Competitive and Collaborative Approach Towards a More Effective Education in Computer Science

Tomas Cerny
Czech Technical University in Prague
tomas.cerny@fel.cvut.cz

Bozena Mannova
Czech Technical University in Prague
mannova@fel.cvut.cz

CLI (2011),
Orlando, FL, USA (May 27 - 31, 2011)
Outline

- Computer science education
- Competitive and collaborative learning
- Our experiment
- Course content
- Evaluation
- Summary and future work
Outline

Computer Science education

Competitive and collaborative learning

Our experiment

Course content

Evaluation

Summary and future work
Computer Science Education

- History goes back to Sumerian and Babylon
  Abacus

- Church -Turing thesis and powerful model Turing machine
  1936
  Things that cannot be solved by computer

- Nowadays multiple disciplines
  Theoretical Computer Science
  Software Engineering
  Algorithms
    Graphs, Math
  Data structures
  Design patterns
  …
Computer Science Education

Schools
- Lectures
  Table driven evaluation and grading

Institutions parallel to school education
- Competitions [ICPC since 1977]
  Student team cooperates and competes with other teams
  Today about 2000 universities participates
  Students are not restricted to study, they are motivated to compete and as an effect they study in order to improve
Computer Science Education

Can we combine school education and competitions?
Outline

Computer Science education

Competitive and collaborative learning

Our experiment

Course content

Evaluation

Summary and future work
Competitive and Collaborative learning

By [Coakley]

**Competition**

a social process that occurs when rewards are given to people on the basis of how their performances compare with the performances of others doing the same task or participating in the same event.

**Collaboration**

a social process through which performance is evaluated and rewarded in terms of the collective achievements of a group of people working together to reach a particular goal.
Competitive and Collaborative learning

**Student-student interaction patterns** by [Thousand]

- Competition
- Individual work
- Team cooperation

**Dominant key**

- US -> Competition  
- Czech -> ?? (not Competition)

**Support for collaborative work**

1. Perceived positive interdependence
2. Face to face interaction
3. Personal responsibility for group goals
4. Use of interpersonal skills
5. Group functioning evaluation to improve future effectiveness
Competitive and Collaborative learning  
(Other experience)

- **[Gross]**
  Students learn best when they are *actively involved* in the process
  Support team work with assigning *team roles*  

- **[Kolawole]**
  *Fits better to Male* rather than to Female  
  Our point: Ethnical and cultural aspects involved  

- **[Attle]**
  To prepare students for *professional employment*:
  Team-like *cooperation* environment  
  Business-like *competitive* environment
Outline

Computer Science education
Competitive and collaborative learning
Our experiment
Course content
Evaluation
Summary and future work
Experiment

Course: Architectures of SW Systems at CTU

6th semester for Bachelor degree
optional lectures mandatory practice
Total 56 student and 39 passed
valid cancelation in first weeks, 3 F

Topics

• Lectures
  SW architectures (a), design patterns (b), enterprise patterns (c), documentation (d)

• Seminars
  Small demo program (e), with documentation (f), research paper discussion (g), programming challenge (h)
Experiment

Evaluation of students’ work

Team

2 members (keep team small)
Small demo program (e) with documentation (f),
programming challenge (h)
and lecture presentation of enterprise patterns (c) -
(half points from teacher, half from audience)

Individual
research paper discussion (g), 2 tests (i)
## Experiment

- **Topics**
  - Lectures
    - SW architectures (a), design patterns (b), enterprise patterns (c), documentation (d)
  - Practices
    - Small demo program (e) with documentation (f), research paper discussion (g), programming challenge (h)

- **Grading**
  Results of all distributed

<table>
<thead>
<tr>
<th>Task ID</th>
<th>Task</th>
<th>Points per task</th>
<th>Points total</th>
<th>Applicability</th>
</tr>
</thead>
<tbody>
<tr>
<td>(c)</td>
<td>presentation of an enterprise pattern</td>
<td>10+10</td>
<td>20</td>
<td>Team</td>
</tr>
<tr>
<td>(e)</td>
<td>architectural programs</td>
<td>4x2</td>
<td>8</td>
<td>Team</td>
</tr>
<tr>
<td>(f)</td>
<td>architectural program documentation</td>
<td>4x3</td>
<td>12</td>
<td>Team</td>
</tr>
<tr>
<td>(g)</td>
<td>paper discussion</td>
<td>5x1</td>
<td>5</td>
<td>Individual</td>
</tr>
<tr>
<td>(h)</td>
<td>challenges</td>
<td>7x3</td>
<td>21</td>
<td>Team</td>
</tr>
<tr>
<td>(i)</td>
<td>two tests (a)(b)(c)(d)(g)</td>
<td>20+20</td>
<td>40</td>
<td>Individual</td>
</tr>
</tbody>
</table>
Outline

Computer Science education
Competitive and collaborative learning
Our experiment
Course content
Evaluation
Summary and future work
Course content

- **Program challenges - pace environment**
  - In given time a challenge is presented and the fastest gets points
  - Result announced at lectures (students were excited to see results)
    - Applause

- **Team**
  - Small projects rather than large, split task strategy or full collaboration

- **Participating education process**
  - Present pattern in the lecture to the audience (required to know for test)
    - Score from both teacher and the audience
      - Applause
  - Great impact on lecture **attendance** (not required)
Course content

- Foreign research papers to read (English)

- All communication patterns applied
  - Students were collaborating in teams and evolving social skills, planning and collective strategies.
  - Teams were competing in order to receive good grades and do better than others.
  - They had their individual responsibilities in reading and tests.

- Positive motivation
  Applause for success

- Gender - 1 Female – the rest Male
Outline

Computer Science education
Competitive and collaborative learning
Our experiment
Course content

Evaluation

Summary and future work
Evaluation
Evaluation

How did students like specifics of the course?
Evaluation

How did students like specifics of the course?
Evaluation

How did students like specifics of the course?
Outline

Computer Science education
Competitive and collaborative learning
Our experiment
Class design
Evaluation of the class
Summary and future work
Summary and future work

- Challenge is interesting part of motivation support
- Student education process involvement shown to be good element of the course
  - Presentation experience, feedback from audience
- Interesting impact on lecture attendance which compete with the practices
  - Audience impacts grade of others
  - Challenge results always kind of show (motivating to show up)
- Not everyone likes the competition and team work
  - Not all people can collaborate well (strong individuals)
  - Not everyone like to compete with others
Summary and future work

- **Best student?** -> Female
- **Test and research paper** -> the “old school” approach
- **Conclusion**
  
  We want to continue with this approach in our course

- **Future plan**
  - Addition – **Dept learning**
  - Team assigned money instead of points and these must be used every month for food and housing, team with low credit can get a loan, but must pay back double.
  - Team with very low credit bankrupts and fails the class
    - We all like monopoly game
Thank you

@InProceedings{cernyCompetitiveHI,
  author =  {Cerny, Tomas and Mannova Bozena},
  title =  {Competitive and Collaborative Approach Towards a More Effective Education in Computer Science},
  booktitle = {In The 9th Annual Hawaii International Conference on Education},
  year = {2011},
  issn = {1541-5880},
  pages = {2886--2895},
  numpages = {9},
}

@Article{cernyCompetitive,
  author =  {Cerny, Tomas and Mannova Bozena},
  title =  {Competitive and Collaborative Approach Towards a More Effective Education in Computer Science},
  journal = {Contemporary Educational Technology},
  publisher = {Ali Simcek},
  issn = {1309-517X},
  year = {2011},
  month = {April},
  volume = {2},
  pages = {163--173},
  URL = {www.cedtech.net/articles/225.pdf}
}
References

- [ICPC] ACM International collegiate programming contest, http://cm.baylor.edu