An Exploratory Investigation of Change in Students’ Subjective Perception of Informatics

Claudio Mirolo

Dept. of Mathematics, Computer Science and Physics
University of Udine, Italy

ISSEP 2016
Münster, October 13–15
Outline

1. Aims and Scope
2. Analysis of the Answers
3. Conclusions
Aims: Research Questions

RQ1. How does students’ perception of informatics change across subsequent instruction levels?

RQ2. Is the perception of first-year students in Informatics the same as that of students in general high schools?

RQ3. How central is programming in students’ perception of informatics?

RQ4. Does the perception of informatics change after exposition to short-term outreach activities?
Approach:
- subjective perception questionnaire (pre-/post-test)
- both open- and closed-ended questions
- change analyzed almost “syntactically”

Context:
- student attending/coming from general schools
- secondary school: K7 (∼40), K10 (∼40) and K12 (∼40)
- first-year students in informatics (∼40)

Small-scale exploratory investigation
Scope: Approach and Context

Approach:
- subjective perception questionnaire (pre-/post-test)
- both open- and closed-ended questions
- change analyzed almost “syntactically”

Context:
- student attending/coming from *general* schools
- secondary school: K7 (∼ 40), K10 (∼ 40) and K12 (∼ 40)
- first-year students in informatics (∼ 40)

Small-scale exploratory investigation
Approach:
- subjective perception questionnaire (pre-/post-test)
- both open- and closed-ended questions
- change analyzed almost “syntactically”

Context:
- student attending/coming from general schools
- secondary school: K7 (∼40), K10 (∼40) and K12 (∼40)
- first-year students in informatics (∼40)

Small-scale exploratory investigation
Background

- Students’ views, attitudes and intentions, Taub et al. (2012) [5]

- (Pre)conceptions, mismatch w.r.t. computer scientists’ perceptions, e.g. Carter (2006) [1], Hewner (2013) [3]

- Most outreach programs (allegedly) successful in terms of declared attitudes/intentions, Decker et al. (2016) [2]

- Some caution is however suggested, Decker et al. (2016) [2], Taub et al. (2012) [5]

Outline

1. Aims and Scope
2. Analysis of the Answers
3. Conclusions
Analysis and Results

- Here focus on the first two items of the questionnaire

- Other items... See appendix
Question: Definition of Informatics

Based on your perception, provide a short definition of “informatics”.

Treatment of the open answers (inductive coding):

- Identification and annotation of relevant keywords;
- Removal of text copied from other items of the questionnaire;
- Revision of definitions to look for synonyms and uses of a same word with different meanings;
- Organization of key terms into areas with some shared feature;
- Merging of sporadic codes into codes of broader ideas;
- Consistency checks.
**Question: Definition of Informatics**

*Based on your perception, provide a short definition of “informatics”.*

Treatment of the open answers (inductive coding):

- Identification and annotation of relevant keywords;
- Removal of text copied from other items of the questionnaire;
- Revision of definitions to look for synonyms and uses of a same word with different meanings;
- Organization of key terms into areas with some shared feature;
- Merging of sporadic codes into codes of broader ideas;
- Consistency checks.
Results: Definition of *informatics*

C. Mirolo, University of Udine
Students’ Perception of Informatics
Results: Definition of *informatics*

- Problem-solving
- Abstraction & modeling
- Automation & workflow
- Data & information
- Algorithms & procedures
- Programming & language
- Computation flow
- Design & development
- Nature & evaluation
- Computer-centered
- IC technology
- User-centered features

C. Mirolo, University of Udine

Students’ Perception of Informatics
Results: Definition of informatics
Results: Definition of informatics
What is informatics primarily about? From the following list choose the three terms that appear most relevant to you:

- algorithms
- information
- applications
- models
- automation
- multimedia
- calculation
- problems
- complexity
- programming
- computer
- simulation
- communication
- systems
data
- technology
Results: Key Terms linked to *informatics*

C. Mirolo, University of Udine

Students’ Perception of Informatics
Results: Key Terms linked to *informatics*

C. Mirolo, University of Udine

Students’ Perception of Informatics
Diversity? Change?

Appropriate treatment $+$ $\chi^2$-test:

- Options selected to answer question 2 by high school (K12) vs. university first-year students in Informatics:
  
  strong evidence of diversity ($p$-value = 0.005)

- Options selected to answer question 2 in the pre-test vs. the post-test:
  
  unclear impact of the outreach programs...
  
  no evidence of change for K7 ($p = 0.48$) and K10 ($p = 0.47$)
  
  but significant evidence of change for K12 ($p = 0.003$)
Diversity? Change?

Appropriate treatment $+ \chi^2$-test:

- Options selected to answer question 2 by high school (K12) vs. university first-year students in Informatics:
  
  strong evidence of diversity ($p$-value $= 0.005$)

- Options selected to answer question 2 in the pre-test vs. the post-test:
  
  unclear impact of the outreach programs. . .
  
  no evidence of change for K7 ($p = 0.48$) and K10 ($p = 0.47$)
  
  but significant evidence of change for K12 ($p = 0.003$)
RQ1: Across subsequent school levels, students’ views of informatics are enriched with new (in particular abstract) ideas.

RQ2: The perception of 12th-grade students does not match that of the freshmen who choose Informatics as their vocation.

RQ3: Programming is firmly regarded as a core activity in high school, whereas university first-year students in Informatics assign a less prominent role to it.

RQ4: The potential of outreach interventions to impact students’ view of informatics cannot be clearly assessed; however, it may have the effect of anticipating the recognition of some conceptual aspects of the computing sphere.
Provisional Conclusions

RQ1: Across subsequent school levels, students’ views of informatics are enriched with new (in particular abstract) ideas.

RQ2: The perception of 12th-grade students does not match that of the freshmen who choose Informatics as their vocation.

RQ3: Programming is firmly regarded as a core activity in high school, whereas university first-year students in Informatics assign a less prominent role to it.

RQ4: The potential of outreach interventions to impact students’ view of informatics cannot be clearly assessed; however, it may have the effect of anticipating the recognition of some conceptual aspects of the computing sphere.
RQ1: Across subsequent school levels, students’ views of informatics are enriched with new (in particular abstract) ideas.

RQ2: The perception of 12th-grade students does not match that of the freshmen who choose Informatics as their vocation.

RQ3: Programming is firmly regarded as a core activity in high school, whereas university first-year students in Informatics assign a less prominent role to it.

RQ4: The potential of outreach interventions to impact students’ view of informatics cannot be clearly assessed; however, it may have the effect of anticipating the recognition of some conceptual aspects of the computing sphere.
Provisional Conclusions

RQ1: Across subsequent school levels, students’ views of informatics are enriched with new (in particular abstract) ideas.

RQ2: The perception of 12th-grade students does not match that of the freshmen who choose Informatics as their vocation.

RQ3: Programming is firmly regarded as a core activity in high school, whereas university first-year students in Informatics assign a less prominent role to it.

RQ4: The potential of outreach interventions to impact students’ view of informatics cannot be clearly assessed; however, it may have the effect of anticipating the recognition of some conceptual aspects of the computing sphere.
References

L. Carter (2006)
Why students with an apparent aptitude for CS don’t choose to major in CS
*Proc. of the ACM SIGCSE Technical Symposium*

A. Decker, M. McGill & A. Settle (2016)
Towards a common framework for evaluating computing outreach activities
*Proc. of the ACM SIGCSE Technical Symposium*

M. Hewner (2013)
Undergraduate conceptions of the field of CS
*Proc. of the ACM ICER Conference*
Aims and Scope

Analysis of the Answers

Conclusions

interpretation of findings

references

thanks...

References

A. Lakanen & V. Isomöttönen (2015)
What does it take to do computer programming?
surveying the K-12 students’ conceptions

Proc. of the ACM SIGCSE Technical Symposium

views, attitudes, and intentions regarding CS

ACM Trans. on Computing Education
Thanks for your attention...
Thanks

...and thanks to:

Federico Battistutta
Maria Cristina Lusiani & Paola Pignoni
Chiara Barbina & Carlo Cassola
Any questions?
Appendix: Questionnaire

Two sections:

- First section about the perception of informatics — questions 1 2 3
- Second section about the perception of programming — questions 4 5 6 7
Based on your perception, provide a short definition of “informatics”.

Appendix: Item 2

What is informatics primarily about?
From the following list choose three terms that appear most relevant to you and sort them by decreasing importance by indicating a number from 1 to 3 (1=most important).

<table>
<thead>
<tr>
<th>algorithms</th>
<th>information</th>
</tr>
</thead>
<tbody>
<tr>
<td>applications</td>
<td>models</td>
</tr>
<tr>
<td>automation</td>
<td>multimedia</td>
</tr>
<tr>
<td>calculation</td>
<td>problems</td>
</tr>
<tr>
<td>complexity</td>
<td>programming</td>
</tr>
<tr>
<td>computer</td>
<td>simulation</td>
</tr>
<tr>
<td>communication</td>
<td>systems</td>
</tr>
<tr>
<td>data</td>
<td>technology</td>
</tr>
</tbody>
</table>
Appendix: Item 3

What are the principal aims of informatics?
From the following list choose two aims that appear most relevant to you and sort them by decreasing importance by indicating the numbers 1 and 2 (1=most important aim).

- understanding what can be explained in terms of information processing
- constructing new multimedia tools
- coordinating and facilitating the interaction with/between information-processing devices
- formalizing problem-solving procedures in a rigorous language
- dealing with and providing access to huge data sets
- organizing work in a rational and efficient manner
- designing highly complex systems
- solving problems by applying systems with a certain level of “intelligence”
- studying complex phenomena in order to control their evolution
- developing “computational” models of everyday life situations
- using information technologies effectively
Appendix: Item 4

Based on your current understanding of the topic, provide a short definition of computer “programming”.

C. Mirolo, University of Udine

Students’ Perception of Informatics
Appendix: Item 5

Which one of the following characterizations better matches your idea of *program*? (choose only one option)

- a program is the product of carefully planned work, carried out with suitable tools, usually by a professional team.

- a program is the formal coding of an algorithm, based on which we can rigorously verify if it solves a problem correctly and efficiently.

- a program is an object with the potential of giving rise, with the aid of a computing device, to interesting processes to analyze and study.
Appendix: Item 6

Based on your perception, which one of the following *program* purposes is most important? (choose only one option)

- communicating clearly and precisely to others problem-solving ideas in the sphere of information processing.

- experimenting with models and algorithmic ideas in order to analyze their properties in detail in a wide range of situations.

- providing a service that meets as much as possible the needs of potential users, in order to make their work and everyday tasks easier.
Appendix: Item 7

Which one of the following is an important reason you are/may be interested in learning to program? (choose only one option)

- the opportunity of experimenting with my own ideas about how to accomplish certain tasks or to solve some problems.

- the opportunity of being able to create myself new applications useful for work, study, or entertainment.

- the opportunity of sharing programs with friends and mates in order to understand the program structure and possibly modify its behavior.
Two-Layer Coding

1. problem-solving (problem-solving, problem approach, task complexity)
2. abstraction & modeling (abstraction, modeling & simulation, virtual machine)
3. automation & workflow (automation, task efficiency, data massiveness)
4. data & information (data/information, data collection & analysis, data processing)
5. algorithms & procedures (algorithms, algorithm logic, procedures & processes)
6. programming & language (programs & programming, task accuracy, formalism)
7. computation flow (computation, instructions & stepwise flow, input/output)
8. design & development (design & products, artifact function, artifact structure)
9. nature & evaluation (mathematical features, scientific features, evaluation)
10. computer-centered (computer, computer operating, hardware architecture)
11. I/C technology (information technology, applications, network & communication)
12. user-centered features (instrumental use, task-oriented tools, learning & sharing)
Results: Characterization of informatics

C. Mirolo, University of Udine

Students’ Perception of Informatics
Results: Definition of programming