Bebras Based Activities for Computer Science Education: Review and Perspectives

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November 16, 2020

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[ISSEP 2020, Tallinn, Estonia]

Bebras Challenge

- Bebras international challenge born in Lithuania in 2004
  - Challenge with tasks on computational thinking (CT)
  - More than three millions pupils participants each year
- Tasks designed by an international community
  - Once a year during an international workshop
  - Research is also being carried out by some members

Research Goals

- Research on designing activities with Bebras tasks is being led

  To serve computer science education, mainly for pupils

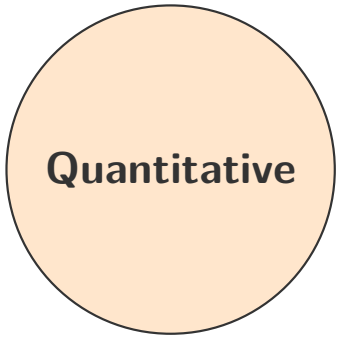
- Two goals to understand the landscape of this research area

  1. Review the literature to find and categorise existing research
  2. Identify research directions and recommendations

Research Methodology

- Mixed-methods research with several data collection methods

Literature review



Questionnaire survey

Literature Review

- Only a few existing research on Bebras-based activities design

  Papers found in the literature review are from 2016 to 2020

- The literature review resulted in two main results
  - Five main categories of designed activities
  - Four characteristics of Bebras tasks

Categories of Activities

- Five main categories of activities covered by researches

  Only the first category is not covered by specific researches

1	**Textbooks**	*Creation of task books or textbooks*
2	**Task creation**	*Activities to imagine and design tasks*
3	**Games**	*Tangible, software, etc. games development*
4	**Assessment tools**	*Evaluate pupils, teachers, etc.'s CT skills*
5	**CT skills training**	*Design of pupils'/teachers' CT skills training activities*

Bebras Tasks Characteristics

- Clear interest in building Bebras-based activities to serve CSEd

  Although research in this direction is quite recent

- Supported by four main characteristics of Bebras tasks
  - Close relationship between Bebras tasks and CT abilities
  - Visual graphics and fun story suitable for younger pupils
  - Both task solving and creation can be used to design activities
  - Metadata associated to Bebras tasks to target activities

Survey

- Web-based questionnaire performed in July 5–18, 2020

  Answers by 24 (out of 67) representatives countries

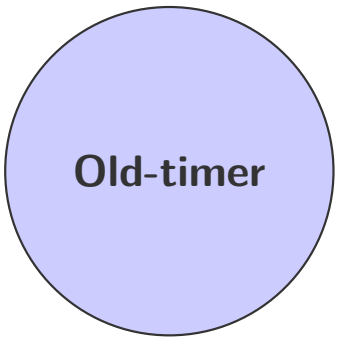
- The questionnaire consisted of 23 questions

18 *Open-ended* + **2** *Five-level Likert-scale* + **3** *Multiple-choices*

Country Experience

- Participating countries divided in three groups

Total of 14 European region countries and 10 non-European

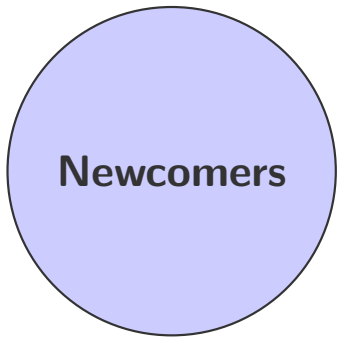


2004–2010

Austria, Canada, Estonia, Latvia, Lithuania, The Netherlands, Switzerland, Ukraine

2011–2015

Australia, Belarus, Belgium, Hungary, Singapore, South Africa, Turkey



2016–2020

Croatia, India, Indonesia, Ireland, Portugal, Serbia, Syria, South Korea, Uzbekistan

Brochure

- Most surveyed countries (22 of 24) prepare annual brochures

  Mainly consisting in books with tasks and solutions

- Better present Bebras challenge as a way to learn CT
  - Most attention paid to teachers, a few targeted to pupils
  - More information about tasks needed (71%)
  - Creation of additional information (42%)
  - Relationships with national curriculum/educational goals

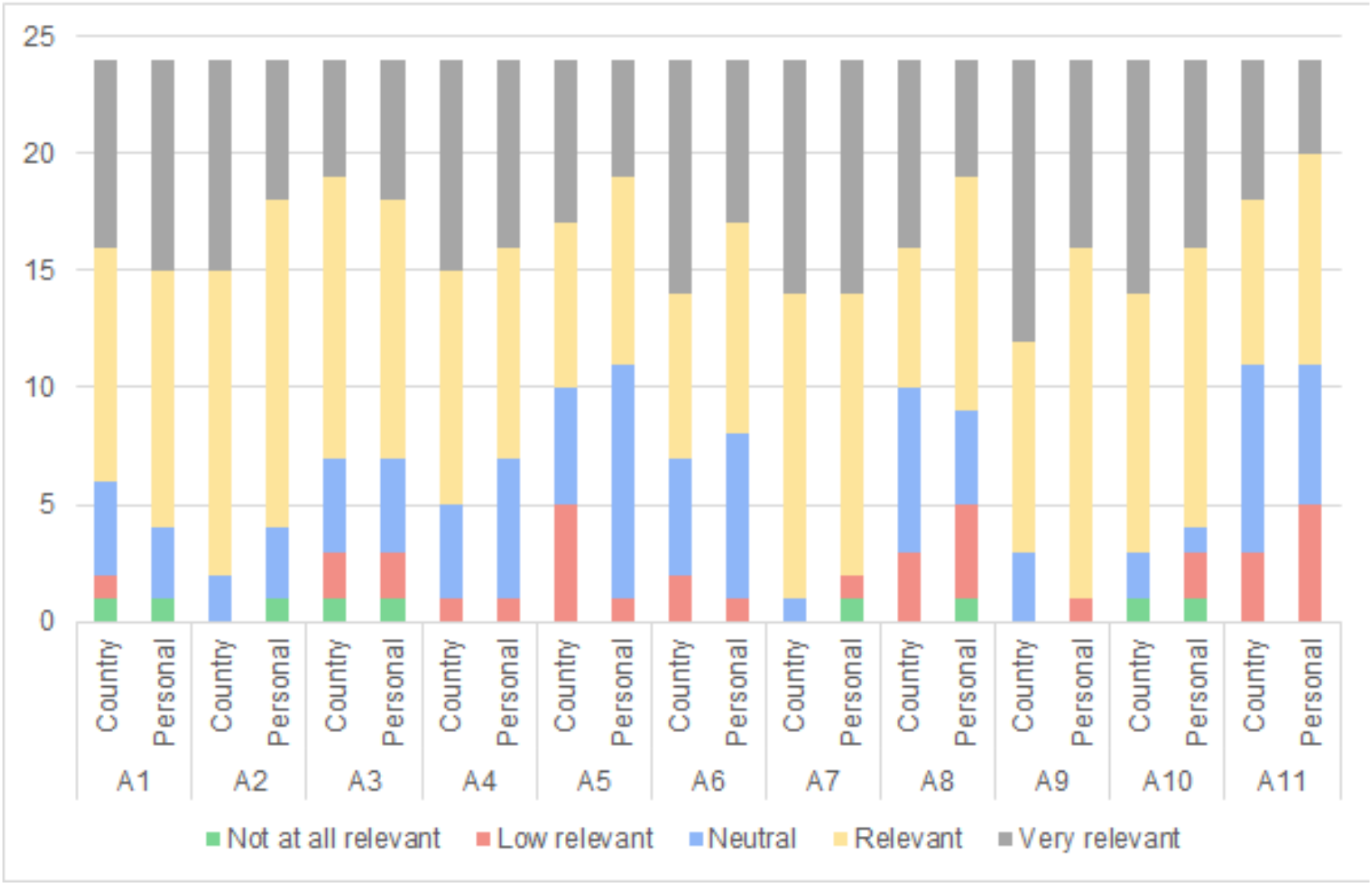
Bebras Task Based Activities

- Eleven activities identified in the five main categories

Relevance for the country and for the representatives

Textbooks	A1. Textbooks for schools
Task creation	A8. Classroom workshops with pupils A10. Teacher training activities for higher CT/CS skills (in/pre-service)
Games	A2. Games development (for unplugged activities) A3. Games development (for mobile/online activities)
Tests	A4. Tests to evaluate pupils' CT skills A5. Tests to evaluate teachers' CT skills A6. Tests to evaluate high school students CT skills
CT skills training	A7. Workshops for classrooms with pupils A9. Teacher training activities to train school teachers for higher CT/CS skills (in/pre-service) A11. Workshops for public targets (for parents, communities, sponsors, journalists, etc.)

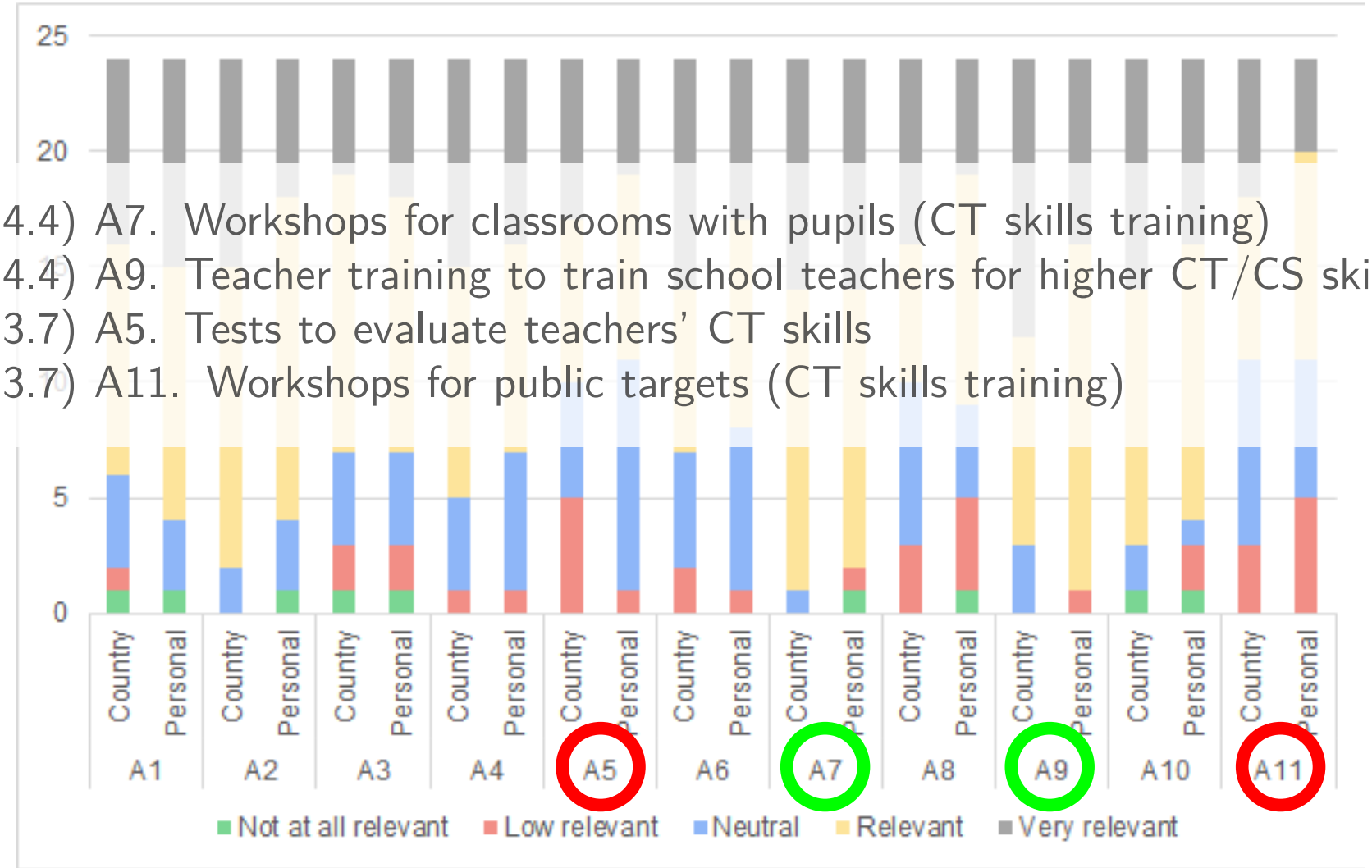
Activity Relevance (1)



Activity Relevance (1)

For the countries

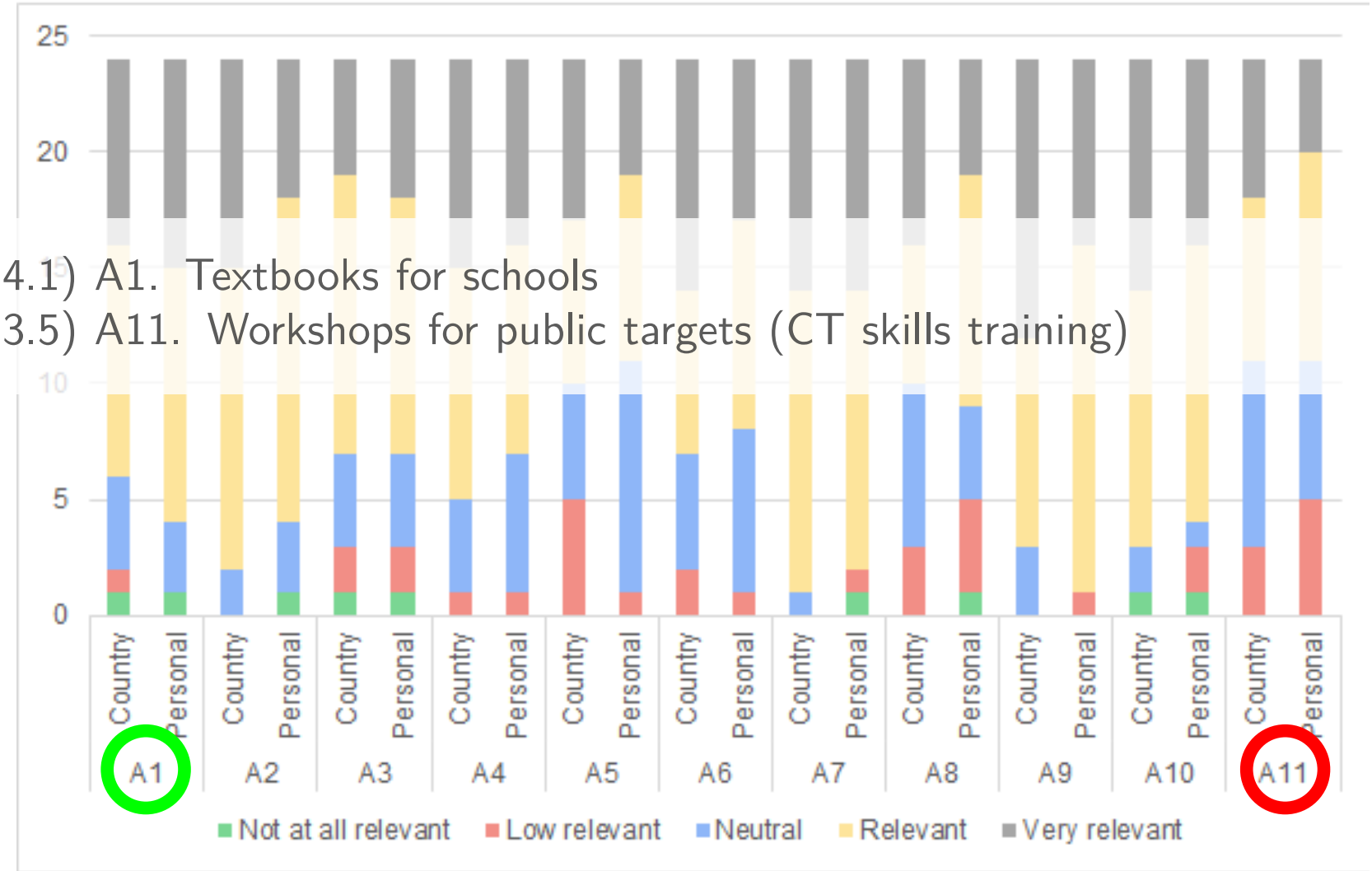
(+, 4.4) A7. Workshops for classrooms with pupils (CT skills training)
(+, 4.4) A9. Teacher training to train school teachers for higher CT/CS skills
(−, 3.7) A5. Tests to evaluate teachers' CT skills
(−, 3.7) A11. Workshops for public targets (CT skills training)



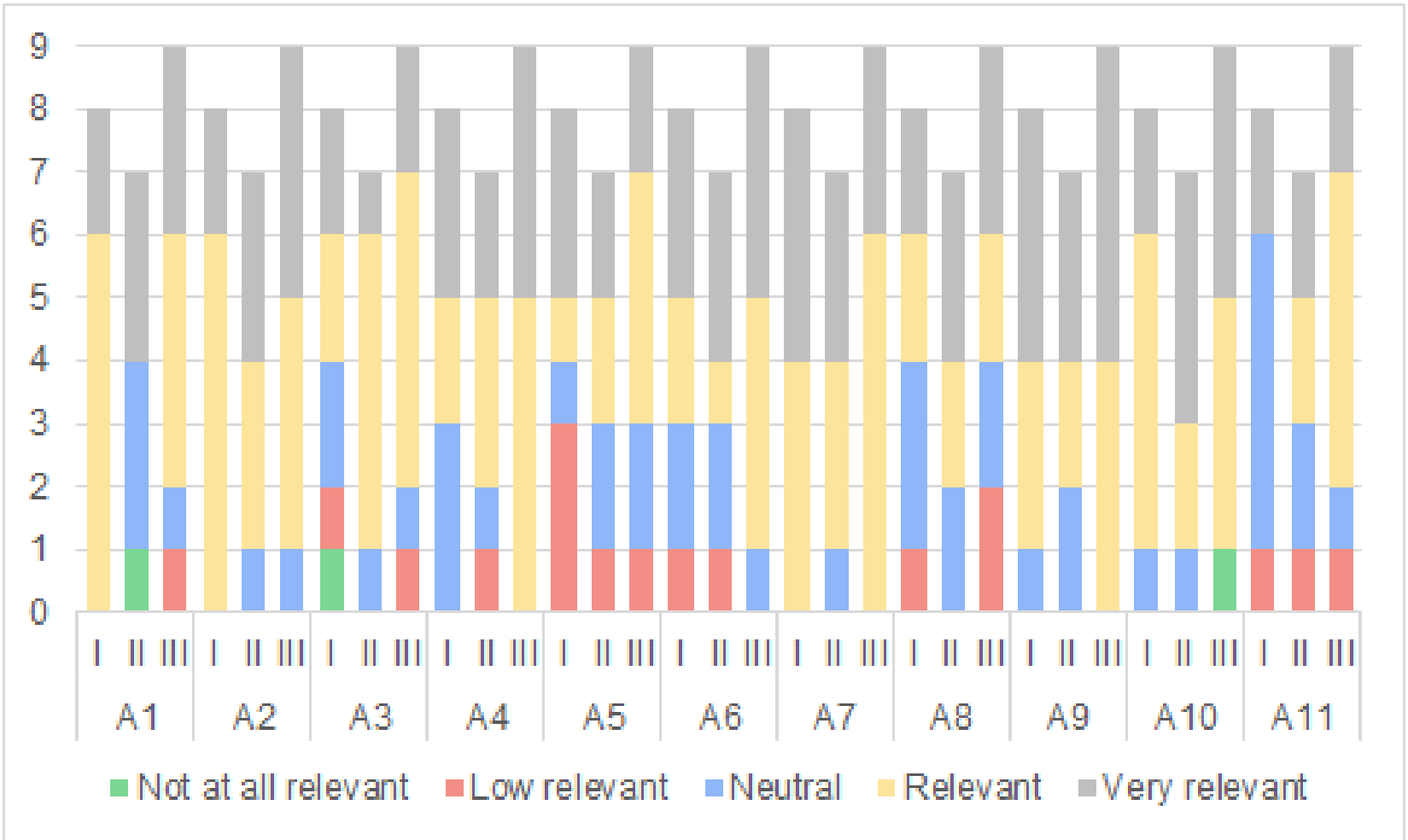
Activity Relevance (1)

According to the personal opinions

(+, 4.1) A1. Textbooks for schools
(−, 3.5) A11. Workshops for public targets (CT skills training)



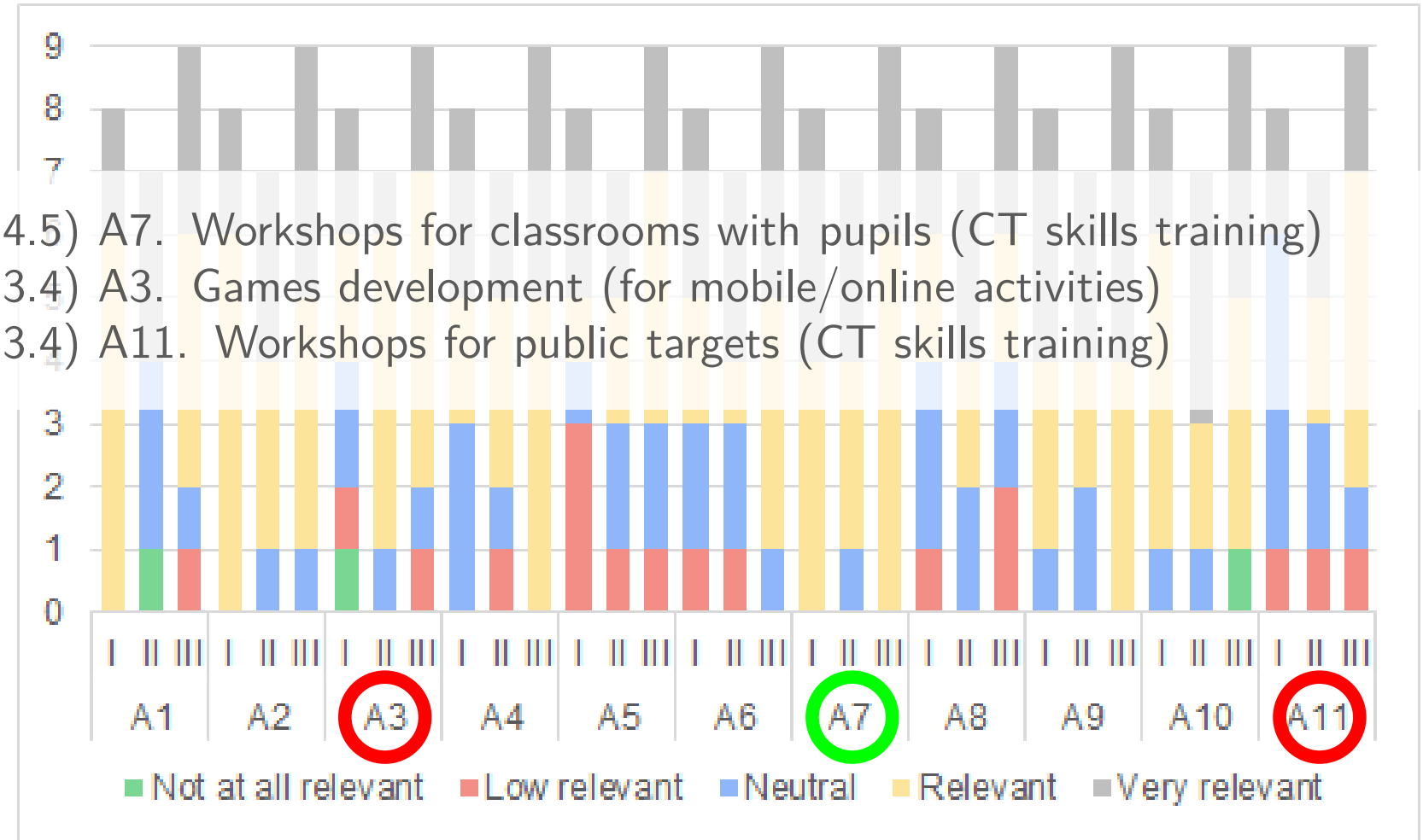
Activity Relevance (2)



Activity Relevance (2)

Old-timer

(+, 4.5) A7. Workshops for classrooms with pupils (CT skills training)
(−, 3.4) A3. Games development (for mobile/online activities)
(−, 3.4) A11. Workshops for public targets (CT skills training)

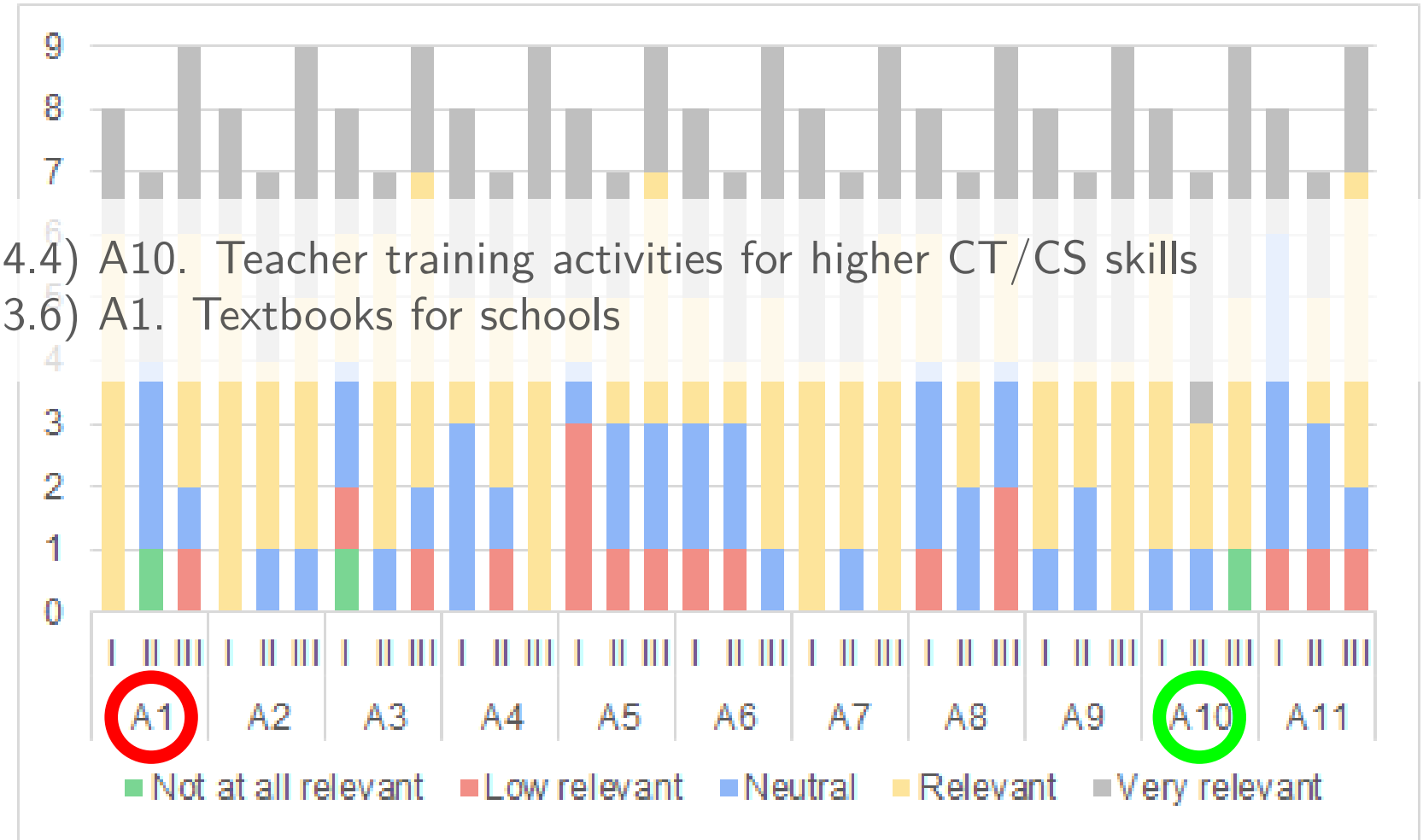


Activity Relevance (2)

Experienced

(+, 4.4) A10. Teacher training activities for higher CT/CS skills

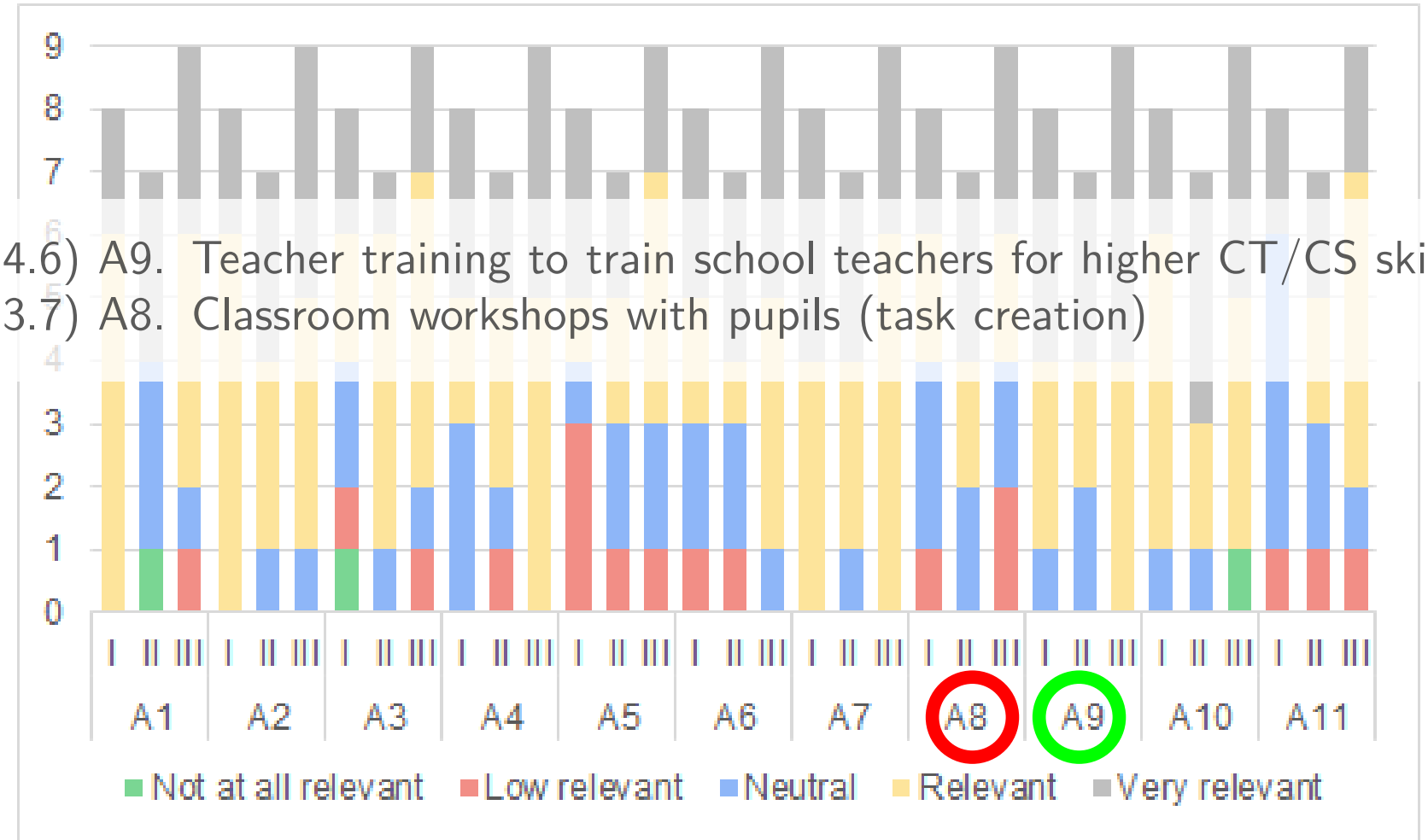
(−, 3.6) A1. Textbooks for schools



Activity Relevance (2)

Newcomers

(+, 4.6) A9. Teacher training to train school teachers for higher CT/CS skills
(−, 3.7) A8. Classroom workshops with pupils (task creation)



Activities Categories Relevance

- For the countries

  CT skills training $>$ *games* $>$ *task creation* $>$ *textbooks* $>$ *tests*

- According to the personal opinions

  Textbooks $>$ *CT skills training* $>$ *games* $>$ *tests* $>$ *task creation*

- According to the country seniorities (newcomers to old-timers)

  CT skills training $>$ *tests* $>$ *games* $>$ *textbooks* $>$ *task creation*
  Task creation $>$ *games* $>$ *CT skills training* $>$ *tests* $>$ *textbooks*
  Textbooks $>$ *CT skills training* $>$ *task creation* $>$ *games* $>$ *tests*

Organised Activities

- Surveyed countries organise activities in the five categories

  Fewer activities organised in games and assessment tools category

- Countries also organised events using Bebras tasks (54%)

  Summer camp, science week, teacher day, software festival, etc.

- Bebras-based activities are not limited to CS/CT

  Also used in mathematics activities and critical thinking

Recommendations (1)

- Textbooks mainly emphasised by old-timer countries
  - Bebras tasks as a way of engagement in CS and CT
  - More data on curriculum issues must be provided
  - No research on the design of textbooks with Bebras tasks
- Task creation mainly highlighted by experienced countries
  - Less relevant for newcomers, countries and personal opinions
  - Not easy since workshop participants must understand CS/CT
  - Suitable for teachers to acquire problem-solving and making
  - Extend research about good tasks to reach teachers

Recommendations (2)

- Games as second most relevant activities for countries
  - Good way to motivate people to learn, especially younger
  - Very few countries are involved in games creation (16%)
  - Physical versions of Bebras tasks and tangible games
  - Developing easily translatable games to reach many people
- Assessment tools for CT skills interest newcomers countries
  - Most scientific research consuming activity
  - Bebras tasks included with other tools to assess CT abilities

Recommendations (3)

- CT skills training most popular and relevant category
  - Countries organise workshops with Bebras tasks
  - To either train pupils (29%) or teachers (50%)
  - Very few research about organising efficient workshops
  - Better measure how effective they are to learn CS and CT skills

Conclusion

- Five main categories of activities have been highlighted

  Textbooks, task creation, games, tests and CT skills training

- Different relevance/priorities depending on country seniority
  - **Old-timer**: Task-solving workshops for classrooms with pupils
  - **Experienced**: Teacher training activities on task creation
  - **Newcomers**: Teacher training activities on task solving

- Large gap between organised activities and researched ones

  Big research potential on Bebras-based activities serving CSEd