Board Game Design for Conservation Organization

A study on the Board Game for Campaign on Indonesian Javan Hawk-Eagle Conservation Foundation

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***Abstract*— A Javan hawk-eagle conservation organization, Yayasan Konservasi Elang Indonesia, is struggling with its marketing & publication activities. The organization then uses a board game to help their conservation works. There are educational and conservative purposes embedded in the game design to be a formal framework to overcome the challenge. Using a board game as a conservation tool engages the players and deepens their understanding of the topic, Javan hawk-eagle. The process we use to develop the framework includes mapping the learning objectives to the game component and actions, board game design steps, and implementation and production of the board game. We then compare the cognitive aspect of the educational goal in a pre-test and post-test of the learners.**

Keywords— Board game design, Educational board game, Game for conservation, Wildlife campaign;

I. INTRODUCTION

The International Union for Conservation Nature, abbreviated IUCN, shows a study that the Javan hawk-eagle population is endangered [1]. Yayasan Konservasi Elang Indonesia (YKEI) is a conservation organization located in Yogyakarta and Bogor, focusing on preserving raptor birds, especially Javan hawk-eagle [2]. Some of the conservation activities in YKEI are publications and campaigns to maintain the sustainability of the conservation programs. However, YKEI is struggling and needs help to execute the publication and marketing activities in general. Conservation is a small picture of wild nature that the young generation can learn and take benefits [3]. A campaign is one of the important activities in conservation as a publication and marketing strategy to educate people about the importance of animal conservation, and we can use games as the media [4][5]. In this paper, we are focusing on two purposes of the organization: educational and conservative purposes. The conservative purpose is specifically focused on the marketing and publication to deliver the message or knowledge from the organization to the public.

Undoubtedly, we can use games as the medium of education [6][7][8]. Furthermore, conservation organizations may benefit from using games as their tool to achieve the organization's purposes [9]. Hence the design and development of a board game for conservation organizations can enhance the success of YKEI's programs. First, we show a map of converting a learning objective to the game components or actions, we then follow the general board game design to make game prototypes, and finally, we test it and observe the player experience after playing the game through pre-test and post-test.

II. RELATED WORKS

Wana Warrior is an educational game used as a medium to convey the environmental campaign, especially animal saving, through gameplay and seamless learning [4]. The author claims that the game educates the people about animal biodiversity in Indonesia without even realizing it. Transferring the information, increasing awareness, and changing the people's behaviour towards nature are parts of the campaign in conservation. Delivering the message to the broad society can be achieved through campaigns with games as media. Several Non-Government Organizations (NGOs), including World Wildlife Fund (WWF) and Greenpeace, have done incredible works on natural or environmental saving campaigns using several strategies, including digital and board games. The same concept we can use to handle the problem in YKEI.

Educational entertainment or shortly edutainment facilitates the learners while enjoying the entertainment simultaneously, i.e., educational games [10]. Study shows that such activity can accelerate the learning process significantly. Games also teach us to improve our literacy skills [11]. In general, storytelling and communication in a game are two critical elements in keeping the player engaged with the game [10]. The challenge of getting people's attention in the presence of continuous information flow impacts the message delivered to the audience. In the end, interactivity in games may overcome this struggle [6].

In the conservation organization, the education and conservation purposes collide and impact each other. For example, the conservation purpose needs the organization to educate the young generation about the importance of saving and keeping the natural habitat of Javan hawk-eagle, while in the education aspect the young learners need a study case and getting the real example of the occurred problem so that they can understand the circumstances in a clearer view. Bloom taxonomy is one tool that the game designer used to deliver the educational message [12][13].

In this paper, we embed the conservation purpose by combining the educational and conservational goals or activities which is educating the learner on how to live in harmony with nature (keeping the environment healthy and utilizing it), Javan hawk-

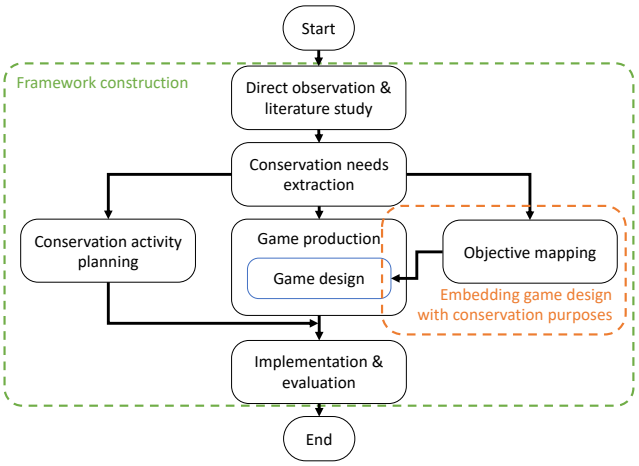

Fig. 1. The steps to construct the board game design framework.

eagle habitat preservation specifically. As stated by the ministry of education and culture of Indonesia, bloom's taxonomy used in Indonesia's education consists of three domains, e.g., cognitive, affective, and psychomotor domains [14]. The cognitive domain emphasizes intellectual development, and the affective domain emphasizes the development of affection, feeling, and emotion. Whereas the psychomotor is focused on the development of motoric activity and skill. It is achievable that the combination of education and conservation purposes is encapsulated as a conservation organization purpose.

The board game design is a series of activities or processes by the game designer to produce a board game. The experience delivered to the players through the designed gameplay is one of the most important aspects of board game design [15]. Therefore, there is a growing need to understand the knowledge of designing a board game to achieve and be used in a conservation organization. This paper shows the conceptual model of how the conservation organization's purpose is embedded and delivered through a board game.

III. METHODOLOGY

To construct a framework of board game design specified for a conservation organization, we follow the flow of steps as shown by Fig 1. The first step is direct observation and literature study to find out the actual problems the conservation organization has and the possible solutions. Extracting the needs of the conservation and using the information in the later steps is the second step. In the third step, we run the general board game production process as it consists of concept, design, prototyping & playtesting, and production. Simultaneously, the step to map the objective obtained from the previous step is performed as the fourth step, and it is part of the concept and design phases of the game production. The next step is discussing the plans of conservation, especially in terms of what kind of activity can be conducted to fulfill the conservation's goals. In the final step, we implement the framework into an actual board game, conducting a playtest and an evaluation.

In this paper, we are constructing a framework of a board game design that can be used in wildlife conservation organizations such as YKEI, but not limited to. Based on Fig. 1, there are three main processes we use to construct the framework, those are embedding the purpose to the game design, constructing the main framework as well as performing prototyping and playtesting, and producing and implementing into an actual game together with the evaluation.

A. Embedding the board game design with conservative organization purposes

Adopting board game design and game design in general from [15] and [16], we then embed purposes consisting of both conservation and education purposes. There are three domains of learning objectives for education purposes: affection, cognitive, and psychomotor. There are five ability levels or categories in the affective domain, e.g., receiving, responding, valuing, organization, and characterization [17]. In the cognitive domain proposed by Bloom [18][19], there are six categories: remember, understand, apply, analyze, evaluate, and create. While initiate, manipulate, precision, articulation, and naturalization are the ability levels constructing the psychomotor domain [20]. Those three domains are then transferred to the developed board game, Eagle Dance, in certain components. While the conservative purpose we discuss in our method is focused on the purposes of publication and campaign referring to the YKEI's problem. Therefore, we highly recommend the board game designers who create a game for a conservation organization to directly observe the research objects if possible to create a fit mapping of the learning objectives to the game content (components). Refers to Table 1 to see the map of learning objective domains to the game contents. The action examples on the table are taken from our game that we discuss later on in section four.

Referring to [10][11][12][13][21] as our basis, we map the objectives to the game contents or actions. Note that the sample actions in Table 1 can be created either before or after the game design has been created. Moreover, the actions to be mapped by the objectives are flexible, depending on the game mechanics in general. In this paper, all of the sample actions are taken from our developed game's contents, meaning that our game has provided various actions that have fulfilled the learning objectives.

TABLE I. THE MAPPING OF LEARNING OBJECTIVES TO THE GAME CONTENTS

Learning Objective Domain	Level of Learning Objective	Examples of designed contents or actions in the game
Affective [10][21]	A1 – Receiving	• Using a resource component • Describing the action card • Following the game rules • Locating the owned token
	A2 – Responding	• Discussing the resource distribution • Answering to rival's challenge • Perform a dance action • Presenting an action
	A3 – Valuing	• Sharing the available resources • Explain the rules or actions • Joining other's altercation • Justifying the strategy to take
	A4 – Organizing	• Formulating the action to perform • Defending the occupied tile or resources • Preparing the strategies to win

Learning Objective Domain	Level of Learning Objective	Examples of designed contents or actions in the game
		• Arranging the action to perform
	A5 – Characterizing	• Influencing rival's actions • Practicing different strategies • Performing different tactics • Proposing collaboration with others
Cognitive [11][12][21]	C1 – Remembering	• Identifying the type of dance cards • Repeating the player action in a turn • Selecting a card from the drafted pool • Listing the eagle dance cards
	C2 – Understanding	• Classifying the card decks and resources • Interpreting the card's symbol to an action • Translating a symbol to be an instruction • Rewriting the dance on the dance stack
	C3 – Applying	• Executing the series of actions • Calculating the trajectory of soaring • Diagnosing the upcoming obstacle • Estimating the rival's action
	C4 – Analyzing	• Differentiating the use of each resource • Organize the owned resources • Comparing different strategies to do • Examining rival's actions
	C5 – Evaluating	• Predicting the rival's action • Rating the importance of rival's action • Judging each rival's strategy • Checking the winning opening
	C6 – Creating	• Planning the long-term strategies • Developing the resources • Managing the use of resources • Constructing a winning factor
Psychomotor [13][21]	P1 – Perception	• Observing with the game components • Moving game components • Feel the different shapes of components • Sensing where the components should be placed according to the setup rule
	P2 – Set	• Knowing to set up the game • Positioning the hands to take resources • Desire to take resources with arranged cards • Understanding the player turn actions
	P3 – Guided response	• Performing the actions as illustrated in the rulebook • Discovering the different types of actions • Deciding actions to take to get the objectives • Arranging the dance actions to try different patterns
	P4 – Mechanism	• Performing all the dance actions successfully • Collecting the right resources to win • Influencing the rival's strategy • Mastering the game rule
	P5 – Complex overt response	• Fluently performing actions from the dance patterns • Mastery in the fighting strategy • Performing different types of arrangements • Managing resources while aware of the dance pattern
	P6 – Adaptation	• Changing strategy in the middle of the game • Pivoting actions in the player turn • Rearrange the dance pattern
	P7 – Origination	• Construct new dance patterns • Performing all actions in the pattern with no miss-play
		• Do a diplomatic move to construct a possible way

B. Constructing the Framework, Prototyping, and Playtesting

Based on the previous step, we are proposing a framework for designing board games aiming to facilitate the conservation organization's purposes. The purposes are the union of conservation's publication and marketing strategy and the education activity in general. Using the proposed framework, we managed to create a game titled "Eagle Dance" to be used by YKEI as a tool to overcome the emergent problem.

The prototyping and playtesting are performed as common board game prototyping and playtesting iterative phases. One of the main objectives of the prototyping and the playtesting process is to validate that the conservation organization purposes are successfully mapped to the game contents designed by the game designer (refer to Table 1). The map of the learning objectives to the game content is designed together with the education and game design experts team in Semarang.

Hypothetically, the conservation organization's purpose is not significantly limit the type of game mechanisms are used in the game design. However, choosing the right game mechanics applied to the game design may lead to better experiences for the players, for both the learning and gaming experience.

C. Producing Board Game as A Medium for Conservation

Finally, the board game to produce can be used as a medium for a conservation organization's marketing tools, counselling media, and even merchandise. As a note, the board game design should facilitate the audience by providing information related to the topic, such as the habitat, life cycle, and threat factors of the Javan hawk-eagle. Such contents can be shown as a mini-encyclopedia in digital or non-digital mediums. Fig. 2 shows the proposed framework of board game design for a conservation organization, specifically wildlife conservation.

IV. RESULTS

To confirm the proposed framework, we have created a board game titled "Eagle Dance". Previously, we have created more than four major prototypes through tens of iterations of reshaping (prototyping and playtesting) the game to fit the needs. We use the programming, card drafting, and dice mechanisms because such mechanisms facilitate the learning objectives very well. The game's narration is that the players will play as an eagle living in their habitat and try to survive and adapt to the harsh conditions by doing some flight patterns. The actions are as follows:

1. A player rolls the dice as a randomizer to determine the produced resources (thermal & food token) on the area tiles.
2. Each player chooses one dance action card and arranges it to be his/her dance pattern.
3. Finally, each player performs their dance pattern consecutively and resolves to get the victory point or

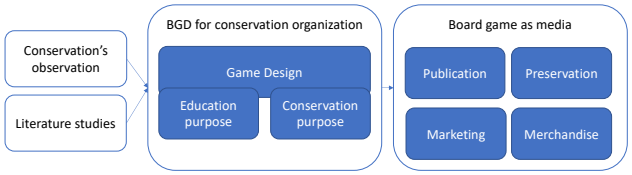

Fig. 3. The framework of board game design for conservation organizations.

penalty to develop their chance of success to win the game.

Fig. 3. shows a case of an eagle occupying the tiles and absorbing two thermals from the tile that can be used for further action, such as diving to hunt the prey. The study case teaches the players how an eagle relies on thermal (warm air) to perform the maneuver in real nature. On the affective domain (but not limited to), such action may occur at more than one level. For instance, a player defends the resources by taking them (A4 - Organizing), but it may also appear as a strategy to disrupt the rival's further actions (A5 - Characterizing).

The campaign is one of the conservation activities in YKEI that needs attention to preserve the organization's sustainability. The organization has done conservation education. The first example is class-based learning, where the teachers of schools explain the important aspect of the Javan hawk-eagle and its habitat using a learning module or material. Moreover, an exhibition where the visitors learn the topic from the prepared medium such as leaflet and poster. Third, observation booth when the observers or common audiences are invited to observe birds' migration through field-direct observation. As stated by the director of YKEI, the game will be used as a medium for all conservation education types (refer to Fig. 4). The game will enhance the use of the medium to reignite the will and curiosity of the audiences who have or have not yet attended YKEI's activities. Theoretically, the board game as a medium will enhance the player's experience to be immersed in the game and be persuaded to save Javan hawk-eagle habitat. After all, the board game may deepen the player's interaction and understanding of the game and given topic. However, the board game itself might be used in any kind of conservation education activity.

To provide players with rich and deep information about Javan hawk-eagle that is not mapped into a game action or

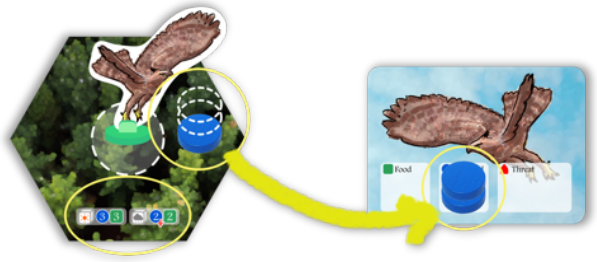

Fig. 4. An eagle absorbs two thermals from the occupied tile. The maximum number of thermals in the tile and that the eagle can occupy is two or more, as stated by the tile rule on the current round. Hence, the absorbed thermals are safely put on the eagle card.

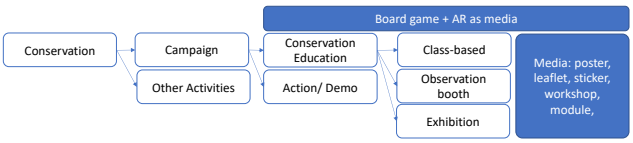

Fig. 2. The usage of medium, including board game, in YKEI.

component, we create a digital encyclopedia containing factual information, and a mini-quiz of Javan hawk-eagle sourced from YKEI using an augmented reality (AR) technology. The AR accommodates the learners to dig the knowledge deeper by providing various knowledge related to the conservation of Javan hawk-eagle. While the players enjoy the gameplay, they can scan the game components, e.g., cards, board, or rulebook, to get broader information.

For further validation, we have asked five experts from the academic and the game design domains to validate whether the learning objectives are implemented in our game "Eagle Dance", based on Table 1. According to Table 1, the learning objectives A1-A5, C1-C6, and P1-P7, all of the experts agreed with no objection stating that the designed actions or components in the board game "Eagle Dance" accommodates the learning objectives (see Table 2).

TABLE II. EXPERTS CONFIRMATION ON LEARNING OBJECTIVES HAVE BEEN MAPPED TO THE GAME CONTENTS

Learning objective	Experts' confirmation				
	1	2	3	4	5
A1 - Receiving	✓	✓	✓	✓	✓
A2 - Responding	✓	✓	✓	✓	✓
A3 - Valuing	✓	✓	✓	✓	✓
A4 - Organizing	✓	✓	✓	✓	✓
A5 - Characterizing	✓	✓	✓	✓	✓
C1 - Remembering	✓	✓	✓	✓	✓
C2 - Understanding	✓	✓	✓	✓	✓
C3 - Applying	✓	✓	✓	✓	✓
C4 - Analyzing	✓	✓	✓	✓	✓
C5 - Evaluating	✓	✓	✓	✓	✓
C6 - Creating	✓	✓	✓	✓	✓
P1 - Perception	✓	✓	✓	✓	✓
P2 - Set	✓	✓	✓	✓	✓
P3 - Guided response	✓	✓	✓	✓	✓
P4 - Mechanism	✓	✓	✓	✓	✓
P5 - Complex overt response	✓	✓	✓	✓	✓
P6 - Adaptation	✓	✓	✓	✓	✓
P7 - Origination	✓	✓	✓	✓	✓

Furthermore, we have conducted pre-test and post-test to observe the impact of our designed game on the knowledge (cognitive) as a learning outcome. We chose twenty students from Universitas Dian Nuswantoro as respondents, where none of them is majoring in the domain related to Javan hawk-eagle. The test respondents are given fifteen questions related to the basic information of the Javan hawk-eagle, including its physiology, habitat, life cycle, and flight pattern. We then compare correct answers as the result of both tests, as shown by

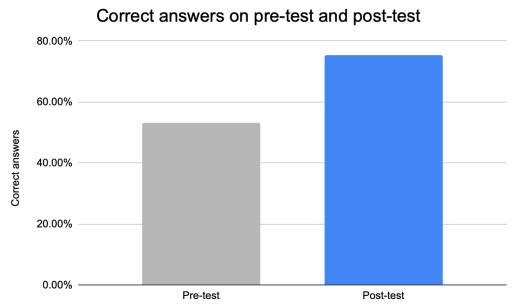

Fig. 5. The comparison of correct answers on the pre-test and post-test.

Fig. 5. In the pre-test, the lowest score is 33.3%, and the highest score is 80%, resulting in an average of 53.3% of correct answers. While in post-test, the average score is 75.5%, taken from the lowest score 53.3% and the highest score 93.3%. The difference between pre-test and post-test is 22.2%, concluding that our board game as a media helps the learners as an alternative to the regular textbook or similar media because of the game's interactivity aspect. Moreover, in the personal interviews, more than half of the participants wanted to know more about the Javan hawk-eagle and wanted to play the game at any other chance.

V. CONCLUSION

In this paper, we propose a formal approach to design a board game for conservation organizations, specifically YKEI, a Javan hawk-eagle conservation located in Indonesia. We combine the educational and conservative purposes as a guideline for the game designer. Designed action of a player may occur at several levels at an objective domain or more. Two or more different learning objectives might be mapped into a game action/ component, and two or more actions/ components might also be constructed from a single level of learning objective. We can use the game as a medium in conservation education activities because it has more interactivity than the other medium. Besides, the board game will also deepen the learners' understanding of the topic. This research shows a 22.2% improvement of the learner measured on the cognitive domain. The occurring player's action on several levels and domains of learning objectives concludes that the player's intention can be viewed more clearly from the player's perspective.

Although the proposed framework is used in eagle conservation in Indonesia, the framework is not limited for use in that organization and can be used for animal saving or even wildlife conservation organizations in general. Moreover, the mapping of learning objectives to certain game components or actions, as shown by Table 1, can also be implemented on any serious board game design with the designed contents that fit the related topic by the game designer.

However, our work has no escape from limitations. The current observation stated in this paper is only focused on the cognitive domain, the further observation on the affective and psychomotor domains is needed. Moreover, the measurement of effectiveness between the medium used in the conservation is needed, e.g., informative poster, flyer, comic, animation, and game. The current framework is designed specifically for a topic of conservation, that is, animal or environmental saving, which relies on the learning activities by the audience. Although it is not limited to that topic, broader domains of topics need further research. We also suggest that the game designer should also do direct observation to get the real experience of the topic on the field.

REFERENCES

[1] Birdlife International, "Nisaetus bartelsi (amended version of 2016 assessment)," 2017. doi: 10.2305/IUCN.UK.2017.

[2] H. Gunawan, D. Yoza, and others, "Studi Perkembangan Perilaku Elang Jawa (Spizaetus bartelsi Stresemann 1924) di Pusat Rehabilitasi Suaka Elang, Bogor." 2016. Accessed: Dec. 02, 2021. [Online]. Available: https://repository.unri.ac.id/xmlui/handle/123456789/7788

[3] C. Romero, "Wildlife rescue as a framework for learning," *Computers in Entertainment (CIE)*, vol. 1, no. 1, pp. 1–7, 2003.

[4] A. R. Putra, E. Widyarto, and A. D. Widiantoro, "Wana Warrior Game As Animal Rescue Campaign Media," *SISFORMA*, vol. 4, no. 1, pp. 1–6, 2017.

[5] S. Wulandari and others, "Safari rangers board game as a campaign media for endangered animal conservation," in *2016 1st International Conference on Game, Game Art, and Gamification (ICGGAG)*, 2016, pp. 1–6.

[6] A. B. Harisa, H. Haryanto, and H. A. Santoso, "Model Tingkat Kesulitan Dinamis Berbasis Logika Fuzzy Pada Game Wayang Ramayana," in *SEMNASTEKNOMEDIA ONLINE*, 2016, vol. 4, no. 1, pp. 2–6.

[7] A. Setiawan, F. Agiwahyuanto, and P. Arsiwi, "A Virtual Reality Teaching Simulation for Exercise During Pregnancy.," *International Journal of Emerging Technologies in Learning*, vol. 14, no. 1, 2019.

[8] H. Haryanto, U. Rosyidah, and A. Kardianawati, "Immersive Activities in Educational Role-Playing Game Based on Appreciative Learning and Artificial Intelligence," in *2019 Fourth International Conference on Informatics and Computing (ICIC)*, 2019, pp. 1–6.

[9] L. Gamberini *et al.*, "Saving is fun: designing a persuasive game for power conservation," in *Proceedings of the 8th international conference on advances in computer entertainment technology*, 2011, pp. 1–7.

[10] P. Alinikula, J.-L. Latikka, and J. Paanajarvi, "Gaming for Good Changing the Game for Corporate Sustainability.," 2014.

[11] J. P. Gee, "What video games have to teach us about learning and literacy," *Computers in Entertainment (CIE)*, vol. 1, no. 1, p. 20, 2003.

[12] P. Haring, H. Warmelink, M. Valente, and C. Roth, "Using the revised Bloom Taxonomy to analyze psychotherapeutic games," *International Journal of Computer Games Technology*, vol. 2018, 2018.

[13] N. Pancaningrum, "Strategi pembelajaran: Taksonomi bloom dalam games simulation method di tingkat raudhatul athfal," *ThufuLA: Jurnal Inovasi Pendidikan Guru Raudhatul Athfal*, vol. 4, no. 1, pp. 112–129, 2017.

[14] F. Nugroho, E. M. Yuniarno, and M. Hariadi, "Game based learning as an alternative during the Covid-19 epidemic based on K-13 for Indonesia elementary schools," 2020.

[15] K. Salen and E. Zimmerman, "Rules of play-game design fundamentals.{MIT} Press." Cambridge, 2003.

[16] M. Selinker, J. Ernest, R. Garfield, and S. Jackson, *The Kobold guide to board game design*. Open Design, 2011.

[17] E. Pierre and J. Oughton, "The Affective Domain: Undiscovered Country.," *College Quarterly*, vol. 10, no. 4, pp. 1–7, 2007.

[18] L. W. Anderson *et al.*, "A taxonomy for learning, teaching, and assessing: A revision of Bloom's taxonomy of educational objectives, abridged edition," *White Plains, NY: Longman*, vol. 5, no. 1, 2001.

[19] P. Armstrong, "Bloom's Taxonomy. Vanderbilt University Center for Teaching." 2017.

[20] M. E. Hoque, "Three domains of learning: Cognitive, affective and psychomotor," *The Journal of EFL Education and Research*, vol. 2, no. 2, pp. 45–52, 2016.

[21] S. Kurt, "Using Bloom's taxonomy to write effective learning objectives: The ABCD approach," *Educational Technology*, 2019.