DIGITEL: Components for learning playground in the classroom

thinking of how to put robots into learning environments

Gwo-dong Chen

Department of Computer Science and Information Engineering

National Central University Taiwan
Evolving thought of our works

- Robot → intelligent toy
- Playground with robot for learning → game based learning → learning games with robot → learning playground with augmented reality and robot (intelligent toys)
- Playground → interactive play with a simulation field as context for learning materials (knowledge)
Robot

- A very engaging intelligent toy even when the game is not fun
- Be supposed to be intelligent
- Playground – a space for robot to interact within learning context [situated learning] → experiential learning (authentic learning)
Goals of learning *playground*

- Constructing **engaging** learning environments that learners can have **fun** and **pleasure**
- Constructing learning environments that learners can experience in context [experiential learning]
  - the situations of knowledge requirements,
  - how knowledge is created to solve the problems,
  - how to apply the knowledge, and
  - how to present knowledge*
Games, plays and toys

- **Game**: A *game* is a structured *activity*, usually undertaken for *enjoyment* and to have *fun* (Wikipedia)

- **Play**: refers to a range of *voluntary, intrinsically* motivated activities that are normally associated with *pleasure* and *enjoyment*.

- **Toy**: is a *thing* used in *play*. An object that you have for *enjoyment* or *pleasure* rather than for a serious purpose

- **Enjoyment, fun, pleasure** → Engaging
Educational games, plays, and toys

- **Educational games** are games that have been specifically designed to make people **learn** about a certain subject, expand concepts, reinforce development, understand an historical event or culture, or assist them in learning a skill as they play. They include board, card, and video games.

- an **educational toy** is actually any **toy**. Most children are constantly interacting with and **learning** about the world. Educational toys claim to **enhance intellectual, social, emotional, and/or physical development**. Educational toys are thus designed to encourage reasonable development milestones within appropriate age groups.
Educational Games, and Toys

- Learning Games: activities, learning, and fun (engaging)
- Learning Toys: objects, learning, and fun (engaging)
- Major components added for learning
  - Objects
  - Activities
  - Interaction [digital enhancement] (fun)
  - Playground*
Why we want to use games and toys in learning?

- Make learning as engaging as games, plays, and toys.
  - With fun and pleasure
  - Learning activities → engaging activities

- Key components of games are goals, rules, challenge, and interaction
  - Arrange learning context and learning activities like components of games
Augmented games and toys

- Game: +playground → augmented reality with horizontal stage and tangible objects [playground stage]
- Toys → toys with embedded intelligent device and intelligent stage
Augment reality (+interaction) NCU
Why extending games or toys with **play stage**?

- We hope learners can learn knowledge in **contextual field** that the knowledge can be used to achieve goals or solve problems
  - Experiential learning/authentic learning
- To let **robot** move/interact on a context field, we need a horizontal stage augmented with scenario and objects. Robot on a stage is like an actor in a drama. ➔ drama stage setting ➔ playground
At Christmas, in the living room, a robot is engaging on stage. Autonomous, unexpected, fantasy.
Playground

- **Playground stage** (learning context)
  1. Classroom
  2. Physical playground stage
  3. A simulated augmented reality environment with
     1. Virtual objects
     2. Tangible objects
  4. Augmented reality environment with **ambient intelligence**
  5. Augmented reality environment with **3D stereo display**

- **Learners participation modes** in playground (activities)
  a) **Robot** as tool [delegate] (when learners are unable to participate)
  b) **Robot** as partner of a team
  c) Learners participate with body natural interaction
Participation mode of robots on a stage

- Robot as a tool
- Robot as the delegate of the learner to enter the context
- Robot as partner of a team with learners to enter the context
Educational Robots

- Learning materials
  - LEGO Mindstorms
    - motivation, mathematics, science, programming, problem solving, and collaboration (Klassner and Anderson, 2003)
  - GENTORO (Ito, Nguyen, and Sugimoto, 2008)
    - A storytelling support system using robots and handheld projectors
    - Transferred physical phenomenon to digital graphs
- Learning companions / pets
  - ROBOVIE (Kanda et al., 2004, 2005, 2007)
    - using it as a peer tutor of foreign language education establishing longitudinal relationships with children.
    - that there was a positive correlation between frequency of interacting with the robot and learning performance.
- Teaching assistant
  - IROBI (Jeonghye et al., 2005)
A possible learning flow

- Knowledge orientation/demonstration
  - Playground as a showcase for knowledge orientation/demonstration

- Knowledge application
  - Act → feedback → refine and reflect
  - Learning activities == play activities
  - Arrange activities along the learning path on the knowledge structure

- Knowledge presentation
Evolution of our approach

PUT ROBOTS IN A LEARNING ENVIRONMENT
CREATE AUTHORING TOOL FOR USERS TO PROGRAM THE ROBOT’S INTERACTION IN THE CLASSROOM

Teachers
Students (to program robots telling an English story)
The robot dialogue editor

[Image of a software interface with options for 'Say It', 'Motion', 'Sound', and 'Multimedia']
The robot dialogue editor

- Teacher
- Teacher assistant

Graphic User Interface

- Dialogue Module
  - Text-To-Speech
- Remote In-time Control Module

Dialogue Functional Modules

- Circumstances Module
  - Image
  - Sound
- Robot Control Module

- Image out
- Speaker out
- Motion out
Scenarios for the RoboStage in a language class

- **Story-telling mode** *(Garvie, 1990)*
- **Oral reading mode** *(Brown, 2000; Castagnaro, 2006)*
- **Cheer mode** *(Csikszentmihalyi, 1990)*
- **Action command mode** *(Asher, 1977)*
- **Q&A mode** *(Higgs and Clifford, 1982; Finocchiaro and Brumfit, 1983)*
- **Delegate mode** *(TBLT)*
Phase 2: robot stage

- Put learning materials into a game with **robot as the leading role** in the game
- Robot as the **delegate** and a tool
- Interaction
  - **Learners** to **robot** [learning materials](commands to robot)***
  - **Robot** to **learners** [no]
  - **Robot** to **physical and virtual objects** [game events]
  - **Virtual world** to **human** [learning materials](questions)
Phase 2: Robot stage

- **Activity**
  - Control the robot – engaging the students
    - Sound [learning], light, board
  - pop up questions [learning]
  - Game as the framework [pacman]
    - Put learning into the game
      - Use English to control the robot
      - Pop up questions
Phase 2: The RoboStage
能量： 0  狀態： 躲課導主任
時間： 37

OK! Best wishes!

第一關分數： 0

There are a lot of bread in the ___
The RoboStage – software design
The ‘bridge’ between physical and virtual world

- Position detection
Usage flow

- Student state
  - Know the Quests
  - Setup target
  - Understand the situation
  - Choice the instructions
  - Move on
    - Command the robot
    - Answer the question
  - Wait for the response
(repeat)
Phase 3: learning playground

- Build the learning context in play stage space
  - Most Activities are learning activities
  - **Effects of activities** response the **effects of the knowledge**
  - Learners need knowledge to perform the activities
  - Teacher act as knowledge guide and mentors
- Robot as a **team member** that perform tasks in the context to complete the given mission for learners
- Learning by experiencing the knowledge in context
  - Every interaction is **act** (use knowledge to direct objects [include robot])-**response**-(show the result of the user’s knowledge) -- **reflection** (feedback to let users know whether they are right or not)
Interaction [activities]

- **Learners to robot** (users use knowledge to direct the robot, team building dialog)
- **Robot to learners** (team building dialog, empathy/caring interactions, discussion on how to perform the task [use the knowledge])
- **Learners to objects** (help robot, same as robot)
- **Object to Learners/robot** (effect of the action/knowledge)
Oriented/demo the knowledge = Guiding/demo the play

- **Teachers** guide and demonstrate how to do in the playground
  - Stage setting is the learning context of the knowledge
  - Goals should be achieve by using the knowledge
  - Moving forward the goal is using the knowledge to complete the task

- Demo how to play is equal to teach the knowledge
  [act-response-reflect]
Learning playground used to demo knowledge
In the play

- **Act**: For each task, learners need to use the knowledge to complete the short term tasks.

- **Response**: The responsive stage will respond with the result of the action.

- **Reflect**:
  - Robot and human will interact about the response and redo or proceed to the next task.
  - Robot has emotion interaction with the learners based on the action’s result.
Learning by experiencing the knowledge
Play activities = learning activities

ACT
1. learners issue commands
2. robot executed
Response
• Responsive stage
  react to the action
HR Emotion interaction (reflect)

- Robot react based on the result
- Emotion interaction

--------------------------

Based on the result
- Refine the action, or
- Proceed to next
Experiences

- tangible robot is more engaging than virtual robot
- In learning playground with robot, robot's interaction play as the key success factor
- horizontal stage produces chances for collaboration for learners of a group
- when combine horizontal stage, robot, and background, we need to manage the **focal point** for learners.
- learners will learn better if the knowledge is used to control the robot or move forward to the goal. The knowledge should come out actively from learners and related to context and goal.
Learning Playground

Just another game based learning?

Yes, However

- **Multiple person** can join. the stage forms a **collaborative learning** space.
- Playground space forms a **microworld for learning materials**. a teacher can bring students enter into the knowledge microworld. it becomes a field for experiential learning.
- The teacher can act as **knowledge guide and coach**. students can act as **knowledge tourists** in the knowledge microworld.
- When **giving mission and arrange tasks** in the microworld, it becomes task based learning or situated learning.
Design issues

- build **a simulated environment** for learning materials.
- design **activities** that can show the effect of knowledge.
- design **possible learning paths** based on the knowledge map.
Design issues (robot)

- activities that can make robot as a *long term companion* of learners.
- design the robot that can show *empathy, caring, and humor interaction*.
- Design robot to have *engaging interactions*
Learning Playground
engaging design

- design engaging storyline
  - activities that move users forward to the goals
  - power up with pleasure and recognition
    - especially response and display of moving
    - forward status feel achievement and recognition
- design engaging activities especially response.
What will be the following move?

- **the best situation of playground stage**: we can build an intelligent environment that can act as real field

- **the best situation of a robot**: the robot is intelligent, humor, empathy, and caring. The learners can train the robot like teaching their companion

- **the best situation of ambient intelligence**: the stage can catch the participants' status and react accordingly like a human.

- connected: the environment should be connected to a **community of learners/teachers** on the web. The environment should be connected to the knowledge database
The issues still remain

- Instructional design
  - Simulated Learning context field
  - Learning activities

- Engaging design
What is the new opportunity?

- Experiential learning in a simulated environment near **authentic learning**
Thank you for your attention