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Review Article

Responding to the COVID-19 Pandemic with the R2D2 Teaching Model: An Organising Aid for Online Higher Education Learners

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During the COVID-19 pandemic, many papers have focused on remote learning and how to promote effective learning. The current research emphasises the applications of the R2D2 teaching model for online learning in higher education. R2D2 represents read, reflect, display, and do. This paper investigates the implementation of the R2D2 teaching model in higher education. The model's characteristics, application in higher education, and use in diversity education are discussed. The detailed literature review of studies of the R2D2 teaching model shows that the approach has a positive impact on online teaching. Specifically, the R2D2 teaching model allows learners to interact with each other. The paper's limitations and recommendations are presented in the conclusion.

1. Introduction

Because of the rapid spread of COVID-19, governments have been compelled to close schools and impose at-home distance learning. Several initiatives are in the works to guarantee that study activities continue despite the lack of face-to-face instruction [1]. As a result, learning methods were supplied through remote learning halfway through the second semester of the 2019-2020 academic year [2]. Higher education institutions are currently confronted with a number of demands imposed by scientific and technical advancements [3]. Distance learning is an innovative and quickly developing strategy for undergraduate students, postgraduates, and health-care practitioners, and its emergence is attributable to developments in technology and social media. It may be the best way to maintain learning processes in extreme and emergency scenarios, such as the COVID-19 pandemic [4].

Due to technological advancements, all sectors, including education, have been evolving at an extraordinary pace during this increasingly globalised period. People throughout the world have a fundamental understanding of how to use technical equipment. Globalisation and the changing world of work, on the other hand, are pressuring educators and members of other sectors to modernise their systems [5].

The R2D2 technique (read, reflect, display, and do) is a novel approach to developing and delivering distance education, especially online learning. This paradigm is crucial for catering to the unique tastes of online learners from all generations and with varying levels of Internet experience. The first component alone can be used independently or as part of a problem-solving process [6].

The R2D2 framework, developed by Bonk and Zhang [6], arranges online learning activities into four phases and takes student needs and preferences into consideration. The model allows learners to express themselves in a variety of ways and through a variety of learning styles by addressing learner needs and preferences. Learner preferences and types are an important part of R2D2, and the approach's ability to address these concerns is one of its distinguishing features. There is a small but significant rise in the number of events between preintervention and postintervention. During the postintervention period, however, there is an obvious impression of a deeper and more intelligent comprehension of R2D2. The approach clearly provides an

increased awareness and deeper understanding of the R2D2 stages [7].

This framework offers multiple learning activities in the above-mentioned four categories to achieve knowledge acquisition, knowledge generation, knowledge display, knowledge application, and knowledge transfer, serving the needs and preferences of online learners. The R2D2 paradigm can also be used to plan and implement project-based or problem-based learning [8]. It can be implemented to select and integrate various emerging learning technologies and is designed to motivate online learning for a diverse range of learners [9].

1.1. Study Objectives. Learning settings have changed as a result of the introduction of information and communication technologies. In the 21st century, blended classrooms and online learning have become commonplace. As a result, new pedagogical approaches have emerged to help usher in a new era of learning and teaching. R2D2, as shown in some researches [5], has an effective impact in blended classrooms that are presented through distance education and online learning.

Furthermore, to stimulate outcomes-based education, the R2D2 model is used to construct online active learning activities. Some graduate faculty associate active learning with R2D2. This study investigates the R2D2 model in higher education online courses to encourage active learning engagement [10]. Thus, the research questions are as follows:

(1) What is the definition of the R2D2 teaching model?

(2) In what contexts could the R2D2 teaching model be used in higher education?

(3) What are the challenges facing the R2D2 teaching model for applications in higher education?

(4) What are the characteristics of the R2D2 teaching model?

(5) How does R2D2 promote online learning for diverse learners?

2. Materials and Methods

2.1. Searching. The researchers conducted a systematic literature search to find articles that address topics related to R2D2 and higher education and that were published before October 18, 2021. The following databases were used to conduct the searches: Google Scholar, Eric, Oxford University Press, EBSCO, askZad, Web of Science, Social Sciences Citation Index, ProQuest, Scopus, PubMed, and Cochrane Library Reviews.

2.2. Selection of Research. Studies with data generated or published were reviewed until January 30, 2020. The geographical location, journal impact factor, or publication impact factor were all unrestricted. The search terms included "R2D2 in higher education," "R2D2 and distance learning," "R2D2 and online learning," and "R2D2 and diverse learners." We focus on R2D2 and read, reflect, display, and do because there is a different R2D2 model used for other processes in other sciences such as computer science [11].

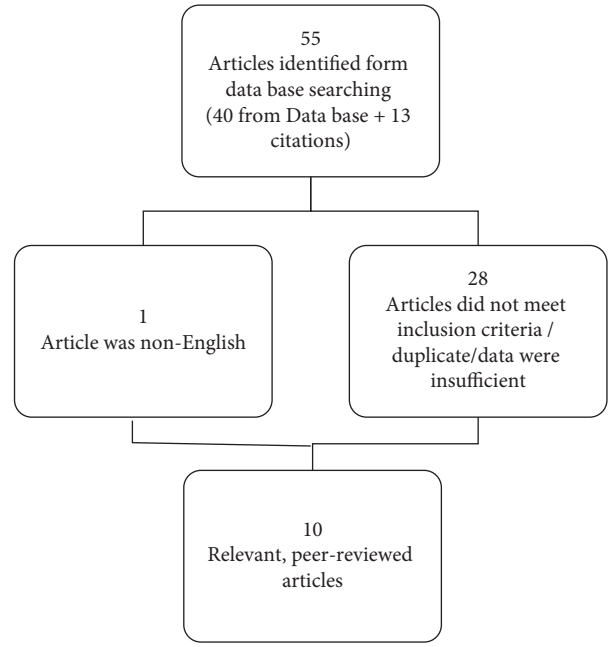

Figure 1: Flow chart of the search and the selection of studies for analysis. Source: authors.

2.3. Eligibility Criteria. The scope of this systematic review was restricted to the essential R2D2 model in higher education. The studies reviewed included only higher education learners. To capture new and relevant research, the reviewed studies must have been published before January 30, 2020.

The search and selection of papers were based on a standardised evaluation process. For papers to be selected for final review, the following five criteria had to be met:

(1) Studies focused on the R2D2 model in higher education

(2) Articles were published in academic, peer-reviewed journals

(3) Articles were published in the period January 30, 2020

(4) Articles were written in English

2.3.1. Review Process. The articles were analysed and the most valuable and relevant ones were selected. Full-text articles that met the inclusion criteria were indicated as relevant for data extraction and were selected for review. Objectivity and the lack of bias were two additional criteria for the analysis of each article.

2.3.2. Data Extraction. Initially, the search of the literature was carried out using the following keywords: "R2D2 teaching model," "constructivist theory," and "higher education." Data were collected on the following characteristics:

author, year of publication, country of origin, type of research paper, characteristics of participants, sample size, method of gathering the primary information, time period of obtaining the results, and the findings.

Eight articles were eligible and were selected for inclusion in this study. The examined articles were not randomly selected; they provided the most relevant primary data.

3. Findings and Theoretical Framework

Our search generated 55 articles. Exact duplicates or nonrelevant papers were removed. Research that focused on other R2D2 models, such as the one used by Wright-Evans [11] and iR2D2, were removed, resulting in 28 articles. Additional articles not written in English were identified and removed, resulting in ten articles (see the PRISMA flow chart in Figure 1).

4. Background

4.1. The R2D2 Model. Bonk and Zhang [6] explain their R2D2 model. Instead of addressing the instructional design and development process, their model encourages thinking about the types of tasks, resources, and activities that may be included in an online course or module to accommodate distinct human learning strengths and preferences or skill target areas. The R2D2 approach, like 4MAT's Learning Styles (4MAT is an eight-step instructional cycle that takes advantage of unique learning styles and processing preferences based on brain dominance. 4MAT can be used by the four major learners (imaginative, analytic, common sense, and dynamic) to activate their entire brain. Learners employ their most natural manner despite being forced to operate in less natural modes) [12]. Also, VARK Learning Style Model (Visual, Audio, Reading, and Kinesthetic) recommends integrating four types of learning activities: reading/listening, reflecting/writing, displaying, and doing. While the R2D2 approach is similar to the VARK method, the former emphasises reflective activities more than auditory activities, which are normally classified within the reading and writing dimensions.

The abbreviation R2D2 refers to the model's four areas (reading, reflecting, displaying, and doing), which address the various preferences of online learners. R2D2 was created to assist in the development of online materials and the selection of the finest online courses after they became widely used around the world and were in high demand by both teachers and learners [13].

On the other hand, the R2D2 model from Willis [14] was developed at the National Air and Space Administration's Johnson Space Center and the University of Houston's Center for Information Technology in Education. Unlike most others, this model was based on an interpretivist epistemology and a constructivist theory of learning, and its revised version was published by Willis and Wright [15]. According to Willis [16], this paradigm has three major and adjustable guiding concepts: (a) recursive, nonlinear design; (b) reflective design; and (c) participatory design. Unlike most instructional development approaches, the R2D2 model encourages a nonlinear approach in which the prescribed activities can be carried out in any order that feels suitable. In addition to being iterative and recursive, the R2D2 paradigm is also iterative. At any point during the product's design and development process, designers can go back and make modifications to any decision, product, or technique. A reflective model of practice can be contrasted with a technical logical approach. With technical rationality, facts are what they are, and designs based on this approach adhere to a set of specified principles that control what should be done. Reflective design, on the other hand, necessitates the designer soliciting and considering feedback and suggestions from a wide range of sources [17].

4.2. R2D2 Characteristics. R2D2 has the following characteristics:

(1) It is a recursive, nonlinear, and sometimes chaotic process
(2) It is dependent on real-world learning issues, which are continually evolving
(3) Objectives arise from design and development work
(4) Planning is organic, developmental, reflective, and collaborative
(5) There are no general ID experts
(6) Instruction focuses on learning in meaningful circumstances
(7) Personal understanding within meaningful contexts is the goal
(8) Formative evaluation is essential
(9) Subjective data may be the most valuable

Furthermore, R2D2 concentrates on three main points: definition, design and development, and dissemination [18].

4.3. R2D2 and Higher Education. E-learning has grown increasingly important in higher education in recent years. To make teaching easier, researchers are combining creative methodologies with e-learning [19]. Rather than providing and feeding information to their learners, instructors are increasingly seen as facilitators of the acquisition of knowledge. When they facilitate and moderate new ways of teaching, the R2D2 model is a perfect foundation for university instructors to use to consider, compare, choose, and apply alternative learning activities using mobile devices [6].

For instance, podcasts, which usually consist of solely an audio program, are becoming increasingly popular in higher education and corporate training. With application sharing, web tours, surveys and polls, online presentations, and chats, online knowledge acquisition can occur in virtual classrooms or in web conferences. It is critical to perform more studies in this field as the forms of online presenting tools proliferate. For example, there are numerous unresolved research concerns around learner satisfaction, utilisation, access, and overall learning when it comes to utilising podcasts [6].

Similarly, this technique may support learners by helping them to follow and accomplish a wide range of mobile learning activities on their own. The R2D2 model's incorporation of essential instructional concerns opens up new opportunities for university instructors to incorporate mobile technologies in their courses, teaching, and student learning activities. An example of this is the R2D2 Center at the University of Wisconsin-Milwaukee, which produced the ACCESS-Life websites that serve as a single clearinghouse for information about universal design in higher education and the community [20].

4.4. Online Learning and R2D2. The R2D2 model is largely focused on the use of various sense-making modalities, but it may also be used to create both online and blended learning formats [21]. Originally, the R2D2 model was designed as a tool to "integrate multiple learning activities with technological systems for efficient online learning." It could also be used for distance learning (which could be online as well). Because of its capability to accommodate the different requirements of the various stakeholders, the R2D2 model was chosen. To begin, this model is intended to be a problem-solving wheel that represents the phases of learning [12] and can guide all types of learners [22], as well as the four types of learning styles [12, 23], through the learning process, from reading and exploring (gaining knowledge) to reflexive writing (interacting), visualisation, and attempts to try out what has been learned. Second, it is a tool that assists teachers in focusing on the various requirements of learners and the wide range of options for presenting material, allowing learners to execute activities, and even evaluating progress and outcomes. Finally, academics can utilise the model to reflect on their instructional strategies cited in [24].

Kolb's Experiential Learning Theory backs up his learning styles model (ELT) [25]. An individual has four learning stages, according to Kolb's model: concrete experience (CE) implies feeling, abstract conceptualisation (AC) denotes thinking, reflective observation (RO) denotes watching, and active experimentation (AE) denotes doing. Converger (ACAE), diverger (CE-RO), assimilator (AC-RO), and accommodator are the four learning styles that arise from this (CE-AE; [11]).

It is argued that technology in education is only beneficial if it enhances the experiences of educators or learners in some way. However, it is not intended to replace what can be accomplished [26]. Mehmood et al. [27] proposed that tR2D2 model is inefficient in terms of data collection methods. It does, however, exhibit strong learning impacts in terms of vocabulary pronunciation, acquisition, note-taking, and student presentations. Initially, online learning in China was fraught with difficulties: teachers struggle to adapt, and learners, particularly adult learners, feel overwhelmed by the amount of material they must study.

4.5. R2D2 for Diverse Learners. Bonk and Zhang's [6] R2D2 model may contain these characteristics. In online courses, instructors face significant hurdles in attracting and retaining a diverse group of learners. Learners in online contexts, particularly those born after the mid-1970s, seek content that caters to their chosen learning approaches. As a result, it is critical to acknowledge the extensive body of literature on learning styles in face-to-face instruction, as well as to provide an expanded theoretical framework and practical guidance to enable online teaching to address a wide range of learning styles, cultural backgrounds, generational differences, and preferences cited in [6, 27].

Bonk and Zhan [6] added that because of these characteristics, the R2D2 model caters to both auditory and verbal learners. Reflective activities, such as online blogs, reflective writing projects, self-check tests, and electronic portfolios, are the focus of the model's second component. Virtual tours, timelines, animations, and concept maps are used to showcase visual representations of content in the third part. Fourth, the approach stresses what learners can do with the material through hands-on activities, such as simulations, scenarios, and real-time situations.

In effect, the R2D2 model is one way of organising and making sense of the vast number of instructional options accessible in distance education today. It shows educators how to incorporate numerous technologies in online learning by providing new ways of learning for diverse online learners and by demonstrating easy-to-apply learning activities. Content presented from this perspective should be more enriching for learners if it is produced well. In online environments, the R2D2 model provides a foundation for more engaging, dynamic, and responsive teaching and learning [6]. This aids teachers in analysing learners' various learning processes. Furthermore, teachers can organise the online learning materials. Data mining is utilised to personalise services for both teachers and learners [27].

5. Discussion

Zhang [9] exposed Chinese readers, in particular, to the R2D2 model [6]. Zhang [9] explained that there are different types of learning activities that are designed for learners with different learning styles and preferences. In R2D2, the reader does not have to proceed from reading to introspection to the conclusion of the presentation. Rather, it is a matter of practice. Different types of teaching activities can be carried out at the same time in specific educational phases.

The R2D2 model for online learning activities is investigated by Cartner and Hallas [28]. The English for Academic Study program provides a framework for the creation of a constructivist environment that promotes collaborative and active learning in a blended environment. Students used the R2D2 model to evaluate four learning experiences. The model was evaluated as part of an initial investigation into students' perceptions of its merits. The findings were favourable and indicated the value of real-life activities that aid in the acquisition of academic abilities, such as vocabulary acquisition, pronunciation, note-taking, and presentations.

Stiffler et al. [29] state that podcasts address one type of learning, and instructors should accommodate the learning preferences of all learners in a class. Learners did not

download the podcast to their mobile devices, but they did multitask while listening, according to the findings. Nursing students rated both the podcast and the books as equally important. In distance-accessible courses, podcasting can engage learners by offering a human voice and thus a stronger virtual connection.

Brown and Woods [30] present a multipart online professional development course aimed at increasing the competence of baby and toddler experts to help children with communication difficulties and their families. The R2D2 and R.O.P.E models were used in this study of professional development. The impact, practicality, and provider satisfaction of the course's initial implementation were investigated using a preliminary program assessment. Providers improved their knowledge and abilities in communication development and intervention and then implemented those skills in family-centred services in natural settings.

Jumaat and Tasir [31] design and develop 2D-animation apps while using R2D2 model in a project-based learning environment. Within the context of the R2D2 paradigm, the learning 2D-animation apps are designed and developed in an organised and systematic manner. The constructivist principle underlies this instructional design methodology. In terms of flexibility, it is a nonlinear model when compared to the ADDIE model and the Morrison, Ross, and Kemp model. It allows designers to recognise the relationships between each stage of the design process and revisit each phase in order, as Willis [14] described.

Oliver [24] shows that learners' responses revealed that using the R2D2 model creatively in combination with engaged teaching and constructive use of online technologies, as well as stimulating course content, might indeed change some attitudes and behaviours. Learners were encouraged to behave as both learners and teachers who think critically about their place in society and the role they may have in promoting change and passing on their knowledge and skills to others. A number of encouraging gestures were recorded, as well as a few ecumenical collaboration efforts. In their study, Pinchot and Paullet [32] mention that R2D2 entails having students use what they've learned in a hands-on situation by building or experimenting with their new knowledge. Finally, R2D2 was thought to be useful by the academic librarians who collaborated on the project designed by Lavoie [7].

Elrick et al. [33] concentrated on the improvement and evaluation of an online forensic science course including hands-on practical exercises for high school students of colour in the Midwest. The paper discusses important challenges that occurred during the designing process, as well as emphasized evaluation outcomes. The study shows that R2D2 model was used for development since it was specifically created with online learning in mind, with the goal of addressing learning variability. Four prerequisites were defined for each topic, which correspond to the four components of the R2D2 learning approach. According to Bonk and Zhang, these elements are linked to pupils' different learning styles.

Ismail and Gary [34] examine tutors' attitudes about students' group work while they learn online as a potential solution to classroom overcrowding. The study was conducted in the Egyptian higher education system, using 20 higher education instructors who teach in a blended learning environment or in a virtual classroom as participants. The data for this study were gathered through focus groups and individual interviews, using a phenomenological qualitative technique. According to the findings, online collaborative learning provides options for studying outside the traditional brick-and-mortar classroom, potentially alleviating the problem of overcrowding. Although this solution offers some advantages, it also has some drawbacks. Tutors acknowledged the advantages of online collaborative learning, but they also expressed several cultural and pedagogical problems that they believed were impeding overall learning effectiveness for Egyptian educators.

Ismail and Gary [34] recommend the R2D2 model of [6] for autonomous learning because it outlines a variety of learning activities for various individual learners. Another study by Pinchot et al. [32, 35, 36] led to the conclusion that the model proposed in the booklet of activities was effective in integrating ICTs into the second-language learning process while also innovating with the approaches utilised to incorporate pedagogic techniques in this sort of class.

Karemore and Karemore [26] explain the R2D2 model's use in dentistry. In this study, the impact of COVID-19 on the digital transformation of the education sector is explored. In essence, the study investigated how educators can provide higher education learners with a quality education through various teaching models, one of which is the R2D2 model. The study participants adopted the R2D2 teaching model during the COVID-19 lockdown period to encourage students to interact with each other. Each student learns through their own style; they then discuss the information gained from the online course with their peers. The study was based on a review of secondary data sources, including articles published in peer-reviewed journals during the pandemic and some papers related to the R2D2 model. The findings showed that, during the pandemic, the education sector switched to remote learning en masse. This motivated the creation of new technology applications.

These observations point to the fact that there is strong potential for these online learning applications. Due to the diversity of learning styles among students, such as those who prefer words or text, reflective exercises, visual representations, or hands-on activities, there are numerous opportunities to be addressed. The R2D2 model allows instructors to take into account learners and learning activities at every stage, resulting in an engaging and stimulating environment for online learning. This approach also includes a learning and problem-solving method that progresses from content acquisition to reflection and visual pictures, and finally to real use. The value for students of real-life activities in the development of academic skills, such as vocabulary acquisition, pronunciation, note-taking, and presentations, is demonstrated using the R2D2 model, according to some studies. Finally, the R2D2 approach lets students employ what they have learned in a hands-on

environment by building or experimenting with their new knowledge.

Naturally, there are a number of unresolved concerns and questions that must be considered with this paradigm, as well as a number of constraints. In terms of restrictions, it is clear that several concepts overlap many phases of the model. At the same time, this contributes to the model's utility because some learning activities cater to more than one type of learner; the model also provides a method to make sense of the complexity and opportunities that exist between online teaching and learning.

6. Conclusion

In distance and online learning, the R2D2 model has been used to make the learning process more dynamic. The findings of this study reveal that R2D2 provides numerous types of teaching activities that could be carried out at the same time in different educational phases. It also improves learning engagement by providing a human voice and, as a result, a stronger virtual connection. It also promotes communication and assists in the resolution of communication issues. Learners' achievement and contentment are aided by the model's flexibility and learners assuming responsibility for their own actions, which leads to better learning outcomes. This study, like others, supports the use of R2D2 in the learning process because of its educational effectiveness.

6.1. Practical Implications. During the COVID-19 pandemic, educational organisations, including higher education institutions, were forced to shift to online learning. During the campus closures, to affirm effective teaching and learning styles, various teaching models have appeared, such as the R2D2 teaching model from Bonk and Zhang [6].

Applying the R2D2 teaching model in online courses would benefit the learning process. First, using R2D2 would give teachers and learners opportunities to develop their own learning styles (as described in Kolb, 1984) [37]. Second, the application of the R2D2 teaching model enhances information retention, improves interpersonal skills, and may lead to higher achievement. On the other hand, due to the diversity of learning styles, not all of the activities suit all students. Thus, the learning activities must be designed carefully and must be labelled to encourage learners to explore the information deeply and correctly. This emphasises the application of assessment and performance evaluations. Thus, the academic gains should be confirmed by qualitative and quantitative evaluations of student accomplishments.

6.2. Research Limitations. This analysis focuses on the use of the R2D2 model in higher education. Thus, the results do not include findings regarding related models, such as learners' preferences or learning design models. As described above, the R2D2 model is an excellent technique to teach students with diverse learning styles online. However, there is a need to ensure learners' satisfaction when using this model. At the same time, an empirical study is needed to investigate the learners' achievements after utilising the R2D2 model. Other issues, such as digital inequalities, digital pedagogies, and practices of online education approaches while engaging in remote learning, should also be considered.

6.3. Recommendations. Within the framework of these results, this paper sheds light on studies that should be conducted on course design or the online educational environment not only in higher education but at all levels of learning. To explore this further, it is necessary to design learning activities with some features that attract most learners. Diverse distance learning activities are also needed to keep students interested and to motivate them to learn on their own. Training the teachers in how to use R2D2 is also necessary for the success of this approach. Finally, further research should explore the evaluation tools used to assess the model to ensure strong higher education outcomes.

Data Availability

This statement should describe how readers can access the data supporting the conclusions of the study and clearly outline the reasons why unavailable data cannot be released.

Conflicts of Interest

The authors declare no conflicts of interest.

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