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Collaborative decision making: Evaluations of methodologies and cognitive design

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14. ABSTRACT
In the project, we took into account, modified and refined our team's previous research ideas and previous studies (Hou & Keng, 2021; Hou, Fang & Tang, 2022) proposed a multidimensional scaffold-oriented framework for strategy planning ability training (Hou, 2022). This framework integrates multi-dimensional scaffolding (including cognitive scaffolding, metacognitive scaffolding, strategic scaffolding, peer scaffolding, and procedural), technology, and game interaction mechanism to provide an integrated game-based interactive environment for players to learn strategic planning in the game. The study took augmented reality as technology example and board game as game example. As shown in the Figure below, the entire framework is divided into four modules, which provide four functions: realistic situations, strategy monitoring, real-time diagnosis, and collaborative interaction.

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ACCOMPLISHMENT

- What were the major goals and objectives of this project?

  Strategy planning and decision-making is an important topic in many fields for decades. Decision-making training has gained more attention. Game-based learning (GBL) describes an environment where game content and game play enhance knowledge and skills acquisition, and where game activities involve problem solving spaces and challenges that provide players/learners with a sense of achievement (e.g., Kirriemuir & McFarlane, 2004; McFarlane et al., 2002; Prensky, 2001). During the pandemic period, DGBL became an important alternative and trend in education. DGBL is an approach, where digital games and instructional materials were integrated together. This is due to the fact that DGBL provides students with opportunities to take the initiative in their learning by analyzing, synthesizing, evaluating, and performing higher-order thinking skills, such as critical thinking and problem-solving (Dindar, 2018; Yang, 2015).

Moreover, DGBL can potentially improve learning motivation (Huizenga et al., 2009), provide immediate feedback (Yang et al., 2017), develop complex problem-solving skills (Eseryel et al., 2014), reduce anxiety (Pham Q et al., 2016) and enhance learning performance (Chen & Lin, 2016; Wang & Chen, 2010). Due to above status quo, the goals of this project are listed below based on developing the situated and simulation game-based decision-making training and strategy planning activity with cognitive flow-based design:

1. Propose the framework of training of strategy planning and decision-making with multidimensional scaffolding mechanism in distance collaborative learning context
2. Design situated gamification training to assist learners' decision making in their collaborative problem-solving process of complex and cross-disciplinary tasks and explore the effectiveness and importance of multidimensional scaffolding educational games in different subjects

- What was accomplished under these goals?

➢ **Research Questions 1: Proposing Framework**

In the project, we took into account, modified and refined our team's previous research ideas and previous studies (Hou & Keng, 2021; Hou, Fang & Tang, 2022) proposed a multidimensional scaffold-oriented framework for strategy planning ability training (Hou, 2022). This framework integrates multi-dimensional scaffolding (including cognitive scaffolding, metacognitive scaffolding, strategic scaffolding, peer scaffolding, and procedural), technology, and game interaction mechanism to provide an integrated game-based interactive environment for players to learn strategic planning in the game. The study took augmented reality as technology example and board game as game example. As shown in the Figure below, the entire framework is divided into four modules, which provide four functions: realistic situations, strategy monitoring, real-time diagnosis, and collaborative interaction. The following descriptions are quoted and condensed from the published journal article of this study:

Hou, H. T. (2022) Augmented Reality Board Game with Multidimensional Scaffolding Mechanism: A Potential New Trend for Effective Organizational Strategic Planning Training, Frontiers in Psychology. 13:932328.

Among them, the realistic context module will apply the design principles of situated learning (Brown et al., 1989), provide a realistic contextual context through multimedia and AR technology, and provide a cognitive scaffold (Hannafin et al., 1999; Saye and Brush, 2002; Hou and Keng, 2021) to provide a variety of external and internal

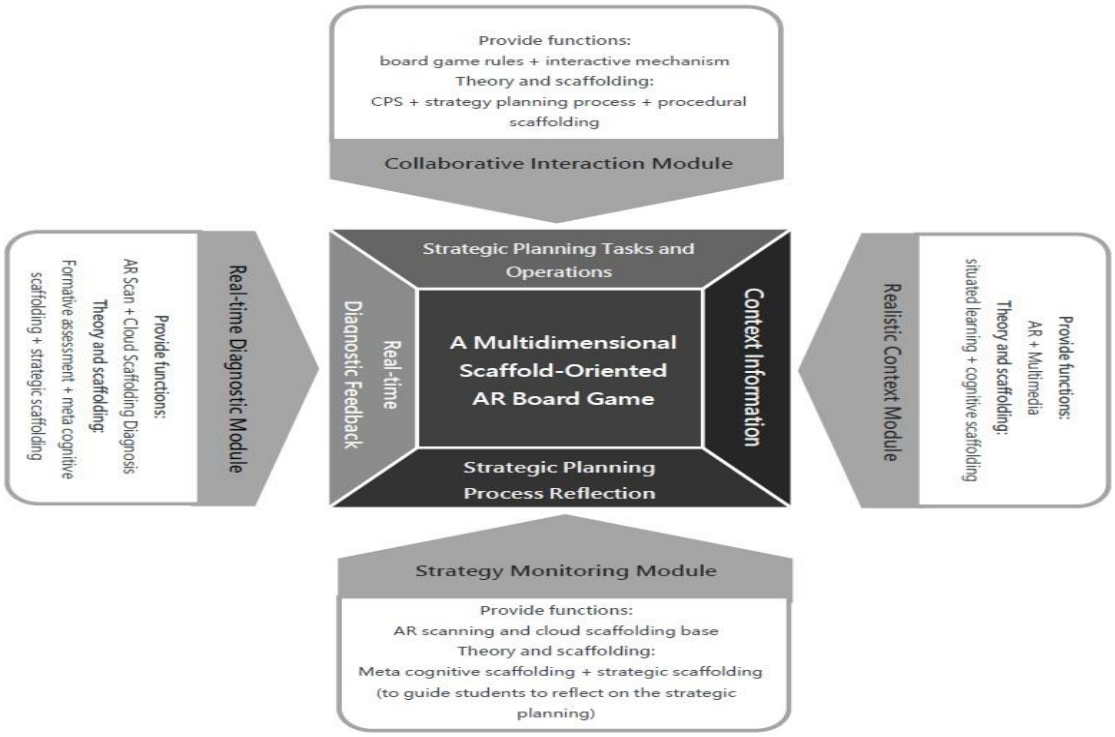
contextual contexts and scenarios (e.g., news, environmental economic events, competitor news, internal organizational temporal events, or data models) for managing the context as a contextual context for tasks and clues. These clues can be used as cognitive scaffolds to facilitate learning and thinking.

In addition, a physical board game is used as a collaborative interaction module to design collaborative interaction game rules based on the collaborative problem solving theory (CPS) (Nelson, 1999) to guide groups of learners in the same camp to collaborative problem solving, in which the game card content, game rules, and goal tasks need to be integrated into each stage of the strategy planning process (Hill et al., 2016) to facilitate the alignment of game goals with learning objectives. Players need to conduct resource planning or process planning within the organization to achieve the goals of the strategic planning task. The guide to the strategic planning process can be used as a procedural scaffold to assist players in the complete process of strategic planning.

The strategy monitoring module provides a meta-cognitive scaffold that allows learners to scan or enter decision data on specific cards using AR. The module can provide corresponding cues before, during, and after the execution of a strategy based on the data.

Finally, the real-time diagnostic module provides a formative assessment of the diagnostic and feedback after reviewing the implementation of the player's proposed strategy. Through the scanning of specific combinations of different board cards and the cloud-based scaffolding diagnostics (e.g., diagnostics of strategies and outcomes formed by players by combining related action cards), the app will display various triggered outcomes after the execution of strategies (e.g., diagnostic feedback on the latest value changes and realtime conditions resulting from the implementation of strategy combinations). These formative evaluations can also be used as meta cognitive scaffolds and strategy scaffolds to guide learners to make more in-depth strategy adjustments.

Instructors can use this framework to design board game cards and game interaction rules (e.g., matching, combination, sorting, and other game mechanisms) according to learning objectives. With the common AR picture recognition editing tools on the Internet, various multimedia scaffold designs can be made, and a scaffold-oriented AR educational board game can be completed.



Multidimensional scaffold-oriented educational game framework for strategy planning ability training. (Source: Hou, 2022)

(Hou, H. T. (2022) Augmented Reality Board Game with Multidimensional Scaffolding Mechanism: A Potential New Trend for Effective Organizational Strategic Planning Training, Frontiers in Psychology. 13:932328.*)

- **Research Questions 2 : Design and Evaluation of scaffolding based education games**

Based on the research questions and framework proposed above, the study designed ten multidimensional scaffold-oriented educational games in different domain (e.g., flight booking, strategy planning in business industry, history etc.) with various technology (e.g., google earth, google form, google Jamboard, Gather town, meet etc.) to foster not only domain knowledge learning but also decision making skill development.

No1. Design and evaluation of a contextual distance management training game with a real-person non-player character mechanism for SWOT decision making skill

Paper published: Chien, C. C., Huang, S. T., & Hou, H. T. (2022, November 28-December 1). *Design and evaluation of a contextual distance management training game with a real-person non-player character mechanism*. In 14th Asian Conference on Education (ACE2022), Tokyo, Japan. (Online poster presentation)

1. **Keywords:** real-person NPC, educational game, situated learning, scaffolding, strategic planning training, online distance learning
2. **Abstract:** *With the COVID-19 pandemic, teleconferencing has become a common mode for companies and many professional training courses have been moved to the Internet. In this study, a highly realistic game "Strategy Challenger" is designed with a realistic company environment through the teleconferencing software Gather Town, in which learners complete and learn SWOT analysis to make the best decisions. The study provides multi-dimensional scaffolding in the game, including cognitive scaffolding, procedural scaffolding, emotional scaffolding, etc. In each department established in the game, there are NPC characters to provide information about the current situation of the company and the external market environment. The real person-NPCs give different guidance to the learners in the game, so that the scaffold has a mixed mechanism of active and passive. The real person-NPCs are administrative assistants, which simulate the mode of veteran employees leading new employees and solving learners' problems. The learners experienced the company situation and strategy planning process during the activity. According to the research results, the learners had flow higher than median3 of Likert 5-point scale during the game and felt clear activity goals and high sense of control, while their anxiety was close to the median of Likert 5-point scale, which is moderate anxiety is helpful for the learners.*
3. **Game Diagrams:**

Gather Town-based game: Strategy Challenger

Relevance message guidance in different departments

No2. The Development and Preliminary Evaluation of an Educational Game for Decision Making skill in Online Flight Reservation Services That Involves Real Person-NPCs

Paper published: Ho, Y. T., Kuo, C. C., Hou, H. T. (2022, November 28- December 2), *The Development and Preliminary Evaluation of an Educational Game for Online Flight Reservation Services That Involves Real Person-NPCs*, In 30th International Conference on Computers in Education (ICCE2022). (Online poster presentation)

1. **Keywords:** real person-NPCs, online educational game, situated learning, Flight reservation
2. **Abstract:** *With the COVID-19 pandemic, distance learning has become a norm. In this study, we developed a flight booking service educational game "Ticketing Expert" through Gather Town, a social and learning distance learning software, and created a realistic scenario in which three real person-NPCs play the role of customers, and the learners need to help customers to book special needs (e.g., special seats or meals) according to their needs. In the game, three real-life NPCs play the role of customers, and learners are required to help customers book special needs (e.g., special seats or meals) according to their needs. The game provides a scaffolding of knowledge about ticketing services, and a live NPC who interacts with the learner as a ticketing supervisor and provides timely assistance. According to the study, learners' flow state significant higher than median of Likert 5-point scale and had high acceptance significant higher than median of Likert 5-point scale to the game, learning ticketing knowledge and applications.*

3. **Game diagram:**

Online Situational Flight Reservation Game

Online Decision Making Discussions on a Collaborative Ticketing Service

No3. An Analysis of the Acceptance and Anxiety of a Historical Battle Strategic Planning Decision Making Game by Combining Real Person Non-player Character Mechanism

Paper published: Chan, H. Y., Liu, S. W., & Hou, H. T. (2022, November 28-December 1). *An Analysis of the Acceptance and Anxiety of a Historical Strategic Planning Game by Combining Real Person Non-player Character Mechanism*. In 14th Asian Conference on Education (ACE2022), Tokyo, Japan. (Online poster presentation) (An extended version has been submitted to a journal and is under review)

1. **Keyword:** real-person NPC, online educational game, history learning, game acceptance, activity anxiety
2. **Abstract:** *Under COVID-19, distance and synchronous learning is becoming more and more common, and history courses are no exception. This study developed a history strategy game "The Battle of Yiwei" through Gather Town, which recreates the scenes of "The Battle of Yiwei" and allows learners to take on the role of historical figures and work with the group to complete historical events, as well as send out reporters to investigate the enemy and obtain current historical information. Real person-NPCs also play the role of historical figures and will guide the learners in the game. According to the results of the study, learners did not feel too much anxiety during the game significant lower than median of Likert 5-point scale, and the game also received good reviews, helping learners in terms of historical knowledge and game operation. The freedom of exploration also increases learners' uncertainty and sense of accomplishment. The acceptance of the game was significantly higher than median of Likert 5-point scale.*

3. **Game diagrams:**

The starting screen of the game "The Battle of Yiwei"

The answer page of a battle **decision making** task

No4. The Development and Evaluation of an Online Educational Game Integrated with Real Person-NPC mechanism for Decision Making for History Learning

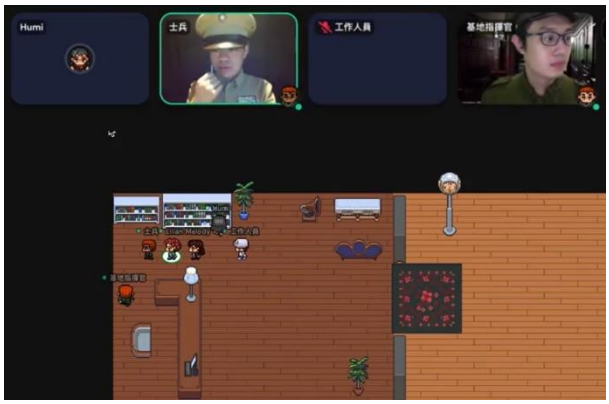
Paper published: Liu, S. W., Chan, H. Y., Hou, H. T. (2021, November 22-26). *The Development and Evaluation of an Online Educational Game Integrated with Real Person-NPC mechanism for History Learning*. In 29th International Conference on Computers in Education (ICCE2021). (Online poster presentation)

1. **Keyword:** Real-person NPC, online educational game, situated learning, history learning
2. **Abstract:** *Due to the popularity of COVID-19, the education method has changed. If the teaching design still adopts the method without interaction, such as presentation or video teaching, the learning effect may be poor. Therefore, this study developed an online synchronous history game "1946 Base Exploration", and applied the real NPC mechanism in the game to provide more realistic dialogues, and also used it as a dynamic scaffold to provide real-time feedback*

and guidance to guide the learners' game planning in a timely manner. This game uses Gather Town as a development tool to recreate the appearance of the base in 1946. Learners will play the role of "military officers" and two real person-NPCs will play the roles of "commander" and "soldier " respectively. Learners are required to explore the terrain and military buildings in the base, as well as to know their uses and master their usage, patrol routes, etc., to complete the three stages of the mission. According to the results of the study, the learners' historical knowledge and planning skills were significantly improved, and they had a good flow experience significant higher than median of Likert 5-point scale in the game.

3. **Game diagram:**

Game screenshot of 1946 Base Exploration(beta)



Real person-NPCs as scaffolding

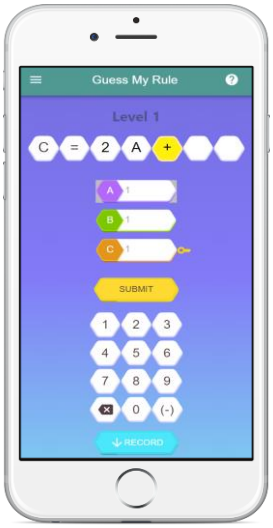
No5. The Development and Preliminary Evaluation of a Mobile Game for Pattern Recognition Decision Making.

Paper published: Chao, C. Y., Chen, Y. C., Hou, H. T. (2022, November 28-December 2). *The Development and Preliminary Evaluation of a Mobile Game for Pattern Recognition Learning*. In 30th International Conference on Computers in Education (ICCE2022). (Online poster presentation)

1. **Keyword:** computational thinking, pattern recognition, mobile education games
2. **Abstract:** *As information technology has become an important aspect of human society, Computational Thinking (CT) has become increasingly emphasized. Among them, pattern recognition is a critical skill in CT, and it is also a key ability in mathematics and STEM. In this study, a mobile game "Guess My Rule" was developed to foster pattern recognition skills, which combined with algebraic thinking in mathematics, allowing learners to develop pattern prediction skills in a code-solving scenario. This preliminary study investigated the learners' flow state, motivation, and anxiety during the game. Descriptive statistical analysis*

revealed that the participants' flow state and motivation in "Guess My Rule" were significantly higher than the median of Likert 5-point scale and anxiety was significantly lower than the median of Likert 5-point scale, indicating that the design of the game had a positive effect on learners to engage in pattern recognition.

3. **Game diagram:**



Code-solving Breakout Game

Current Level Answer Records

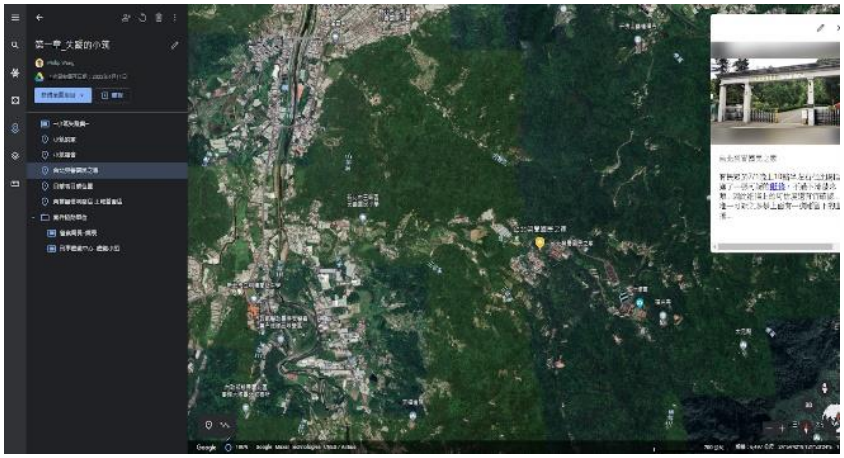
No6. A Remote Collaborative Decision-Making Training Game with a Real-Person Non-Player Character

Paper published: Wang, T. H., Kuo, C. C., & Hou, H. T. (2022, November 28-December 1). *A Remote Collaborative Decision-Making Training Game with a Real-Person Non-Player Character*. In 14th Asian Conference on Education (ACE2022), Tokyo, Japan. (Online poster presentation)

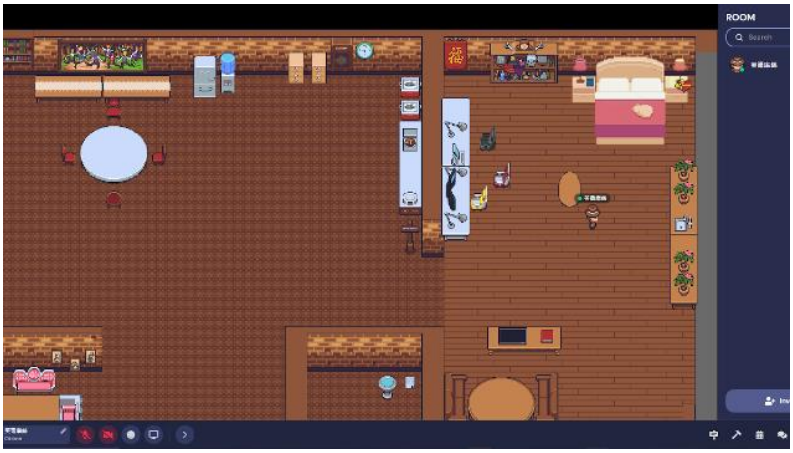
1. **Keyword:** real-person NPC; educational game; situated learning; scaffolding; Decision-Making Training ; Online distance learning
2. **Abstract:** *In order to train and evaluate learners' decision-making power, and considering the current trend of remote online learning, we designed the contextual remote collaborative decision-making training game "The Case of the Missing Xiaozhu", developed through Google Earth, Gather Town, and Google Jamboard. The game mechanism is based on clue finding and time consumption to test learners' observation, planning, and decision making skills. In the game, researchers act as real person-NPCs, police officers and forensic teams to provide learners with relevant information. Learners need to form teams online, collaborate remotely, explore and analyze clues together, find the missing person - Xiaozhu, and deduce who the killer is. The game incorporates real-life NPCs to*

create a realistic learning situation and to work with learners to solve puzzles. According to research findings, learners' flow experience is significantly higher than the median of Likert 5-point scale.

3. Game diagrams:



《The Case of the Missing Xiaozhu》game interface-Google Earth



《The Case of the Missing Xiaozhu》game interface --Gather Town

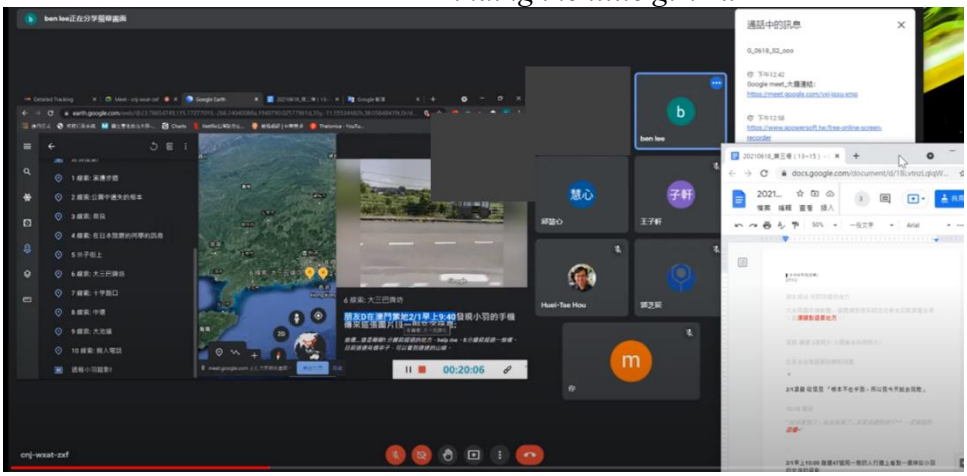
《The Case of the Missing Xiaozhu》game interface --Google Jamboard

No7. The Development and Preliminary Evaluation Learner's Flow State of an Online Decision-making Detective Game (SSCI submitted)

Paper published: Kuo, C. C., Wang, T. H., & Hou, H. T. (2021, November 25-28). *The Development and Preliminary Evaluation Learner's Flow State of an Online Decision-making Detective Game*. In 13th Asian Conference on Education (ACE2021), Tokyo, Japan. (Online poster presentation)

1. **Keywords:** educational online game, game-based learning, decision making, flow
2. **Abstract:** *Due to the pandemic of COVID-19, many physical first aid courses have been converted to online courses. However, first aid courses emphasize providing realistic situations that facilitate the learner's ability to make accurate and immediate judgments and decisions according to patients' conditions. This study aims to develop an online educational board game- Heartbeat Moment (beta) with a contextual and authentic learning environment using Google Jamboard application for learning first aid abilities. By providing simulated dynamic electrocardiogram data and descriptions of the patients' conditions to create an authentic environment and improve the ability to make correct decisions on the treatment methods according to the patient's condition. The learner also asked to decide the treatment sequence based on the electrocardiogram and clinical conditions of each patient card and adhere to the principle of priority treatment for emergency and severe cases. Through our preliminary analysis, it is found that. Although the progress in learning outcomes is limited (there was no significant difference between the scores of the pre-test and the post-test), the level of learner engagement is high. All learners were analyzed for their flow and technology acceptance. The results showed that the overall flow and game acceptance were significantly higher than the median (the median in a five-point scale =3). A high level of flow means that the learner is fully engaged in the learning activity and demonstrates a high level of concentration, which is critical to first aid learning and facilitates objective analysis and decision making for the patient's condition.*
3. **Game diagrams:**

Content of *Finding the little girl Yu*



Capture shoot of *Finding the little girl Yu* game experiment

No8. Design and evaluation of an online workplace promotion decision analysis training game with provided simulation context

Paper published: Chien, C. C., & Hou, H. T. (2023, February 10-13). *Design and evaluation of an online workplace promotion decision analysis training game with provided simulation context*. The Southeast Asian Conference on Education (SEACE2023), Singapore. (poster presentation)

1. **Keywords:** Career advancement, Distance education and training
2. **Abstract:** *Traditional appraisal methods are usually based on performance appraisal or professional performance to determine the promotion of staff, but ignore the development potential and personal characteristics of individuals. In this study, we designed a contextual simulation game "Who is the Successor", which was created through Gather Town, a realistic company scenario, including various departments, with many departmental colleagues and their respective views and information on promotion, for learners to explore through Google form. The game allowed participants to experience how a real organization operates and how to collect and use the information obtained, and allowed them to take on*

the role of a promotion decision team and complete promotion decisions. The participants in this study had a flow experience significantly higher than median of Likert 5-point scale in the decision making task and lower learning anxiety of median of Likert 5-point scale, indicating a high level of engagement in the distance learning task.

3. Game diagrams:

Game interface of "**Who is the Successor**"

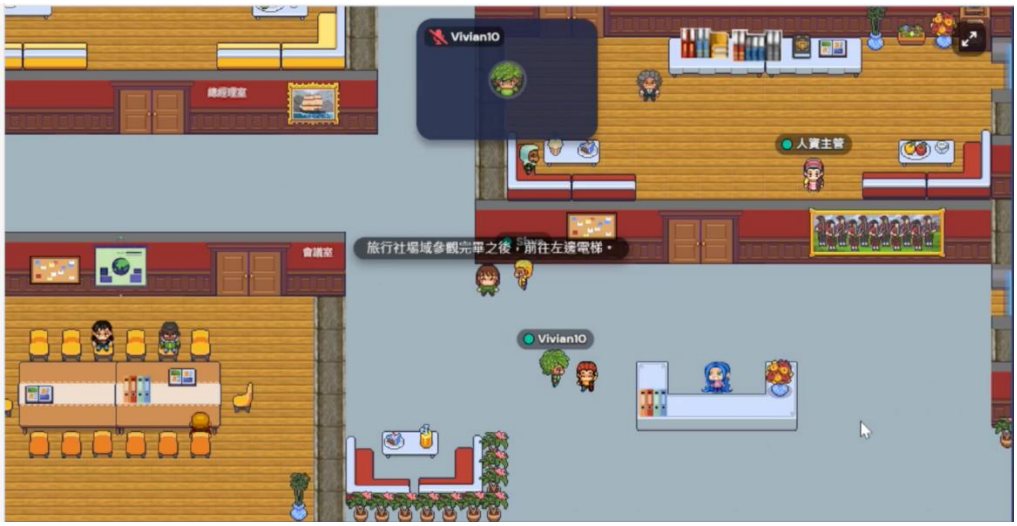
Vice President's Office in "**Who is the Successor**"

No. 9 The Design and Evaluation of an Online Educational Game for the Development of Communication and Response Skills in the Service Industry

Paper published: Ho, Y. T., & Hou, H. T. (2023, February 10-13). *The Design and*

Evaluation of an Online Educational Game for the Development of Communication and Response Skills in the Service Industry. The Southeast Asian Conference on Education (SEACE2023), Singapore. (poster presentation)

1. **Key words:** Distance education training, communication skills, and response skills
2. **Abstract:** *For service providers, learning how to deal with a variety of situations and different customers is a must. In response to the post-epidemic learning trend, service industry training courses are also using distance learning. The study designed a remote service industry training game "Difficult Customers", in which a virtual travel agency was created through Gather Town and the interactive mechanism of Google form was used to simulate how employees should respond and communicate with customers when they encounter different groups of customers. The Google form is used to simulate how employees should respond to different customer groups and how they should reply when customers ask for different things. After learning and solving travelers' problems step by step, learners will also receive feedback. Through the simulation of real situations, learners can learn communication skills and response abilities in the game, and also generate a high state of flow and low anxiety, presumably due to the realistic situations in the game and the real interaction with customers, so that learners had flow state and acceptance significantly higher than median of Likert 5-point scale in the training course, and lower anxiety of median of Likert 5-point scale.*
3. **Game diagrams:**



***G*ame interface of "Difficult Customers"**

Learners were looking at the knowledge provided by the game

Summary:

According to the statistics in the following table, flow of the 9 studies were significantly higher than the median of Likert 5-point scale in overall flow, flow attendance, and flow experience. This results reveled that leaners of 9 educational games highly engaged in online distance learning no matter what subject domain are. The games related to decision making, either through contextual integration with clue analysis or the inclusion of real person-NPCs as forensic examiners, provide learners with a good flow experience.

Questionnaire commonality results for above 9 studies

(√: Significantly higher than the median 3 of Likert 5-point scale, **Anxiety** significantly below median 3; N/A: not evaluated in that study**)**

NO	Research Title	Flow	Flow Attendance	Flow Experience	Game Acceptance	Usefulness	Ease of use	Game Elements	Motivation	Anxiety
1	Design and evaluation of a contextual distance management training game with a real-person non-player character mechanism for SWOT decision making skill	√	√	√	N/A	N/A	N/A	N/A	N/A	N/A
2	The Development and Preliminary Evaluation of an Educational Game for Decision Making skill in Online Flight Reservation Services That Involves Real Person-NPCs	√	√	√	√	√	√	√	N/A	N/A
3	An Analysis of the Acceptance and Anxiety of a Historical Battle Strategic Planning Decision Making Game by Combining Real Person Non-player Character Mechanism	N/A	N/A	N/A	√	√	√	√	N/A	N/A
4	The Development and Evaluation of an Online Educational Game Integrated with Real Person-NPC mechanism for Decision Making for History Learning	√	√	√	N/A	N/A	N/A	N/A	N/A	N/A
5	The Development and Preliminary Evaluation of a Mobile Game for Pattern Recognition Decision Making	√	√	√	N/A	N/A	N/A	N/A	√	N/A

6	A Remote Collaborative Decision-Making Training Game with a Real-Person Non-Player Character	√	√	√	N/A	N/A	N/A	√	N/A	N/A
7	The Development and Preliminary Evaluation Learner's Flow State of an Online Decision-making Detective Game (SSCI submitted)	√	√	√	N/A	N/A	N/A	N/A	N/A	N/A
8	Design and evaluation of an online workplace promotion decision analysis training game with provided simulation context	√	√	√	N/A	N/A	N/A	N/A	N/A	N/A
9	The Design and Evaluation of an Online Educational Game for the Development of Communication and Response Skills in the Service Industry	√	√	√	√	√	√	N/A	N/A	N/A

In addition, the two games using the real NPC scaffolding mechanism had high game acceptance and allowed learners to learn about service and historical decision-making strategy planning respectively, and the games were easy to operate. In addition to game acceptance, learners also rated the game design elements highly, indicating that the design of the game mechanism can bring learners a sense of achievement and control. It shows that learners accept the real NPC mechanism and even have a good learning experience. Therefore, with the guidance and assistance of real person-NPCs, they may have a positive influence on learners.

Pattern recognition game, on the other hand, allow learners to be highly motivated and engaged in the pattern recognition decision-making process, which shows that the use of multiple difficulty levels may bring these effects to learners.

A total of four games related to corporate educational decision-making training, including the development of staff decision planning skills, workplace promotion decision making skills, ticketing service response training, and service staff communication skills, all made the learners highly engaged in the training process without feeling overly anxious. In this way, it shows that the game with realistic learning situation and the introduction of real NPC mechanism or Google form interactive mechanism are helpful to the education training.

What opportunities for training and professional development has the project provided?

- How were the results disseminated to communities of interest?
  From above results, 9 educational game in the studies are seen as 9 strategy planning and decision-making teaching materials and they are easily to further be developed as curricula. Therefore, we are holding a series of multidimensional scaffolding educational game workshops for trainers, teachers and educators to experience the game in distance learning context, to understanding the framework behind the game, and to further apply these games and framework in their own class.

- What do you plan to do during the next reporting period to accomplish the goals and objectives?
  Nothing to Report

PRODUCT

- publications, conference papers, and presentations;

1	Hou, H. T.* (2022) Augmented Reality Board Game with Multidimensional Scaffolding Mechanism: A Potential New Trend for Effective Organizational Strategic Planning Training, *Frontiers in Psychology. 13*:932328.
2	Chien, C. C., Huang, S. T., & Hou, H. T. (2022, November 28-December 1). *Design and evaluation of a contextual distance management training game with a real-person non-player character mechanism*. In 14th Asian Conference on Education (ACE2022), Tokyo, Japan.
3	Ho, Y. T., Kuo, C. C., Hou, H. T. (2022, November 28- December 2), *The Development and Preliminary Evaluation of an Educational Game for Online Flight Reservation Services That Involves Real Person-NPCs*, In 30th International Conference on Computers in Education (ICCE2022)
4	Chan, H. Y., Liu, S. W., & Hou, H. T. (2022, November 28-December 1). *An Analysis of the Acceptance and Anxiety of a Historical Strategic Planning Game by Combining Real Person Non-player Character Mechanism*. In 14th Asian Conference on Education (ACE2022), Tokyo, Japan.
5	Liu, S. W., Chan, H. Y., Hou, H. T. (2021, November 22-26). *The Development and Evaluation of an Online Educational Game Integrated with Real Person-NPC mechanism for History Learning*. In 29th International Conference on Computers in Education (ICCE2021)
6	Chao, C. Y., Chen, Y. C., Hou, H. T. (2022, November 28- December 2). *The Development and Preliminary Evaluation of a Mobile Game for Pattern Recognition Learning*. In 30th International Conference on Computers in Education (ICCE2022).
7	Wang, T. H., Kuo, C. C., & Hou, H. T. (2022, November 28-December 1). *A Remote Collaborative Decision-Making Training Game with a Real-Person Non-Player Character*. In 14th Asian Conference on Education (ACE2022), Tokyo, Japan.
8	Kuo, C. C., Wang, T. H., & Hou, H. T. (2021, November 25-28). *The Development and Preliminary Evaluation Learner's Flow State of an Online Decision-making Detective Game*. In 13th Asian Conference on

	Education (ACE2021), Tokyo, Japan.
9	Chien, C. C., & Hou, H. T. (2023, February 10-13). *Design and evaluation of an online workplace promotion decision analysis training game with provided simulation context*. The Southeast Asian Conference on Education (SEACE2023), Singapore.
10	Ho, Y. T., & Hou, H. T. (2023, February 10-13). *The Design and Evaluation of an Online Educational Game for the Development of Communication and Response Skills in the Service Industry*. The Southeast Asian Conference on Education (SEACE2023), Singapore.

- website(s) or other Internet site(s): Nothing to Report
- technologies or techniques: Nothing to Report
- inventions, patent applications, and/or licenses: Nothing to Report
- other products, such as data or databases, physical collections, audio or video products, software, models, educational aids or curricula, instruments or equipment, research material, interventions (e.g., clinical or educational), or new business creation:
  Nine educational games in the project could not only be applied in the class as educational aids, but also can be developed as curricula.

PARTICIPANTS & OTHER COLLABORATING ORGANIZATIONS:

- What individuals have worked on this project?

Name	Hou, Huei-Tse
Total Number of Months	24 months
Project Role	PI
Researcher Identifier	1
Contribution to Project	Prof. Hou has performed work in area of managing and planning the research
State, U.S. territory, and/or country of residence	N/A
Collaborated with individual in foreign country	N/A
Country(ies) of foreign collaborator	N/A
Travelled to foreign country:	N/A

If traveled to foreign country(ies), duration of stay:	N/A

Name	Kuo, Chih-Chen
Total Number of Months	24 months
Project Role	PhD Graduate Student (research assistant)
Researcher Identifier	2
Contribution to Project	Ms. Kuo has performed work in area of coordinating the whole project and conducting the research as well.
State, U.S. territory, and/or country of residence	N/A
Collaborated with individual in foreign country	N/A
Country(ies) of foreign collaborator	N/A
Travelled to foreign country:	N/A
If traveled to foreign country(ies), duration of stay:	N/A

Name	Chien, Chih-Chung
Total Number of Months	6 months
Project Role	PhD Graduate Student (research assistant)
Researcher Identifier	3
Contribution to Project	Mr. Chien has performed work in area of conducting the research
State, U.S. territory, and/or country of residence	N/A
Collaborated with individual in foreign country	N/A
Country(ies) of foreign collaborator	N/A
Travelled to foreign country:	N/A
If traveled to foreign country(ies), duration of stay:	N/A

Name	Wang, Jui-Jong

Total Number of Months	8 months
Project Role	PhD Graduate Student (research assistant)
Researcher Identifier	4
Contribution to Project	Ms. Wang has performed work in area of conducting the research
State, U.S. territory, and/or country of residence	N/A
Collaborated with individual in foreign country	N/A
Country(ies) of foreign collaborator	N/A
Travelled to foreign country:	N/A
If traveled to foreign country(ies), duration of stay:	N/A

Name	Ho, Yen-Ting
Total Number of Months	6 months
Project Role	PhD Graduate Student (research assistant)
Researcher Identifier	5
Contribution to Project	Ms. Ho has performed work in area of conducting the research
State, U.S. territory, and/or country of residence	N/A
Collaborated with individual in foreign country	N/A
Country(ies) of foreign collaborator	N/A
Travelled to foreign country:	N/A
If traveled to foreign country(ies), duration of stay:	N/A

Name	Chan, Hung-Yu
Total Number of Months	2 months
Project Role	PhD Graduate Student (research assistant)
Researcher Identifier	6
Contribution to Project	Mr. Chan has performed work in area of conducting the research

State, U.S. territory, and/or country of residence	N/A
Collaborated with individual in foreign country	N/A
Country(ies) of foreign collaborator	N/A
Travelled to foreign country:	N/A
If traveled to foreign country(ies), duration of stay:	N/A

Name	Liu, Shu-Wei
Total Number of Months	6 months
Project Role	PhD Graduate Student (research assistant)
Researcher Identifier	7
Contribution to Project	Mr. Liu has performed work in area of conducting the research
State, U.S. territory, and/or country of residence	N/A
Collaborated with individual in foreign country	N/A
Country(ies) of foreign collaborator	N/A
Travelled to foreign country:	N/A
If traveled to foreign country(ies), duration of stay:	N/A

Name	Lin, Yu-Cheng
Total Number of Months	6 months
Project Role	PhD Graduate Student (research assistant)
Researcher Identifier	8
Contribution to Project	Mr. Lin has performed work in area of conducting the research
State, U.S. territory, and/or country of residence	N/A
Collaborated with individual in foreign country	N/A
Country(ies) of foreign collaborator	N/A

Travelled to foreign country:	N/A
If traveled to foreign country(ies), duration of stay:	N/A

Name	Chen, Yu-Chi
Total Number of Months	6 months
Project Role	PhD Graduate Student (research assistant)
Researcher Identifier	9
Contribution to Project	Mr. Chen has performed work in area of conducting the research
State, U.S. territory, and/or country of residence	N/A
Collaborated with individual in foreign country	N/A
Country(ies) of foreign collaborator	N/A
Travelled to foreign country:	N/A
If traveled to foreign country(ies), duration of stay:	N/A

Name	Wang, Tzu- Hsuan
Total Number of Months	16 months
Project Role	Graduate Student (research assistant)
Researcher Identifier	10
Contribution to Project	Mr. Wang has performed work in area of conducting the research
State, U.S. territory, and/or country of residence	N/A
Collaborated with individual in foreign country	N/A
Country(ies) of foreign collaborator	N/A
Travelled to foreign country:	N/A
If traveled to foreign country(ies), duration of stay:	N/A

Name	Yeoh, Chou-Pai

Total Number of Months	7 months
Project Role	Graduate Student (research assistant)
Researcher Identifier	11
Contribution to Project	Mr. Yeoh has performed work in area of conducting the research
State, U.S. territory, and/or country of residence	N/A
Collaborated with individual in foreign country	N/A
Country(ies) of foreign collaborator	N/A
Travelled to foreign country:	N/A
If traveled to foreign country(ies), duration of stay:	N/A

Name	Yu, Hua-An
Total Number of Months	2 months
Project Role	Graduate Student (research assistant)
Researcher Identifier	12
Contribution to Project	Mr. Yu has performed work in area of conducting the research
State, U.S. territory, and/or country of residence	N/A
Collaborated with individual in foreign country	N/A
Country(ies) of foreign collaborator	N/A
Travelled to foreign country:	N/A
If traveled to foreign country(ies), duration of stay:	N/A

Name	Chang, Chieh
Total Number of Months	2 months
Project Role	Graduate Student (research assistant)
Researcher Identifier	13
Contribution to Project	Ms. Chang has performed work in area of conducting the research

State, U.S. territory, and/or country of residence	N/A
Collaborated with individual in foreign country	N/A
Country(ies) of foreign collaborator	N/A
Travelled to foreign country:	N/A
If traveled to foreign country(ies), duration of stay:	N/A

Name	Hsieh, Chih-Yun
Total Number of Months	4 months
Project Role	College student (research assistant)
Researcher Identifier	14
Contribution to Project	Ms. Hsieh has performed work in area of conducting the research
State, U.S. territory, and/or country of residence	N/A
Collaborated with individual in foreign country	N/A
Country(ies) of foreign collaborator	N/A
Travelled to foreign country:	N/A
If traveled to foreign country(ies), duration of stay:	N/A

Name	Huang, Szu-Ting
Total Number of Months	1 month
Project Role	Graduate Student
Researcher Identifier	15
Contribution to Project	Ms. Huang has performed work in area of conducting the research
State, U.S. territory, and/or country of residence	N/A
Collaborated with individual in foreign country	N/A
Country(ies) of foreign collaborator	N/A

Travelled to foreign country:	N/A
If traveled to foreign country(ies), duration of stay:	N/A

Name	Chao, Chi-Yu
Total Number of Months	1 month
Project Role	Graduate Student
Researcher Identifier	16
Contribution to Project	Ms. Chao has performed work in area of conducting the research
State, U.S. territory, and/or country of residence	N/A
Collaborated with individual in foreign country	N/A
Country(ies) of foreign collaborator	N/A
Travelled to foreign country:	N/A
If traveled to foreign country(ies), duration of stay:	N/A

- Has there been a change in the active other support of the PD/PI(s) or senior/key personnel since the last reporting period? Nothing to Report
- What other organizations have been involved as partners? Nothing to Report
- Have other collaborators or contacts been involved? Nothing to Report

IMPACT: What was the impact of the project? How has it contributed?

For the development of the principal discipline(s) of the project

All these multidimensional scaffolding mechanism educational games provide potential solution for challenges in distance collaborative decision-making learning, such as low engagement, motivation, interaction with peers and high anxiety.

For other disciplines:

All these educational games not only enhance learning effectiveness in different subject domain knowledge, but also develop higher order thinking. Most important impact is that the project provide possible solution for cultivate key competence including problem solving, decision-making, and strategy planning in distance learning context.

The framework the project prosed all the games as examples enable educators

have to design their own distance learning educational game in different subject domain with low technology threshold.

- the development of human resources: Nothing to Report
- teaching and educational experiences: Nothing to Report
- physical, institutional, and information resources that form infrastructure: Nothing to Report
- technology transfer (include transfer of results to entities in government or industry, adoption of new practices, or instances where research has led to the initiation of a start-up company): Nothing to Report
- society beyond science and technology: Nothing to Report
- foreign countries: Nothing to Report

CHANGES/PROBLEMS

- Changes in approach and reasons for change: Nothing to Report
- Actual or anticipated problems or delays and actions or plans to resolve them: Nothing to Report
- Changes that had a significant impact on expenditures: Nothing to Report
- Significant changes in use or care of human subjects, vertebrate animals, biohazards and/or select agents: Nothing to Report
- Change of primary performance site location from that originally proposed: Nothing to Report

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