## Not just fun, but serious strategies: Using metacognitive strategies in game-based learning

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## Needs and Purpose

- Computer games have potential as a learning environment because they are a form of play that motivates students through entertainment.
- Gaming is becoming a new form of interactive content, worthy of exploration for learning purposes.
- Games are engaging. They motivate students using entertainment, and this is a part of the natural learning process in human development.

#### Learning Processes Supported by Game-Based Learning

- Learners are encouraged to <u>combine knowledge</u> from different areas to <u>choose a solution</u> or to <u>make a</u> <u>decision</u> at a certain point.
- Learners can <u>test</u> how the <u>outcome</u> of the game may change based on their decisions and actions.
- Learners are encouraged to contact other team members to <u>discuss and negotiate</u> subsequent steps, thus improving, among other things, their <u>social</u> <u>skills</u>

## Game-Based Learning

- In a game, the ideal balance between entertainment and learning is difficult to achieve. In general...
  - Commercial games: entertainment > learning
  - Educational games: entertainment < learning</p>

#### Suggestion:

- First, rather than designing and developing educational computer games requiring much time and effort, it is suggested that educational providers use commercially available games in gamebased learning (Baek, 2006; Kim & Kim, 2005).
- Second, educators should develop relevant guidelines and instructional strategies in order to take advantage of commercial games.

## Game-Based Learning

- Game-based learning is focused on achieving the particular objectives of given educational content through game play.
  - In game-based learning: Learning strategies = Gaming strategies
  - Higher scores in learning and gaming require better problem solving abilities, which require, in turn, wellchosen strategies for both learning and gaming.

## Metacognition in Gaming

- Metacognitive strategies are very important in gaming.
- Gamers need to:
  - Plan actions
  - Check their initial plan
  - Change strategies if needed
  - Evaluate their actions in game
- Higher scores in learning and gaming require better problem solving abilities, which require, in turn, wellchosen strategies for both learning and gaming.
- In this study, meta-cognitive strategies for gaming are developed and adopted to help students effectively exercise social problem solving skills.

#### The Game – Gersang (Wealthy Merchant)

- A Massively Multiple Online Role Playing Game (MMORPG), <u>Gersang</u>, was selected as a game-based learning environment.
- Gersang simulates the Korean economy of 200 years ago and it contains many aspects of economics.
  - Economic scenario: Players experience economic activities such as inflation, deflation, currency exchange, investment, international trade, and factory management for goods production.
  - Battle scenario: Players battle for better weapon items and an upgraded player level.
- The learning goal of Gersang is to understand and apply the principles of a market economy.
- Main activity in Strategic Management courses in the College of Business Administration at Chung-Ang University, South Korea.

## Objectives of the Study

Examine the effects of metacognitive strategies on students' achievements in learning and gaming.



Explore the effects of social problem solving on both learning in economics and gaming.

#### Hypotheses

- There is a significant effect of the metacognitive strategies on both the achievement in gaming and the achievement in learning.
- □ There is a significant effect of the metacognitive strategies on the social problem solving ability.
- There is a significant effect of the metacognitive strategies via social problem solving on both the achievement in gaming and the achievement in learning.

## Social Problem Solving in Game Play

- Social problem solving is defined as the self-directed cognitive behavioral process of trying to identify or discover effective or adaptive ways of coping with problems in daily life (D'Zurilla & Nezu, 1999).
- A problem is seen as any life situation or as a present task requiring a response for a person's adaptation.

Positive Problem Orientation	Negative Problem Orientation
<ul> <li>Appraisal of problems as challenges</li> <li>Belief that problems are solvable</li> <li>Belief in one's personal ability</li> <li>Belief that successful problem solving takes time and effort</li> <li>Commitment to solving problems rather than avoiding them</li> </ul>	<ul> <li>View of problems as a significant threat to well-being</li> <li>Doubt in one's own personal ability</li> <li>Easily becoming frustrated and upset when confronted with problems</li> </ul>

## Social Problem Solving in Game Play

Social problem solving skills are very similar to skills needed in game play.

Steps In Problem Solving	Steps In Game Play
Problem definition and formulation	<ul> <li>Adopting a role and an identity appropriate to the environment. Perceiving tasks to be completed and the progress to be made.</li> </ul>
<ul> <li>Generation of alternative</li> </ul>	<ul> <li>Learning the necessary game vocabulary and exploring intriguing hidden corners and alluring vistas</li> </ul>
Decision making	Adapting and interacting
<ul> <li>Solution implementation and verification</li> </ul>	<ul> <li>Realigning expectations and judgments through each exploration and interaction, reappraising the cause and consequence of each experience</li> </ul>

Metacognition: Thinking about one's learning and thinking (McKeachie, 2000).

Metacognitive strategies: instructional strategies that allow learners to use their metacognition in problem solving (McKeachie, 2000).

Games put learners in the role of decision-maker, pushing them through ever-harder challenges while engaging the player in experimenting with different ways of learning and thinking.

Considerations in implementing metacognitive strategies:

Metacognitive strategies should be implemented after the student has acquired an understanding of the concept/skill.

Metacognitive strategies must be taught.

Metacognitive strategies provide students the opportunity to practice independently.

Student use and performance using strategies should be monitored.

This study defines metacognitive strategies as "the specific activities activating meta-cognition."

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Fig. 2. Meta-cognitive strategies that facilitate meta-cognition.

- However, it is not easy to control learners' metacognition because it has no physical form."
- Therefore, physical activities such as watching, listening, speaking, writing, and operating are needed to control and activate metacognition."

The metacognitive strategies developed in this study are self-recording (writing activity), modeling (watching activity), and thinking aloud (listening and speaking activity).

- Self-recording: Record of experiences related to the learning plan, learning process and learning outcomes.
  - 1. Record of prior knowledge.
  - 2. Record of activities every 10 min.
  - 3. Record of reflections.

- Modeling: Observing others' play and decide on one's own strategies.
  - 1. Students identify the game missions and the activities required to achieve those missions.
  - 2. Students determine the target player to observe during game play.
  - 3. Students observe the target player's game play and conceptualize their own strategies.
  - Students play the game based on their own strategies.
  - Students evaluate their efficiency of game play according to level, power, and items compared to the target player.

- Thinking aloud: verbal expression of the normally covert mental processes (predictions, mental images, correcting misunderstandings, or main ideas and details).
  - 1. Creation of cooperative gaming groups.
  - 2. Students relate their game plan to the learning objectives before they start playing the game.
    - "I will learn about 'inflation' through game play today.
       'Inflation' is a general increase in the level of prices accompanied by a fall in the purchasing power of money."
  - 3. Students explain their game process to their fellow players throughout the game play.
    - "It is a good job that I did sell the item," and "I will deal with the Japanese merchant until the game is over."

# Methods

Participants: 132 ninth-grade students (Ages = 15 to 16).

#### Instruments:

- The online game Gersang.
- Social problem solving ability inventory revised (SPSI-R).
  - Positive problem solving
  - Negative problem solving
  - Rational problem solving
  - Impulsivity/Carelessness style
  - Avoidance style

Achievement test: (20 multiple-choice questions on economics).

- Used to assess the students' knowledge of economic principles covered in the game Gersang.
  - Economic knowledge & Economic Function
- Game scores: (Gersang's scoring system).

# Procedures

- Pre-tests: (academic achievement & problem solving skills).
- Detailed explanation about the game and the strategies.
- The participants then played Gersang until they all reached the third level.
- Participants played 45 min a day, twice a week, for 10 weeks.
- Post-tests: (academic achievement & problem solving skills).

## Results



#### Correlation between variables

	Self-recording	Modeling	Thinking aloud	Achievement in learning	Achievement in gaming	Social problem solving ability
Self-recording modeling Thinking aloud Achievement in learning Achievement in gaming Social problem solving ability	1 .171* .171* .460*** .225** 173*	1 .136 .393*** .676*** 064	1 .324*** .138 481***	1 .491*** 469***	1	1

# Results



#### Estimate of path coefficients

Paths	Estimate	S.E.	C.R.	р
Social problem solving ability ← self-recording	.061	.048	1.262	.207
Social problem solving ability $\leftarrow$ modeling	011	.051	213	.832
Social problem solving ability	.411	.067	6.129	.000
Achievement in gaming ← social problem solving ability	.414	.083	5.015	.000
Achievement in learning ← social problem solving ability	.372	.089	4.187	.000
Achievement in gaming ← self-recording	.237	.046	5.210	.000
Achievement in gaming ← modeling	118	.077	-1.527	.127
Achievement in gaming ← thinking aloud	.047	.072	.658	.510
Achievement in learning ← self-recording	.065	.049	1.334	.182
Achievement in learning ← modeling	.229	.048	4.763	.000
Achievement in learning ← thinking aloud	.572	.052	11.027	.000

- Among three meta-cognitive strategies developed for effective game-based learning, the <u>'thinking aloud'</u> <u>strategy is the strongest</u> variable affecting social problem solving ability. <u>The second strongest variable</u> <u>is 'modeling'</u> and <u>the weakest variable is 'self-</u> <u>recording'</u>.
- These results were as expected because self-recording is an individual activity rather than a social one.
- Social problem solving, affected both achievements in learning and gaming very strongly.

A commercial game in game-based learning in conjunction with metacognitive strategies can be an effective learning environment for increasing students' performance.

Teachers should find the educational aspects of commercial games, map them onto their curriculum objectives, and apply metacognitive strategies for players in order to secure learning effectiveness.

Talking and watching strategies such as thinking aloud and modeling <u>are more effective</u> than writing activities in enhancing the students' performance in game-based learning as long as the game is social.

Talking and modeling are socially interactive and have more significance, while writing is very individual and less effective in promoting achievement.

□ For that reason, teachers should:

- Identify the types of proposed learning outcomes.
  - Choose proper gaming activities.
- Develop strategies according to the game's genre and learning content.

Understanding the results according to:

- Mediation Effects: Mediation is the mechanism through which external and social activities are transformed into internal and mental cognition (Vygotsky, 1978).
  - The three meta-cognitive strategies could mediate between their game-playing and cognition. Thinking aloud and modeling could transform into self-regulation in learning.

Interaction in peer-assisted learning: Students' cognitive and metacognitive outcomes are enhanced by peer interaction (Carvalho, in press; Shamir & Lazerovitz, 2007).

#### Thank you for your attention





# The Game - Gersang

















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