INSTRUCTIONAL DESIGN BASED ON CONSTRUCTIONISM FOR ENHANCING HIGHER-ORDER THINKING SKILLS OF LEARNERS IN AN ONLINE LEARNING CONTEXT

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ABSTRACT

Teachers use instructional design to solve problems and creatively develop and implement various concepts, theories, and techniques to design and manage the elements of teaching and learning and assess learning outcomes that are generally accepted according to Bloom's taxonomy, in which the cognitive domains of lower-order thinking connect to higher-order thinking. Teachers apply various learning theories that are appropriate for efficient and effective learning management. Constructionism can be used as a guideline to enhance a learning process that develops thinking and responds to the interests and needs of individual learners. This article proposes a synthesis of the elements of constructionism as a guideline to design instruction that emphasizes the enhancement of the higher-order thinking skills of learners, supports a more varied instructional design for teachers, and integrates technology-based learning, especially in an online learning context. It also proposes some applicable models and processes as practical guidelines for instructional design to support learners' learning environments and develop core competencies and skills for the 21st century and beyond.

Keywords: *Constructionism, instructional design, higher-order thinking skills, online learning*

INTRODUCTION

For several decades, technology has influenced society and culture to accelerate rapid changes. Today's society is knowledge-based, diverse, and complex, with a large learning ecosystem, many sources, and multiple platforms accessible by learners at any time (Wongyai & Patphol, 2020). In the meantime, knowledge and thinking are produced, demolished, recreated, transited, sent and received, and passed on conveniently and rapidly from one person to another in this environment. Learners are capable of using technologies to make their own choices to receive and learn in a different and diversified way according to their aptitudes and interests through new models of learning methods in response to the nature and needs of individual learners (i.e., personalized learning) (Azukas, 2019; Clark, 2017; Herath & Jayarathne, 2018).

Learning in modern times is now about developing the competencies of continuous self-learning and becoming lifelong learners that can adjust and be flexible to respond to the modern world learners are living in. Therefore, the world requires people with learning competencies who possess discretionary thinking and decision-making, can analyze data, create and innovate, and harness the power of digital technologies to support continued learning to develop their lives and confront crises (Johnson & Davies, 2014; Ossiannilsson, 2017; Shishigu et al., 2019).

Each level of the education system prioritizes the development of learners' competencies by promoting quality education and learning in response to challenges and changing contexts. Teachers are required to have knowledge and skills in current pedagogy and technologies. They should also have competencies in innovative learning design and management and need to promote new models of learning to use modern technological instruction media to help learners achieve crucial skills for the 21st century (Ehlers & Kellermann, 2019) such as systematic thinking, self-learning, collaborative learning, creativity and innovation, interaction and creative communication, and media and digital literacy (Bakhshi et al., 2017; Grand-Clement, 2017). These skills are generated by promoting and developing higher-order thinking skills in learners.

Current teaching and learning models have changed in different ways, depending on the social situation, learning problems, or restrictions on education management in each area. Online learning is a new context that grew in response to the teaching and learning management crisis during the COVID-19 pandemic. This event motivated, in a serious manner, many parties in education management to be alert and aware of learner-centered teaching and learning approaches (Rapanta et al., 2020).

Teachers must establish clear and specific rules for problem-solving. The pandemic provided an opportunity for teachers at various educational levels to learn a body of interdisciplinary knowledge about redesigning, utilizing, and integrating technology, collaborating, developing innovative instructional materials, and publicizing this to share professional knowledge widely (Crowley & Overton, 2021; Theodosiou & Corbin, 2020).

Instructional design is an important process that teachers use to solve problems and creatively develop and implement through systematically analyzing situations or conditions of learning and various concepts, theories, and techniques to design and manage important components of teaching and learning management as a guideline for managing teaching and learning and for evaluating the learning outcomes of learners (Kunarak, 2019). These guidelines lead to desirable learning outcomes as generally accepted according to Bloom's taxonomy, in which the cognitive domains of lower-order thinking, i.e., remember, understand, and apply, relate to higher-order thinking, i.e., analyze, evaluate, and create (Krathwohl, 2002).

Bloom's learning objectives focus on reviewing and improving outcomes within a framework, especially in an online learning context in which technology is needed for a virtual classroom and instrumental to learning and creativity (Songkram et al., 2021). These are considered key elements in designing teaching and learning outcomes that are consistent in the online context. Teachers apply different learning theories that are consistent and suitable with a learning management guideline that leads to efficient and effective learning management. Constructionism is one of many theories that form the basis of learning development and are applied to instructional design (Girvan & Savage, 2019).

Constructionism is a paradigm and process for active teaching and learning management that focuses on promoting important skills for learners by learning from and with technology. Constructionism is currently successful in the field of education since it can be used as a guideline to enhance a learning process that develops thinking and responds to the interests and needs of individual learners. It also encourages learners to construct a body of knowledge and think in real terms to develop their creativity to its full capacity. This includes promoting participatory learning that leads to meaningful and valuable learning that is beneficial to themselves and society (Griffin, 2018; Kafai, 2012; Papavlasopoulou et al., 2019).

This article proposes a synthesis of the elements of constructionism as a guideline to design instruction that emphasizes the enhancement of the higher-order thinking skills of learners, supports a more varied instructional design for teachers, and integrates technology-based learning, especially in an online learning context. Also, some applicable models and processes as practical guidelines for instructional design are proposed to support learners' learning environments and processes according to actual situations in a learning community.

INSTRUCTIONAL DESIGN

Instructional design has evolved over a long time. It started with making a systematic school implementation plan in the early 19th century and grew to include a formal instructional design process in the early 20th century (Gibbons et al., 2014). It emphasized means and system methods,

i.e., input, processes, and output that could be controlled, checked, and evaluated from the feedback of its implementation to reach set goals. The models of instructional design were customized according to the levels of teaching and learning management and depending on the goals of development.

The development goals vary according to the philosophy of education during certain periods. Therefore, instructional design was significant for inventing, designing, and creating methods, including new tools. According to the study of theories related to teaching and learning, a model obtained from the development is a draft plan to be used to design and manage efficiently teaching and learning. The system can be checked and developed; this is considered a type of innovation. In this regard, instructional design is a design thinking process, and Galyen et al. (2020) proposed six principles as follows: (1) considering decision-making when using learning innovation; (2) using the design thinking process; (3) gaining an empathic understanding to find out and determine a problem and target it by considering learners' needs; (4) having visionary implementation plans and an explicit framework in designing lessons; (5) reviewing concepts and checking accuracy and development; and (6) engaging in continuous learning.

Instructional design is a concept for managing processes, procedures, and models when planning or determining important components and setting up systems. The relationship of elements is prioritized as (1) goals, (2) content, (3) purposes/objectives, (4) learning activities, (5) methods, strategies, techniques, (6) instructional media/sources of learning, (7) application, (8) evaluation, and (9) improvement or development of a guideline for implementing teaching and learning management to achieve efficiency and effectiveness according to learning outcomes in terms of knowledge, skills, and adhered values determined to be the goals for education management (Joyce et al., 2015; Wiboolyasarin, 2018).

Learning management design relies on learning unit design according to components by determining goals, developing teaching and learning activities, and choosing evaluation criteria. The teacher is expected to focus on the learning outcomes empirically and determine a guideline to reach those outcomes. In that situation, the idea of backward design can be considered. There are three procedures, namely: (1) specify desirable outcomes; (2) check, consider, and determine evidence for learning outcome evaluation; and (3) make a plan for learning experience management and methods of teaching and learning (Wiggins & Mc Tighe, 2011).

In cases where instructional media and teaching and learning innovations are directly developed, the ASSURE model can be employed. It is structured in six major steps that include: (1) analyzing learners; (2) stating goals and objectives; (3) selecting instructional methods, media, and technology; (4) utilizing media and technology; (5) requiring learner participation; and (6) evaluating and revising the blended learning strategy (Smaldino et al., 2019). The ADDIE model can also be used since it will respond to the implementation as it is an instructional system design framework. There are five stages of a development process: (1) analysis; (2) design; (3) development; (4) implementation; and (5) evaluation (Gibbons et al., 2014). I synthesized and adjusted instructional design procedures for this article according to the backward design, the ASSURE model, and the ADDIE model. I present this model in the final part of this article.

Constructionism Theory

Constructionism is a learning theory developed by professor Seymour Papert of the Massachusetts Institute of Technology during the 1960s and 1980s. Later, it became the basis for changes in teaching, learning management, and educational technology (Noss & Clayson, 2015). Born from an idea used to test theories in various research studies, constructionism shows the integrated relationship, connection, and development in both dimensions of psychology and sociology that focuses on using learning activities to encourage learners to interpret evidence, construct knowledge, and perform individual learning outcomes (Kafai & Resnick, 2011).

Advanced technologies have been used to support learning activities while serving various objectives. The principle is making a conceptual model that tangibly reflects what learners learn, how they learn, or what methods of learning they learn from, and then check if what they learn is correct or not based on creative and re-creative approaches. This is a cycle of development made in the cognitive process in learners surrounded by a sociocultural atmosphere that affects learning (Parmaxi & Zaphiris, 2014).

Consequently, the outstanding feature of constructionism is giving importance to a complex conceptual framework, explaining and checking thinking to consider the knowledge learned. From the perspective that any concept, paradigm, or bit of knowledge can be shown practically, learners can develop a category of presentation, interaction, connection, and connectivity of those thoughts, paradigms, or bits of knowledge that can be developed further into higher-order thinking skills. Therefore, teachers need to consider what knowledge should be taught and what skills both teachers and learners possess, as well as the abilities learners should have in modern learning communities that have been established with new learning goals, tools, and revision and evaluation (Holbert et al., 2020).

The experimentalism of thought served as the foundation for constructionism. Its primary traits are as follows:

(1) Using technologies to facilitate knowledge creation, i.e., surveying and solving problems of experiments by oneself and connecting new knowledge to existing and previous experiences (according to the steps of inquiry, collection, analysis, conclusion, knowledge creation, and knowledge storage).

(2) Using technologies for creative design, in which existing knowledge is brought to create new things. Computer technology shall be a tool that helps develop learning and create new things that challenge learners to explore and apply the knowledge they have obtained from learning.

(3) Using technologies such as media to present outcomes and communicate knowledge and ideas arising from the learning process. It is the principle of expressing intangible things tangibly and using tangible things to get a deep understanding of intangible things.

(4) Using technologies for learning and working cooperatively through computer programs, social media sites, and other platforms with the idea of creating knowledge in which environment and culture play an important role in establishing interactions in the process of social learning (i.e., social constructionism). This promotes learners using their metacognition to direct themselves, take responsibility for their work, and learn in groups and includes measuring and evaluating thoughts and outcomes from practice as well as thinking about and practicing systematic

management for learning improvement (Nam & Osman, 2017; Noss & Clayson, 2015; Papert, 1993; Vanichwatanavorachai, 2019).

The important elements in constructionism that should be taken into consideration are (1) construction, (2) task of artifacts, (3) technology, (4) interactive and collaborative learning, (5) individual creation, and (6) empowerment to determine and set an instructional system. The principles of the theory can be synthesized as follows: (1) organizing multiple experimental learning environments; (2) learning through design and creativity; (3) learning about systems such as computers and technology, thinking, and working and social; (4) learning in communities; and (5) ICT literacy (Griffin, 2018; Kafai, 2012; Papavlasopoulou et al., 2019; Rojprasert et al., 2020).

The teaching and learning model is the same as constructivism and integrates learning to be more powerful, e.g., through problem-based learning, project-based learning, research-based learning management, etc. Each of these emphasizes the process of problem-solving based on learners' interests or their awareness and how they manage information and restate knowledge. From this arises a discussion that leads to analysis, synthesis, and the correct application of the scientific method in case problems have to be solved from a situation or from phenomenon-based learning or design-based learning management that piques their interests.

HIGHER-ORDER THINKING SKILLS ENHANCEMENTS

Developing higher-order thinking is a goal for learners. According to Bloom's Taxonomy, it is thinking developed from lower-order thinking that adheres to a conceptual framework with six levels in the form of a pyramid. Anderson & Krathwohl (2001) reviewed and proposed two new dimensions, i.e., a knowledge dimension that includes (1) factual knowledge, (2) conceptual knowledge, (3) procedural knowledge, and (4) metacognitive knowledge, and a cognitive process dimension that is comprised of (1) remember, (2) understand, (3) apply, (4) analyze, (5) evaluate, and (6) create. These dimensions need to be consistent and associated with the educational trilogy comprising educational objectives, learning experiences, and evaluation. In this article, the three higher-order thinking skills that are on top of the

pyramid of learning are as follows (Brookhart, 2010; Krathwohl, 2002):

1) Analytical thinking is the ability to identify and determine the relationships in a structure. This process of thinking requires the ability to differentiate, organize, and attribute.

2) Critical thinking is the ability to consider and judge value based on standard principles and criteria. This process of thinking requires the ability to check and critique.

3) Creative thinking is the ability to make new things while knowing that what already exists can produce something in a new structure. The process of thinking requires generating, planning, and producing.

Higher-order thinking is cited as one of the 21st Century skills and refers to the ability to solve problems. This is thinking that is developed from recognizing the facts and details of information and knowledge as the base of understanding to which the complex thinking process can be applied. It starts with analytical thinking, which is a system of relationships for problem-solving, then critical thinking, which is to determine goals and processes that lead to problem-solving, gather hypotheses used in problem-solving, consider thoughtfully, and creatively make decisions for solving problems, and finally creative thinking, which is creating new things and processes. Creative thinking is flexible and diversified, and it is the initial thinking for solving problems in a better way. (Bellanca et al., 2019)

Higher-order thinking skills are an umbrella of skills and competencies in the digital society that supports learning development. Enhancing and developing higher-order thinking skills starts with modifying both teaching methods and learning processes to use intervention strategies to promote deep learning. Learners possess skills that lead to competencies according to their educational levels. Learning management design should give importance to (1) learning motivation, (2) teaching and learning strategies, (3) learning interaction, (4) learning activities and learning tasks that give rise to various skills, (5) time for reflection and revision, and (6) skills assessment.

There are criteria for considering abilities to be skill components and authentic assessments in terms of processes and performance that use a participatory assessment. These emphasize evaluating the thinking process, practices, presentation of knowing, and knowledge processed through task creation or further independent study. This is done in conjunction with learning assessment and feedback from teachers and peers, including reporting progress from learners' self-assessments (Darling-Aduana, 2021; Lu et al., 2021; Mahoney & Harris-Reeves, 2019; Saifer, 2018).

Teachers play a vital role in promoting the learning environment by using strategies to integrate content and sources of learning, especially entertainment media, into instructional media and related content to fill the gap between the curriculum and learners' real lives. The use of teaching methods and learning strategies such as high-level questions, the flipped classroom, STEM education, problem-based or research-based learning, situation-based learning, educational games, micro-learning, etc., are utilized to practice creative intelligence by integrating knowledge and self-learning, blending professional learning and practice, and practicing in diverse situations all of which increase the capability to use technologies for modern education (Alawi & Soh, 2019; Brennan, 2015; Dagiene & Futscheck, 2019; Daniela & Lytras, 2018; Montiraj et al., 2018).

Constructionism can be applied to enhance higher-order thinking skills because it contains a significant characteristic, i.e., a new way of thinking and learning. In addition to possessing design thinking and the design process mentioned above, important principles and components of the theory must be considered.

ONLINE LEARNING

Since 2005, online learning has been widely used as both fully online and blended learning, including using technologies to promote a learning environment for web-based learning. Online learning is a learning experience managed in a learning environment over the internet through communication devices such as mobile phones, laptop computers, tablets, etc. This learning model allows learners to learn by themselves. Embraced by larger digital platforms, learners can interact with content, teachers, and other learners while acquiring learning processes for inquiring about knowledge, creating new meanings, and developing complex thinking processes from their learning experiences (Dhawan, 2020; Gregor, 2020; Keengwe & Kidd,

2010; Means et al., 2014; Singh & Thurman, 2019).

Online teaching and learning management are divided into synchronous learning, in which learners learn from a distance by virtually attending a class session at the same time as their instructors and classmates, much like a live lecture, and teleconferencing through different video conference services such as Webex, Zoom, Google Meet, etc., and asynchronous learning, which is a form of education, instruction, and learning that does not occur in the same place and allows learners to learn on their schedule, within a certain timeframe, using a web board, web block, audio lessons, content modules, etc. (Mayanondha, 2019; Tolga, 2021; Wang & Wang, 2021).

Instructional design focusing on synchronous learning maintains real-time interaction since a regular classroom is adapted to a virtual classroom through an e-classroom system, which requires (1) teleconferencing, (2) learning accessibility, (3) preparedness of equipment by teachers and learners to facilitate different platforms, (4) a teaching and learning log, and (5) feedback. Asynchronous learning can be employed to support learners' self-learning by reinforcing their knowledge and understanding before attending synchronous learning and by providing a guideline for self-practice that has a flexible timeframe that learners can manage. According to many studies, a combination of synchronous and asynchronous learning should be employed since both affect the quality and efficiency of teaching and learning management and have benefits and restrictions that should be thoroughly considered (Adedoyin & Soykan, 2020; Leichty, 2021; Palvia et al., 2018; Phelps & Vlachopoulos, 2020; Tilotta, 2020).

Various elements need to be planned and determined for instructional design. Carrillo & Flores (2020) proposed considering three significant components, i.e., pedagogical approach, learning design, and facilitation in learning. Learning activities should be designed to be flexible, promote personalized learning, be associated with contexts, and be involved with formative assessment. Technologies and instruments need to be appropriately considered and selected, with an emphasis on social skill development, learners' attitudes, and promoting a learning environment based on the teaching abilities (teaching presence) of teachers who are committed to the development.

Cognitive presence is developed from action and emphasizes a learning process that helps learners transfer knowledge, skills, and attitudes using higher-order thinking skills in active learning activities by asking in-depth questions, criticizing evidence, and presenting thinking and knowledge in the form of task artifacts. Learners learn collaboratively in online learning communities based on a co-construct strategy, a narrative approach, an online reflection forum, in-depth discussion, higher-order questions, peer feedback, etc.

Social presence is developed through participatory learning in online learning communities. Skills, instruments, technologies, and communication are prepared to create learning interactions in a positive learning environment. Relationships and trust in each other are promoted by learning and working collaboratively, using a group member strategy based on what they are interested in, having subgroup discussions, creating tasks, and periodically sharing content, knowledge, concepts, experiences, or feedback through different communication channels in different forms.

Most learning activities are based on content processing that is transferred through electronic media, including taking advantage of computer-based learning platforms, submission of learning methods, and various media and sources of learning; therefore, learners have to learn increasingly by themselves. In this regard, teachers should consider and give importance to the addition of metacognition strategies to reflect the thinking and learning outcomes and use collaboration strategies to create interaction with others in a small virtual learning community (Camach & Legare, 2021; Kerr, 2016; Lewis, 2021).

DISCUSSION

To support constructionist learning processes and improve learners' higher-order thinking abilities, I propose an instructional design in this article by synthesizing the ideas, practices, and procedures for each of the previously mentioned issues, including design and environmental management, as shown in Figure 1.

Source: Synthesis of concepts according to the issues proposed in this article.

The advantage of the instructional design model is that it is a systematic approach to technology integration. Teachers can design an environment

Figure 1. Instructional Design Model for Enhancing Higher-Order Thinking Skills of Learners in an Online Learning Context According to Constructionism.
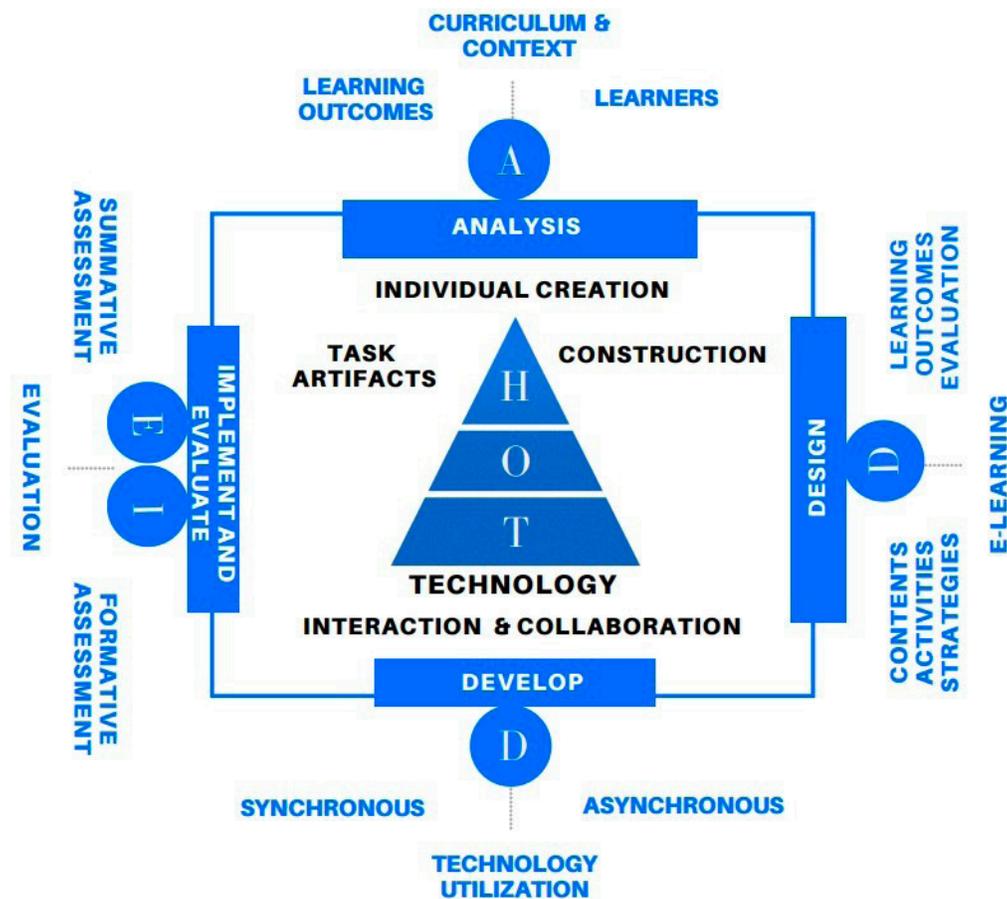
to promote online learning, deploy information and communication technologies for e-learning, and adapt active learning management techniques by considering integration with the platforms and various characteristics of the learners.

The model not only promotes the development of thinking skills, practical skills, and social skills in an integrated learning management approach, but it also provides teachers the opportunity to select a variety of assessment tools. The assessment focuses on processes, practice, and knowledge presentation by using educational technology in a supportive way, including providing feedback, giving learning suggestions from teachers or peers, and reporting the progress of the student's self-assessment.

Moreover, this model also supports the integration of ICT competence with the development of cognitive processes. Learners who have enhanced their higher-order thinking skills will be able to develop other competencies that can be adapted to

effectively integrate future learning for learners in the digital age.

CONCLUSION

Constructionism seeks to manage a new concept of learning. Teachers have to create a modern classroom to move forward with constructionist learning, in which technologies give an opportunity and facilitate collaboration in learning. Teachers also need to create a learning community by blending diversity and different points of view that are useful and valuable, which can lead to learning and the creation of new meaning for students and society.

The outstanding feature of this theory is the need to design a learning environment by integrating technologies. Quality learning occurs with a positive learning environment and diverse learning design and requires a new vision from its inception. It is not just an idea to create something; it uses the "power of ideas" to create deep

learning value. Therefore, teachers must consider and explore how to connect creative thinking and learning, including instilling ideas, processes, and skills that enable learners to grow in a world that never stops moving. The modern classroom will be changed in the future, so it is important to encourage learners to create with their intelligence, and learning management should have the quality and literacy to produce a quality of life and a quality of society.

To achieve positive relationships among components in such an environment, including teaching and learning activities, requires teaching designs for creative problem-solving and development, since in each learning context, each learner perceives information and understands it according to what they perceive and how they apply it, which is known as lower-order thinking. Later, when learners inquire about diverse knowledge and use technology, a process of cooperative and collaborative learning between individuals and technologies occurs, along with conflicts. Thus, higher-order thinking is required to help learners adjust and transfer knowledge and experience to be able to think. Reasons can be given according to the learner's principles of decision-making, including reflecting on thinking assessments to determine the choice of problem-solving or other development, which brings about the power of thinking from social learning rooted in both real society and virtual society.

However, the concern is not about teaching methods and their quality but about revising the goals and vision of teaching and learning management to ensure learners follow the designated curriculum. In this regard, understanding the contexts and situations and being aware of the roles and duties in delivering learning to learners is important for developing a teaching and learning system in a better way. Teachers are required to use their skills to find a way of connecting systematic relationships, creating learning value, and developing synergy to promote learning in the world of modern education, in which teachers are both lifelong instructors and learners.

References

Adedoyin, O. B. & Soykan, E. (2020). Covid-19 pandemic and online learning: The challenges and opportunities. Interactive Learning Environments, 1–13. https://doi.org/10.1080/10494820.2020.1813180

Alawi, N. H., & Soh, T. M. T. (2019). The effects of project-based learning (PjBL) on critical thinking skills from four students on dynamic ecosystem topic "vector! oh! vector!" Creative Education, 10(12), 3107–3117. https://doi.org/10.4236/ce.2019.1012235

Anderson, L. W., & Krathwohl, D. R. (2001). A taxonomy for learning, teaching and assessing: A revision of Bloom's Taxonomy of Educational Objectives: Complete edition. Longman.

Azukas, M. E. (2019). Cultivating a blended community of practice to promote personalized learning. Journal of Online Learning Research, 5(3), 275–310.

Bakhshi, H., Dowing, J. M., Osborn, M. A., & Schneider, P. (2017). The future of skills: Employment in 2030. Pearson and Nesta.

Bellanca, J. A., Fogarty, R. J., & Pete, B. M. (2019). How to Teach Thinking Skills: Seven key student proficiencies for college and career readiness. Solution Tree.

Brennan, K. (2015). Beyond technocentrism: Supporting constructionism in the classroom, Constructivist Foundations, 10(3), 289–296.

Brookhart, S. M. (2010). How to assess higher order thinking skills in your classroom. ASCD.

Camacho, D., & Legare, J. M. (2021). Pivoting to online learning: The future of learning and work. The Journal of Competency-Based Education, 6(1), 1–8. https://doi.org/10.1002/cbe2.1239

Carrillo, C., & Flores, M. A. (2020). COVID-19 and teacher education: A literature review of online teaching and learning practices. European Journal of Teacher Education, 43(4), 466–487. https://doi.org/10.1080/02619768.2020.1821184

Clark, J. P. (2017). Engagement's personalized mediation of relationship between personalized and achievement learning [Doctoral Dissertation, Western Kentucky University]. WKU TopSCHOLAR. https://digitalcommons.wku.edu/diss/131/

Crowley, E., & Overton, L. (2021). Learning and skills at work survey 2021. Chartered Institute of Personal and Development. https://www.cipd.co.uk/Images/learning-skills-work-report-2021-1_tcm18-95433.pdf

Dagiene, V., & Futscheck, G. (2019). On the way to constructionist learning of computational thinking in regular school setting. Constructivist Foundations, 14(3), 231–233.

Daniela, L., & Lytras, M. (2018). Learning strategies and constructionism in modern education setting. Latvia University.

Darling-Aduana, J. D. (2021). Development and validation of measure of authentic online work. Educational Technology Research and Development, 69, 1729–1752. https://doi.org/10.1007/s11423-021-10007-6

Dhawan, S. (2020). Online learning: A panacea in the time of COVID-19 crisis. Journal of Educational Technology Systems, 49(1), 5–22. https://doi.org/10.1177/0047239520934018

Ehlers, U. D., & Kellermann, S. A. (2019). Future skills: The future of learning and higher education. Results of the International Future Skills Delphi Survey. Beden Wurttemberg-Cooperative State University.

Galyen, K., Davis, L. C., & Culbertson, M. H. (2020). Fundamentals of exceptional instructional design: Essentials of mindset and approach. In W. Kilgore & D. Weaver (Eds.), Connecting the dots: Improving student outcomes and experiences with exceptional instructional design. Pressbooks.

Gibbons, A. S., Boling, E., & Smith, K. M. (2014). Instructional design model. In J. M. Spector, M. D. Merrill, J. Elen, & M. J. Bishop (Eds.), Handbook of research on educational communications and technology (pp. 607–615). Springer. https://doi.org/10.1007/978-1-4614-3185-5_48

Girvan, C., & Savage, T. (2019). Virtual worlds: A new environment for constructionism learning. Computers in Human Behavior, 99, 396–414. https://doi.org/10.1016/j.chb.2019.03.017

Grand-Clement, S. G., Devaux, A., Belanger, J., & Manville, C. (2017). Digital learning: Education and skills in the digital age. RAND Corporation. https://doi.org/10.7249/CF369

Gregor, K. (2020). What is student engagement in online learning . . . and how do I know when it is there? [Melbourne CSHE Discussion Paper]. Melbourne Centre for the Study of Higher Education. https://melbourne-cshe.unimelb.edu.au/__data/assets/pdf_file/0004/3362125/student-engagement-online-learning_final.pdf

Griffin, J. M. (2018). Constructionism and de-constructionism: Opposite yet. Complementary Pedagogies, 14(3), 234–251.

Herath, D., & Jayarathne, L. (2018). An architecture for a personalized learning recommendation on knowledge level of learner. Journal of Scientific and Engineering, 9(6), 98–103.

Holbert, N., Berland, M., & Kafai, Y. B. (2020). Designing constructionism future: The art, theory and practice of learning design. MIT Press.

Johnson, G. M., & Davies. (2014). Self-regulated learning in digital environments: Theory, research, praxis. British Journal of Research, 1(2), 1–14.

Joyce, B., Weil, M., & Calhoun, E. (2015). Models of teaching (9th ed.). Pearson.

Kafai, Y. B. (2012). Constructionism. In R. K. Sawyer (Ed.), The Cambridge handbook of the learning science (pp. 35–46).

Cambridge University.

Kafai, Y. B., & Resnick, M. (2011). Constructionism in practice: Designing, thinking and learning in a digital world. Routledge.

Keengwe, J., & Kidd, T. T. (2010). Toward best practices in online learning and teaching in higher education. MERLOT Journal of Online Learning and Teaching, 6(2), 533–541.

Kerr, P. (2016). Personalization of language learning through adaptive technology: Part of the Cambridge Papers in ELT series. Cambridge University Press.

Krathwohl, D. R. (2002). A revision of Bloom's Taxonomy: An overview. Theory into Practice, 41(4). 212–218. https://doi.org/10.1207/s15430421tip4104_2

Kunarak, K. (2019). Instructional design. Silpakorn University.

Leichty, R. (2021). Online learning for rural students. State Education Standard, 21(1), 12–17.

Lewis, R. S. (2021). Technology, media literacy, and human subject: A post human approach. Open Book Publisher. https://doi.org/10.11647/OBP.0253

Lu, K., Yang, H. H., Shi, Y., & Wang, X. (2021). Examining the key influencing factors on college students' higher order thinking skills in the smart classroom environment. International Journal of Educational Technology in Higher Education, 18(1), 1–13. https://doi.org/10.1186/s41239-020-00238-7

Mahoney, J. W., & Harris-Reeves, B. (2019). The effects of collaborative testing on higher order thinking: Do the bright get brighter? Active Learning in Higher Education, 20(1), 25–37. https://doi.org/10.1177/1469787417723243

Mayanondha, O. (2019). Developing an interactive web-based TOEIC tutors course to improve grammar proficiency [Doctoral dissertation, Thammasat University]. TU Digital Collections. https://digital.library.tu.ac.th/tu_dc/frontend/Info/item/dc:176296

Means, B., Bakia, M., & Murphy, R. (2014). Learning online: What research tell us about whether, when and how. Routledge.

Montiraj, K., Hongsiriwat, A., & Polsaram, P. (2018). Developing of training program using constructionism theory to develop critical, creative, productive and responsible mind (CCPR) of higher education students in communication arts in private higher education institutions. Dusit Thani College Journal, 12(2), 209–223. https://so01.tci-thaijo.org/index.php/journaldtc/article/view/126003

Nam, L. A., & Osman, K. (2017). Developing 21st century skills through a constructivist-constructionist learning environment. K–12 STEM Education, 3(2), 205–216. https://www.learntechlib.org/p/209542/.

Noss, R., & Clayson, J. (2015). Reconstructing constructionism. Constructivist Foundations, 10(3), 285–288.

Ossiannilsson, E. (2017). Blended learning. The state of nation [International Council for Open and Distance Education Report]. ICDE

Palvia, S., Aeron, P., Gupta, P., Mahapatra, D., Parida, R., Rosner, R., & Sindhi, S. (2018). Online education: Worldwide status, challenges, trends, and implications. Journal of Global Information Technology Management, 21(4), 233–241. https://doi.org/10.1080/1097198X.2018.1542262

Papavlasopoulou, S., Giannakos, M. N., & Jeccheri, L. (2019). Exploring children's learning experience in constructionism-based coding activities through design-based research. Computers in Human Behavior, 99, 415–427. https://doi.org/10.1016/j.chb.2019.01.008

Papert, S. (1993). The children machine: Rethinking school in the age of the computer. BasicBooks.

Parmaxi, A., & Zaphiris, P. (2014). The evolvement of constructionism: An overview of the literature. In Learning and collaboration technologies. Designing and developing novel learning experiences (pp. 452–461). Springer International Publishing. https://doi.org/10.1007/978-3-319-07482-5_43

Phelps, A., & Vlachopoulos, D. (2020). Successful transition to synchronous learning environment in distance education: A research on entry-level synchronous facilitator competencies. Education and Information Technologies, 25, 1511–1527. https://doi.org/10.1007/s10639-019-09989-x

Rapanta, C., Botturi, L., Goodyear, P., Guàrdia, L., & Koole, M. (2020). Online university teaching during and after the Covid-19 crisis: Refocusing teacher presence and learning activity. Postdigital Science and Education, 2, 923–945. https://doi.org/10.1007/s42438-020-00155-y

Rojprasert, S., Neanchaleay, J., Boonlue, S., & Sinlarat, P. (2020). Designing and implementing constructionist learning in a blended advertising photography course. International Journal of Technology Enhanced Learning, 12(1), 20–37. https://doi.org/10.1504/IJTEL.2020.103813

Saifer, S. (2018). HOT skills: Developing higher order thinking in young learner ages 4 to 8. Redleaf Press.

Shishigu, A., Michael, K., & Atnafu, M. (2019). Can blended learning enhance students' tendency to regulate their own learning? An experience from pedagogical experiments. In F. G. Giuseffi (Ed.), Self-directed learning strategies in adult educational contexts (pp. 44–70). Information Science Reference/IGI Global. https://doi.org/10.4018/978-1-5225-8018-8.ch003.

Singh, V., & Thurman, A. (2019). How many ways can we define online learning? A systematic literature review of defining of online learning (1988–2018). American Journal of Distance Education, 33(4), 289–306. https://doi.org/10.1080/08923647.2019.1663082

Smaldino, S. E., Loether, D. L., & Mims, C. (2019). Instructional technology and media for learning (12th ed.). Pearson.

Songkram, N., Songkram, N., Chootongchai, S., & Samanakupt, T. (2021). Developing student's learning and innovation skills using the virtual smart classroom. International Journal of Emerging Technology Learning, 16(4), 34–51. https://doi.org/10.3991/ijet.v16i04.15221

Theodosiou, N. A., & Corbin, J. D. (2020). Redesign your in-person course for online: Creating connections and promoting engagement for better learning. Ecology and Evolution, 10(22), 12561–12572. https://doi.org/10.1002/ece3.6844

Tilotta, T. R. (2020). COVID-19 online learning: Thriving and surviving. Research Issues in Contemporary Education, 5(3), 119–125.

Tolga, K. M. (2021). Perspectives of university students on the efficiency of synchronous and asynchronous learning. Journal of Education Leadership and Policy Studies, (special issue), 1–18.

Vanichwatanavorachai, S. (2019). General teaching methods. Silpakorn University.

Wang, J., & Wang, Y. (2021). Compare synchronous and asynchronous online instruction for science teacher preparation. Journal of Science Teacher Education, 32(3), 265–285. https://doi.org/10.1080/1046560X.2020.1817652

Wiboolyasarin, W. (2018). Methodology of Thai language learning management. Chulalongkorn University Press.

Wiggins, G., & McTighe, J. (2011). The understanding by design guide to creating high-quality units. ASCD.

Wongyai, W., & Patphol, M. (2020). From online learning to innovative creation. Srinakharinwirot University.