

An Infrastructure for Teaching Skills for Group Decision Making and Problem Solving in Programming Projects

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Motivation

Projects in classes	Projects in industry
Little or no group work	Programming and decision making in groups

We cannot assign group work and expect students to develop the necessary skills

How do we teach skills for group work in CS classes?

Three-part Approach

1. Introduce group work, one skill at a time, over three semesters
2. Use an infrastructure to selectively hide the complexity of group work
3. Interview students/analyze data to understand how well we are doing

We have done quite a bit on (2) and some work on (1) and (3)

Outline

- Highlights of the infrastructure
- Three skills that we focus on and an example assignments teaching these skills
- Challenges and preliminary results
- Status and conclusions

Highlights of the Infrastructure

Web based user interface		
Sentry		
Group Module	Assignment Module	Action Module
WebObjects		Tools (compilers, analysis, abstraction, planning, ...)

Publicly or cheaply available infrastructure

Highlights of the Infrastructure (2)

Web based user interface		
Sentry		
Group Module	Assign./Policy Module	Action Module
WebObjects	Tools (compilers, analysis, abstraction, planning, ...)	

Students may be grouped manually or automatically

Highlights of the Infrastructure (3)

Web based user interface		
Sentry		
Group Module	Assign./Policy Module	Action Module
WebObjects	Tools (compilers, analysis, abstraction, planning, ...)	

Assignment module support many kinds of assignments (coding, form-based, rating alternatives...)

Policies determine how group members interact

Highlights of the Infrastructure (4)

Web based user interface		
Sentry		
Group Module	Assign./Policy Module	Action Module
WebObjects		Tools (compilers, analysis, abstraction, planning, ...)

Instructor can create actions

Actions hide unnecessary low-level details (e.g., architecture, authentication, paths, ...)

Highlights of the Infrastructure (5)

Web based user interface		
Sentry		
Group Module	Assign./Policy Module	Action Module
WebObjects		Tools (compilers, analysis, abstraction, planning, ...)

Sentry enforces policies (*can Student A look at B's code?*)

Highlights of the Infrastructure (6)

Web based user interface

Sentry

Group Module	Assign./Policy Module	Action Module
WebObjects		Tools (compilers, analysis, abstraction, planning, ...)

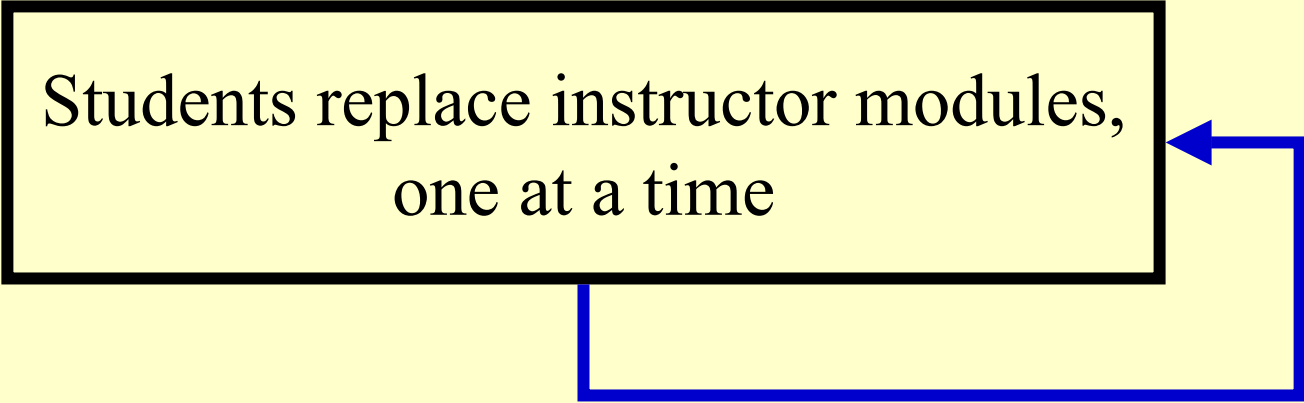
Web based interface allows students easy access

Skills Needed for Group Work

- **Interdependence**
- **Negotiation**
- **Group problem solving and creating**

Ex. 1: Interdependence

Students replace instructor modules,
one at a time

A diagram consisting of a black-bordered rectangular box containing the text "Students replace instructor modules, one at a time". To the right of the box, a blue arrow starts from the right edge, goes down, then left, then up, and finally points into the right side of the box.

- Student is dependent on instructor (but low risk)
- Students are exposed to debugging their code while interacting with someone else's code

Ex. 2: Negotiation

Focused coding exercises expose students to alternatives

Preparation



Students argue for their favorite in a facilitated online discussion

Negotiation



Students write a document describing the outcome of the discussion

Reflection

Ex. 3: Group problem solving and creating

Preparation and negotiation

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graph TD; A[Preparation and negotiation] --> B[Students rank criteria and rate alternatives]; B --> C[System picks winner]; C --> D[Students implement the winner];
```

Students rank criteria and rate alternatives

System picks winner

Students implement the winner

Variations on Example 3

- Students may work in groups
 - Instructor may provide all or part of the code so group members do not hold each other back
- Students may propose new alternatives and criteria

Challenges

- Projects are difficult to design
 - Must have multiple alternatives to choose between
 - Must be decomposable
- We are refining several projects for the *Programming Languages* course

Preliminary Experience

- Easy availability makes it easier for students to work in groups
- Student sometimes students pick inferior alternatives
 - e.g., picking one that is easiest to implement
 - e.g., proposing and supporting an infeasible alternative
- It is important to push the discussion to students rather than wait for them to access the system

Conclusions

- We have described a methodology for teaching group-work skills to students
- We have a preliminary prototype of the infrastructure and a number of projects
- We have been collecting data manually and automatically and hope to report on it in the near future