Development of Software for Educational Activities

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The problem

*There is a lack of specific methodologies targeted to educational software development*
Goals

Propose an approach to educational software development based on Activity Theory

Analyse the application of the approach on constructionist education and, more specifically, on a practical activity using the Cocoa software
Hypothesis

Activity Theory can help describe important aspects of educational activities and guide the development of software for education.
Points to consider

What is understood by “educational activity”?

How to describe it for educators and software engineers?

What is the role of computers within the activity?
Activity Theory

Theoretical body that studies human activities and, in special, the sociocultural dynamics and the importance of tools within this context

Is gaining space in education and in the area of software engineering that deals with human-computer interaction (HCI)
The activity diagram (based on Engeström’s)

Artifact

Subject

Object

Rules Community Division of Labor Product
Aspects analyzed by Activity Theory

Hierarchical structure of the activity
Internalization and externalization
Object-orientedness
History and development
Mediation
Constructionism

Theory that studies the use of technology on the creation of educational environments

Created about 20 years ago by Seymour Papert

Most well-known by Logo, an education software used by millions of people all over the world
Logo’s turtle geometry

forward 100 right 30
forward 80 right 50
right 10 forward 70
Construcionism

Problem: there is too much focus on Logo
The constructionist practice goes beyond the mere use of a tool
How to develop software to support the constructionist approach of other domains?

*There is a lack of methodologies for the development of constructionist software...*
The proposed approach

Is based on a sociocultural and historical analysis of the educational activity

Identifies the specific contributions of the computer

Opens space for the other “more technical” software engineering methodologies

Establishes a permanent communication channel between the user (actor) and the activity designer
The traditional software development life-cycle

- Analysis
- Design
- Implementation
- Testing
- Maintenance
The proposed development cycle

- Analysis of the Educational Activity
- Design of the Computational Artifact
- Implementation of the Computational Artifact
- Test of the Computational Artifact
- Maintenance of the Computational Artifact
The analysis of the educational activity

Describes the educational activity in all its dimensions

Is oriented by guiding questions

Has both a generic and a specific part
The generic and specific parts of the educational activity

- **Generic Educational Activity**
  - Domain: English
  - Environment: Uninformal, home

- **Specific Educational Activity A**
  - Domain: Economy
  - Environment: Formal, company

- **Specific Educational Activity B**
  - Domain: English
  - Environment: Uninformal, home

Generic theoretical principles
Context-specific restrictions
The analysis of the computational artifact

Describes the role of computers within the activity

Distinguishes among computational artifacts, digital artifacts, digital objects and applications

Is also driven by guiding questions
A Generic Constructionist Learning Activity

- Computerized and non-computerized artifacts
- Personally meaningful and shareable product
- Transitional objects

Learner:
- Rules (duration and amount of sessions, relationship among participants, …)

Community:
- (teacher, other students, reference authors, visitors)

Division of Labor:
- (learner, facilitator, source of reference, actor, activity designer)
A Graphical Logo Activity

- Turtle commands, editor commands and additional language commands
- Picture in the computer screen
- Graphical turtle and procedures
- Learner
- Community
- Division of Labor
- Rules
- Community Division of Labor
- Graphical Logo
A practical case: The Games Workshop

Institute of the III Millennium - Ibirapuera Park

“Development of games about the park using the Cocoa software”

Served as an object to think about this work
A Cocoa screen
Why Cocoa?

Considered a successor of the Graphical Logo

A programming language for kids
Created within the concepts of multimedia, Internet, windows and mouse

It was relatively easy to adapt it to Portuguese
The Workshop activity

Mediating Artifacts
(planning sheets, computers with Cocoa, camera, etc.)

Subject
(III Millennium student)

Outcome
(game about the park)

Objects
(Cocoa components, annotations, etc.)

Rules
(schedule, write on personal diary, etc.)

Community
(teachers, other students, authors of examples, guests)

Division of Labor
(facilitator, actor, learner, source of reference, activity designer)
Conclusions about the Game Workshop

Computers should be seen as components within a larger context

Applications (such as Cocoa) should be analyzed as part of the computational artifact

There is a lack of tools to support the facilitator (assessment, annotations)
Conclusions about the Game Workshop

There is a lack of tools to support the development of long activities (backups, student’s notes)

It is important to allow time for the appropriation of the artifact (instrumentalization)

Cocoa could offer tools to avoid student’s distraction and to facilitate the description of student’s actions
Major conclusions of the research

The proposed approach addressed important aspects of the educational activity:

- Theoretical orientation
- Specific characteristics of the environment
- Social dynamics (relationship between roles)
- Development of the participants
- Analysis of the computer against and in partnership with other technologies
In relation to Constructionism

Helped organize the theoretical concepts
Opened space for discussion with other fields of research
Made explicit Logo characteristics to be explored in other applications
Raised questions for further research
Questions raised about Constructionism

Student motivation for action description

New understanding of computers

Cycle of idealization-construction-assessment-debugging-description actions

Importance of the instrumentalization phase

Lack of tools to support facilitators
Major challenges faced

- Interdisciplinarity
- Lack of references
- Areas that are recent and in constant evolution
- Translation problems
Major contributions

Made explicit the need for a methodology for the development of software for education
Proposed an approach for that
Reinforced the idea that computers should be analyzed in relation to a context of use
Critically revised the concepts of Activity Theory and Constructionism
Articulated the theories studied
Open questions

Can the proposed approach be used with other educational theories?

Can it be applied to non-education areas?

How to turn it into a real methodology?

How to make it more useful for educators and engineers?
Next steps

Write articles to spread and improve the ideas

Use the proposed approach in the creation and analysis of new applications