use ICT to learn or practice basic skills or reproduce information. They are not constructing knowledge.</td>
</tr>
<tr>
<td>3</td>
<td>Students use ICT to support knowledge construction BUT they could construct the same knowledge without using ICT.</td>
</tr>
<tr>
<td>4</td>
<td>Students use ICT to support knowledge construction. AND the ICT is required for construction this knowledge. BUT students do not create an ICT product for authentic users.</td>
</tr>
<tr>
<td>5</td>
<td>Students use ICT to support knowledge construction. AND the ICT is required for construction this knowledge. AND students do create an ICT product for authentic users.</td>
</tr>
</tbody>
</table>
RESULTS AFTER LESSON ANALYSIS

Usage of ICT in science lessons according to the rubric criteria

- 1. level: 86%
- 2. level: 9%
- 3. level: 3%
- 4. level: 2%
Discussion and conclusions I

• In teacher professional development on the focused area: building of student digital competence in Latvia over period of 10 years we can identify two stages: 1) teachers acquire the technical skills of using ICT (basic learning model); 2) teachers develop and enhance ICT skills for organizing the teaching/learning process (support system model).

• The observed lessons allowed us to detect the presence of ICT in teaching and learning process compared to 2006 when it was virtually non-existent in Latvia.
Discussion and conclusions II

• The use of ICT in the classroom will be meaningful if the teacher has the appropriate skills that allow him/her to choose the most efficient method for the lesson, and if the teacher knows how to apply this method in order to achieve the goals.

• Lesson observations in Latvia reveal a gap between policy and actual teaching approaches:
  • ICT is still mainly used by teachers as a tool for transmitting information and the involvement of students in the application of ICT is low.

• Should be offered a new model of CPD for teachers.
LEARNING PHYLLOSOPHY

Effectiveness of
lesson
Literacy
IT skills

New experience

Collaboration

Community Support
Trust

Reflection

See
Speak
Write
Think
RESEARCH QUESTION 2

What should the next stage CPD model of building student digital competence be like?

Participants

Group of 35 science and mathematics teachers

• have completed CPD classes offered by both projects «Science and math I & II»

• have acquired similar previous experience and understanding of ICT usage
TEACHER LEARNING MODEL

1ST workshop

2ND workshop

... workshop

6TH workshop

REGULARITY

DURATION

1ST YEAR

2ND YEAR

3RD YEAR

Effectiveness of lesson / literacy / IT skills

New experience

Collaboration

Community Support Trust

Reflection

See

Great

Wide

Think
WORKSHOPS
WORKSHOPS
EXAMPLE OF TEACHERS DEVELOPED ACTIVITY PLAN

Subject: physics  
12. grade  
Lesson duration: 40 min

Students create an optical system from two lenses to achieve a maximum enlarged view. Students understand that, by mutually combining a variety of lenses, they can achieve a enlarged view of an object.

Situation
To see distant objects, you can mutually combine a variety of lenses obtaining objective and ocular. How to create a “sight improver” by using given lenses to achieve a maximum enlarged view?

Activities
• Students check sight to make sure later of the effectiveness of the created device.

• Discussion about optical devices. Students create a “theoretical model” - choose lens parameteres, create drawings, showcasing the course of the beam, make calculations.

• Realistic model - “sight improver” creation, using given equipment.

• Sight test, by using the developed device. Comparing results with initial measurements, as well as with calculations and experiment obtained data.


Proposed model

- Learning through collaboration outside the school
- Collaboration in the school
- Teachers' Independent learning study

Continuous lesson based professional development
LESSON STUDIES

• After workshops teachers receive an individual assignment
• Learning study = independent teacher’s work happening between workshops
• Development and piloting of lesson plans with the help of expert-coach
• Reflection and finding artefacts after piloting
• In other words = examination of personal practice with an aim of improving it (action research)
RESEARCH QUESTION 2

What should the next stage CPD model of building student digital competence be like?

Data collection and analysis:

- analyses of field notes
- written feedback from teachers after workshops
- focus group discussions with aim to obtain information about workshop`s impact on the teachers` teaching, reflection and collaboration skills
- analyses of teacher`s developed lesson plans by using of ICT for Learning Rubric
- teachers and experts reflections
# RESULTS AFTER LESSON ANALYSIS

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<th>Lessons, %</th>
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<td>17</td>
</tr>
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</table>
DISSEMINATION MATERIALS FOR TEACHERS

SKOLOTĀJU PROFESIONĀLA PILVEIDE DIGITĀLĀS KOMPETENCES ATTISTĀŠANAI

PAMATPRASMU APGUVE
- tehniskas IKT rīku lietošanas prasmes
- piemērotā digitālo resursu atpazīstama
- mācību savākta visualizēšana un informācijas sniegšana

ABALSKA KIĪMENA
- atvērsta mācību lietošana
- laba prakses piemēri
- uzdevumu skolēniem ar pielāgotiem digitālajiem resursiem
- mācību procesa ierobežošana attīstītā plānojām mērķiem

DZĪLĀ MĀCĪŠANĀS
- tehniskas IKT rīku lietošanas prasmes personālišā mācību procesam
- tehniskas IKT rīku lietošanas prasmes profesionāla pilveide
- mācību procesa pilveide mācību procesa mērķaie IKT rīku lietošana, kas fokusiē uz skolēnu dalāmies kompetences attīstību un pilveide

KO SĀKA PĒJUJUMI?

PARESĪŠO SMACI LUČI!

Skolotāji Latvijā ir argumentējusi pamatprasmē IKT rīku un digitālo resursu lietošana. Skolotāji mir izstrādāju par jēgpirku IKT rīku lietošanu mācību procesā, bet izpildās prakse at se vienkārša patā līdzināja, un jāievēro jaunā profesionāla pilveides nodrošināšanas formāli. UZ DZM IC pētījumā (2014 - 2016) tika vērota 84 dabaszinsītā stundas starpība Latvijas skolās, 78% no stundām tiek lietota IKT rīku un digitālie resursi, bet 12% no stundām jūrāst skolēni IKT rīku, kas īsteno skolās. Kādam tiekāk skolēni lieto IKT pieejamā starpība, tā analīze ir izveidota rubriku IKT lietojumā mācību procesā par Microsoft Pardesio ar Flashino.

CITUR PASAUJU:

Lai skolotāju profesionālie pilveides būtu pilniçts un efektīvs, ir jāizvada, ka skolotāju izvada izmantojot IKT rīkus un digitālos resursus. Skolotājiem ir tieši atvērta mācību attīstīšanā, lai viegli varētu mainīt savus IKT rīkus lietošanas paradumus.

Skolotāju profesionāšanā pilveides faktori, kas šim tehniskām IKT lietošanas praksei mācību procesā:
- jutīgā ir līdzeklis, kas atkārtos un demonstrē iniciatīvu;
- ir pieejami laikā un tehnisko prasmēs atpazīstama;
- ir pielāgotajām atbilstoša mācību atklātā skolotāja plānojām;
- ir rūpīgi redakcijas pieejama skolotāja plānojām.

Skolotāju profesionāšanā pilveides atbilstošas, kas šim tehniskām IKT lietošanas praksei mācību procesā:
- mācīšanās nērīgām grupām kā mācību priekšpārskatām;
- stundas vērtēšana un analīze;
- darbs ar skolēniem - modelēšana.

IZMANTOTA LITERATURA:
## NEXT STAGE

<table>
<thead>
<tr>
<th>ICT tools and resources</th>
<th>III stage</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>To acquire the technical skills to use ICT tools for personalized learning (tablets, mobile phones, digital platforms etc.)</td>
</tr>
<tr>
<td></td>
<td>To identify and acquire new generation ICT education tools and resources for CPD, for example:</td>
</tr>
<tr>
<td></td>
<td>- Learning Designer (<a href="http://learningdesigner.org">http://learningdesigner.org</a>)</td>
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<tr>
<td></td>
<td>- InstaGrők (<a href="https://www.instagrok.com">https://www.instagrok.com</a>)</td>
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<tr>
<td></td>
<td>- Graasp (<a href="http://graasp.eu/">http://graasp.eu/</a>) etc.</td>
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</table>

### Preliminary: Deeper learning model

<table>
<thead>
<tr>
<th>The aim of teaching/learning</th>
<th>III stage</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>To design a teacher own lessons with purposeful use of ICT tools and resources in teaching/learning process:</td>
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<tr>
<td></td>
<td>- to encourage students to think in new ways, to persist in the face of challenges</td>
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<tr>
<td></td>
<td>- to help students actively construct knowledge, to solve complex problems</td>
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<tr>
<td></td>
<td>- to encourage students to communicate effectively, to work well in teams</td>
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<tr>
<td></td>
<td>- to develop student`s skills to monitor and direct their own learning</td>
</tr>
</tbody>
</table>
Discussion and conclusions

The model corresponds to recommendations found in sources of literature:

1) CPD needs to be designed on the basis of meeting teacher individual needs as a priority

2) Collaborative approaches should be core to designing ICT CPD (Daly, Pachler, Pelletier, 2009)

Teachers need to be at the centre of their own learning if they are to change their deep-seated beliefs and habits regarding use of technology.
Further research

• There is room for improvement: a need for more experience in learning how to implement teaching of 21\textsuperscript{st} skills

• Dissemination of good practices

• The testing of proposed model in practice

• More in-depth research on impact of the transversal competences on overall student outcome
REFERENCES


