Fifth Graders’ Flow Experience in a Digital Game-Based Science Learning Environment

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Introduction & Background

- Game-based learning as an innovative approach to K-12 teaching and learning becomes popular
- Research of student emotion during gameplay receives attention
- Students’ enjoyable gameplay experience (e.g., sense of playfulness) motivates them to continuously engage in learning (Mihaly, 1973)

Purposes of Study

- Fifth graders’ emotion (playful learning experience) in the CRYSTAL ISLAND game-based science learning environment from flow theory perspective
- Online intelligent science learning environment
- Educational content generated from NC standard curricula

Theoretical Framework (6/8, 2005)

The term “flow” is used to describe a state of consciousness and deep enjoyment that a person experiences when she or he is completely engaged in doing a specific task (Cukaszmihaly, 1975)

Research Questions

1. To what extent did 5th graders in a suburban elementary school in Southeastern U.S experience game flow while playing the CRYSTAL ISLAND game?
   - 2 gameplay approaches
   - Student characters (gender, prior gaming experience, reading proficiency)
2. What and how did different factors impact students’ game flow experience?
   - Game design features & peer interaction
3. What was the relationship between students’ game flow experience and science content learning gains?

Mixed Methods Research Design

Participants: 5th graders from a suburban public school in NC (N=73)

Phase 1: Pre-test
- Science content knowledge test (research team generated)
- Other info. (prior gaming experience, reading EOG score)

Phase 2: Game play (3 days)
- 2 gameplay conditions:
  - Solo gameplay (n=37)
  - Face-to-face collaborative gameplay (n=36)

Phase 3: Post-test
- Game flow experience measure
  - Adapted game flow experience Survey (Kil, 2005)
    - 15 likert-scale items measuring 5 dimensions of flow experience
    - 18 likert-scale items measuring 6 game design features
  - Focus group interview
    - 5 solo players
    - 5 collaborative players
  - Science content knowledge test

Instrument Validation & Data Analysis

- Adapted game flow survey validation
  - Exploration factor analysis (EFA): Flow experience has 4 dimensions for 5th graders: Time distortion and loss of self-consciousness hang together
  - Reliability: .72 to .84
- Data analysis:
  - Survey data analysis: MANOVA, Regression
  - Focus group interview data analysis: A priori coding & Open coding

Findings

RQ1: Flow experience?
- Quantitative data revealed that students across conditions had high game flow experience
- Interview data confirmed quantitative findings
- No game flow experience difference based on gameplay approaches

RQ2: Flow antecedents?
- Quantitative data revealed that student perceived the game to be well designed with desirable features (Interview data confirmed & contradicted with quantitative findings)
- Game design features that significantly impacted student flow experience include: (1) Challenge/skill balance; (2) Playability; (3) Gamefulness; and (4) Game frame story (p<0.05)
- Peer interaction during collaborative gameplay had marginally significant impact on student flow experience (p=0.066)

RQ3: Flow consequences?
- Students made significant science content learning gains but NO condition differences
- Game flow experience did NOT positively predict content learning gains (residual gain scores)

Conclusions

- CI game was effective in supporting both student learning, both cognitively and emotionally
- Student oral statements revealed that individual gameplay was more appealing
- Implications for structuring collaborative gameplay
  - Need clear goals and specific roles
  - Need effective collaboration strategies
- Implications for game design and refinement
  - Trade-off between enjoyment and learning

Future Directions

Instrument development; Larger sample size; Impact of collaborative gameplay; Impact of emotion on learning