DEVELOPING A STORYTELLING-BASED SCRIPT DESIGN PLATFORM TO FACILITATE COMPUTATIONAL THINKING

[1]TSUNG-YUYANG, [2]SHIAN-SHYONGTSENG

[1]Department of Computer science and Information Engineering, Asia University, Taichung, Republic of China
[2]Department of M-Commerce and Multimedia Applications, Asia University, Taichung, Republic of China
E-mail: [1]zongyu212@gmail.com, [2]sstseng@asia.edu.tw

Abstract - In this paper, we developed a causality storytelling-based script design platform to help students create story and learn the concept of computational thinking. Firstly, we designed a causality storytelling frame to concretize the structure of storytelling. For reducing the students' efforts of making learning feedback, we further designed annotation tools for peer assessment, real-time marking, discussion and revision. To evaluate the performance of the platform, the experimental results showed that students' logical thinking and problem-solving abilities have been improved.

Keywords - Computational Thinking, Storytelling script, Learning Platform

I. INTRODUCTION

J. Wing [4] firstly introduced the term computational thinking(CT) to describe a set of required skills and methods for solving complex real problems. In recent years, the learning of computational thinking become part of primary school education curricula to learn problem solving [2, 6]. However, using traditional programming approachto learn computational thinking is still difficult for novice learners. The storytelling-based computational thinking research was proposed to learn Python in [3].Brennan and Resnick stated that students could learn computational thinking CT concepts through the presentation of causality storytelling to solve life applications [5, 9].The causality storytelling is to describe the sequence of events emphasizing causality and logical thinking [1, 8]. There are four common elements of causal story narrative structure (1) background, including characters and places; (2) questions; (3) goals, including action, problem solving, and (4) story outcomes. This kind of story narrative structure is the easiest for students to imitate and learn. The structure of the story is not only easy to understand in teaching, but also enhances students' grasp of the story situation and the key points of the story, thereby enhancing the ability to read, understand and think.

II. FRAME-BASED KNOWLEDGE REPRESENTATIONFORCAUSALITYSTORYTELLING SCRIPT

Through the knowledge acquisition process, we obtained several different storytelling scripts, each of which is composed of different characters and a series of events and plots. Students can learn the logic reasoning and the corresponding learning content through the causality story creating and imitating. The frame-based knowledge representation is suitable for causality storytelling design. Script is a frame-like structure to represent a common sequence of events [7]. Scenes represent the chain of events to take place. The knowledge frame and script can help students easily modify their work in the creation process. Therefore, students can establish script, and cultivate their logical thinking, problem-solving skills, and creative thinking skills. We then design a causality storytelling frame consisting of seven attributes with data structure knowledge as follows.

"CSB. Theme" is the title of the data structure being used. "CSB. No" is the knowledge number. "CSB. Plot" refers to the Script Plot Frame, celled the SPF, which represents a context page related to the data structure concept. "CSB. Media" means the Storytelling Animation URL. "Problem. Statement" describes the problem using story-situation dialogue. "Problem. Solving" refers to the learning of data structure concepts. "Storytelling Script" is an authoring language for operating scripts. Through storytelling, it trains learners' logical thinking and problem-solving abilities, and help to collect students' learning feedback in the learning process.The students can not only further extend the original story narrative to new stories or new scenes, but also enable different themes to create content with different story situations through students' rich creativity and imagination.

III. THE LEARNING PLATFORM

In this study, we develop the causality storytelling-based Computational Thinking platform. Different storytelling situations can convey different solving goals and strategies. From story dialogue, we can describe story scenes, plots, and characters, which can enhance students' learning motivation [10]. The purpose is to cultivate students' logical thinking and problem-solving skills. Learners need to have different problem-solving strategies for different causality storytelling-based situation. In addition, through peer assessment and feedback, learners' learning conditions can be understood to help

teachers improve teaching effectiveness.This study designs script as a storytelling process to describe the creation and learning of the scaffolding, which consists of four stages: beginning stage, bearing stage, turning stage and merging stage. The beginning stage is to describe the background of the story and the characteristics of the characters; bearing stage is to describe the problems acted by the characters; the turn stage is to describe how characters try to solve problems; the merging stage is to describe the story ending.Through the process, we guide students to use SCRATCH tools from the creation of the initial cases, through the story narrative plot, characters, dialogue, background and other changes, establish a causal structure, in the animation creation process, use the characteristics of real-time animation demonstration, to help students train logical thinking and problem-solving skills.When students using the platform at different stages, the platform provides different learning content and learning diagnosis. In the preparation process, we collected several typical classic cases together with the related concept of computational thinking strategies. Next, during thestorytelling learning process, with the cases, it trains learners' logical thinking and problem-solving abilities. The platform collects students' learning feedback, and further enhances thestorytelling cases DB.This platform includes computational thinking basic concepts course, storytelling-based application course, annotation tool, and case creation. At present, we have collected more than 80 causality storytelling-based cases, and have proposed the storytelling-based knowledge representation frame to help students to construct a complete story.Learners can learn the chosencausality storytelling scripts and story animation examples, make notes with annotation tools, and discuss further with their peers. In addition, they also can create a new story with storytelling animation through imitation, as shown in Figure 1. In classroom learning, students can not only give feedback and revise in real time, but teachers can also further understand whether learners' thinking ability has been improved or not through the process of creation and discussion.

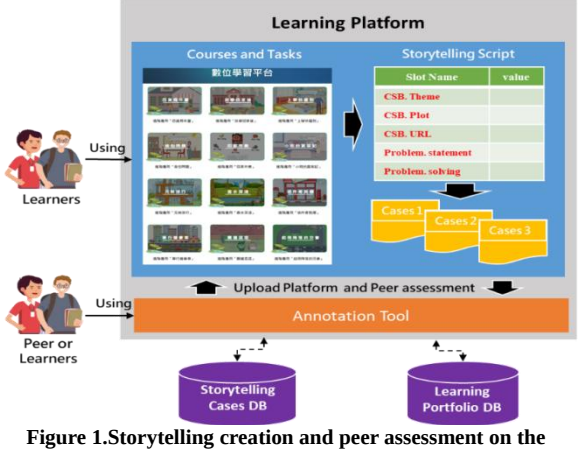


Figure 1.Storytelling creation and peer assessment on the platform

This study has proposed a causality storytelling frame, and constructed a storytelling-based computing thinking platform Version 1, combined with Scratch software tools, where the SCRATCH is the block-structure language to show animation only when block-correct. This feature allows learners to create new programs to represent different coding with storytelling structures.This study builds annotation tools including the self-learning annotation tags and inspection tags for self-regulated learning. Therefore, during the learning process, learners can not only use the self-learning annotation tags to take key notes, but also use the storytelling design inspection tags in the classroom to conduct peer assessment, and conduct learning reflection and revision.

The data structure ontology is built to help students further learn related concepts and knowledge of data structure such as arrays, sequences, stacks, and queues. Therefore, if students use the platform to select and learn such as arrays, the platform will not only provide the knowledge and concepts of arrays, but also provide storytelling scripts and story animations by using the following algorithm, so that students can further learn related concepts and knowledge.

Input: Original Story Elements
Output: Causality Storytelling Script
Step 1. Select features of the script
Define the characteristics of causality storytelling script according to the characteristics of causality.
Step 2. Design examples of causality storytelling script.
Step 3. Use SCRATCH to design storytelling animation for each example.

Algorithm: generating Causality Storytelling Script

As mentioned above, frames and scripts represent the concepts of computational thinking and the design of storytelling. We can use storytelling-based scripts to manipulate object values in the scripted context frame. Through script guidance, different examples cannot only help students learn knowledge, but also make it easier for students to imitate and design, and further training students' logical thinking and problem-solving abilities There were 20 college students participating in the computational thinkingcourse in one-day camp in 2021. We conducted the following computational thinking teaching activities: Introduction to Computational Thinking Learning Platform, Storytelling Script Framework Teaching, Scratch software teaching, Storytelling animation creation experience, Peer assessment and Learning feedback.According to the satisfaction survey, 50% of students thought that the computational thinking learning platform could enhance learning interest, and learn logical concepts. Besides, based on the feedback provided by students in Version 1 of platform, we further proposed Version 2. Next year, the same students got involved in the evaluation of Version 2 again. The evaluated results shows that 85% of the students were very satisfied of

the Version 2. Therefore, we believed that using the storytelling-based script frame to lead students to design and learn computational thinking could further help students increase their learning effectiveness and interest in learning.

IV. DISCUSSION AND CONCLUSION

We are building theproblem-solving ontology ontologies according to different problem-solving strategy and the data structure used to solve the problem, and ontology could be evolving to better support the students' learning.

In the near future, huge amount of the log data and the students' feedbackscould be collected automatically due toactively introducing this platform. However, the manual evolving ontology construction is time consuming and very costly. In order to overcome this issue, we will try to apply the Folksonomy-based Ontology Construction strategy to support the evolution of ontology.

ACKNOWLEDGEMENT

This research was partially supported by the National Science and Technology Council(NSTC)of the Republic of China,Taiwan, under grants MOST 108-2511-H-468-005-MY2 and MOST 106-2511-S-468-002-MY3.

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