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Impact of Quiz-Based Interactive Videos into Personal Learning Environment on Regulating E-Portfolio Design and Learning Engagement: An Experimental Study

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Abstract Since the COVID-19 pandemic, attention has shifted in an unprecedented way to online teaching. This has required innovative methods within online milieux to empower students learning following their own preferences and rhythm. Employing artificial intelligence (AI) represents a fruitful avenue for designing interactive videos in personal learning environments (PLE), consequently changing the face of e-learning. In this experimental design, a series of ADDIE (analysis, design, development, implementation and evaluation) framework-based and quiz-based interactive videos are developed on E-Portfolio instructional content. This study required students to interact with the videos remotely and answer short quizzes to check understanding. Students were required to provide the correct answers to proceed. If incorrect answers were provided, the content was repeated. The level of engagement and design skills were pre- and post-tested on an experimental group and a control group, each consisting of 32 students with a total of 64 at Mansoura University in 2019-2020. The results of the study indicate a statistically significant difference for deploying interactive videos on e-portfolio design skills and learning engagement. The study contributes to knowledge of how interactive quiz-based videos as a source of self-feedback for their level of attention, performance and comprehension. The limitation of the study is that it is a small scale and subsequent case studies could be useful. Further studies are recommended to verify the cognitive processes and performance self-assessment nexus.

Keywords Interactive Video, Personal Learning Environment; ADDIE Instructional Design, Academic Achievement, Learning Engagement

1. Introduction

More integrative approaches are being adopted in Higher Education (HE) with unparalleled advances in technology. Nowadays more than ever, we see an unprecedented increase in online and distance teaching due to the impact of COVID-19 on higher education. One of the most innovative applications is artificial intelligence (AI), which has invigorated the agenda of education with a focus on adaptive, integrative, and interactive personal learning ecosystems [1,2,3]. Modern learning interfaces are defined in those innovative educational contexts as not only driving individualized learning [4], but also shifting towards an entrepreneurial education [5].

Thus, due to the disruptions of educational programs

caused by COVID-19, educators have increasingly looked towards the advances in ICT to assist in scaffolding learners' cognitive abilities. However, the nexus between revolutionary technology and pedagogy remains somewhat problematic [6]. No quick or easy fixes have been found to the challenges involved in keeping the necessary structure and personal interaction as the learners are expected to utilize self-directed approaches according to their own dispositions and rhythm. This predicament becomes particularly onerous when the learners lack a proactive attitude, the right dose of intrinsic motivation, or the necessary skills to achieve what is asked of them.

Therefore, the focus of the discussion about the current technological spaces in education needs to be steered towards more robust interactive learning environments that can be tailored to learners' needs, skills, and styles. Moreover, doing this would require that the learners become agents who are increasingly able to more intuitively make effective decisions by themselves rather than in response to their teachers' directives. In keeping with this, previous studies have indicated the need for provision of integrated and immediate feedback within learning [7]. In an attempt to rethink personal learning environments (PLEs), this paper incorporates interactive video with quizzes as a new tool for online and blended teaching.

Study Objectives and Hypothesis

The study aims to test the impact of employing videos that incorporate quizzes on two variables: e-portfolio designing and learning engagement. Hence, two hypotheses are going to be tested:

H1 there is a statistically significant difference on e-portfolio design skills in the experimental group when employing interactive videos

H2 there is a statistically significant difference on learning engagement in the experimental group when employing interactive videos

2. Literature Review

In recent decades, HE has increasingly espoused adaptive systems which can be personalized to the learner's needs. Personal learning environments (PLE) are one of the commonest applications of AI [1] which have been adopted in order to tailor learning to "each student's strengths, needs and interests – including enabling students' voices and choices in what, how, when and where they learn" and as a means "to provide flexibility and supports to ensure mastery of the highest standards possible" p.3 [8]. Hamada and Hassan [9] talk about the extension of the e-dimension tools – such as audio, video, animations, simulations, graphics, and text – which allow students to meaningfully interact with the interface. Hence, personalized learning environments permit the configuration of personal spaces through preferred tools such as blogs, wikis, RSS, and YouTube [10].

There are indeed numerous reasons why PLEs have the potential to significantly enhance learning. Balackrishnan [11] expressed a marked interest in PLEs for their capability to promote students' self-motivation and self-regulation by allowing them to state their preferences, set their goals, and keep track of their progress and achievement. Moreover, PLEs support process learning [9], problem solving [12] and longer cognitive retention [13]. The review of the results of an interactive Erasmus+ project course called *Interactive Course for Control Theory – ICCT* reported that the use of a PLE led to improved grades [14]. This initiative was conducted by four European Universities as a response to students' difficulties comprehending control theory. However, since comprehension was not measured and the project depended on survey results and test results, further investigation through experimental studies into comprehension is recommended. Similarly, other studies, e.g. [3,15] validated their findings via test results and surveys. Hence, the present study attempts to investigate development of curriculum skills and learning engagement through experimental study.

VanLehn [16] distinguished between human teaching and machine-aided teaching, rightly arguing that the human element is irreplaceable as it allows for unplanned creative and dynamic interactions between the tutor and students. With a shift towards learner self-directed learning, cognitive dynamicity is placed at the heart of students' active interactivity with the interface. In deploying interactive videos, Giorgdze and Dgebuadze [13] stress the importance of using innovative and new tasks that are managed by the student rather than the teacher. Likewise, VanLehn's [16] discussion emphasized the urgent need to design a tentative model that allows for interactivity which is flexible and controlled by the learner while still making room for the teacher. Based on VanLehn's [16] recommendation, the current study employs interactive videos for the learners' input as they perform some of the required curricular components. Such types of videos directly incorporate a wide variety of interactive elements directly into the videos itself, including hotspots, questions, and calculations.

Beyond the role played by each agent of the educational ecosystem are the pedagogical integration and implementation of tools and techniques. Research requires a clear positioning of theories underlying application. Zhu et al. [17] introduced a visualization and multimodal interaction system called VisMi at Beijing Normal University that is constructed based on *Great Didactic from Comenius and the theory of constructivism*. Wang and Wang [15] deployed three modes of teaching similar to *task-based, workshop-based, and project-based* lesson design and the seminar method. Indeed, use of the analysis, design, development, implementation and evaluation (ADDIE) instructional framework in promoting instructional materials to integrate technology into

teaching has been plentiful [18,19,20]. Notwithstanding, less attention has been paid to PLE interactive videos.

Clearly, ADDIE shows significant potential as a flexible and dynamic tool which can be integrated into teaching without disruption [18,21]. The five elements of the acronym ADDIE represent are processes or stages involving continuous evaluation in which checking effectiveness is conducted [22]. The two Ds incorporate development of different resources and materials in addition to proper integration of technology into instructional materials. This instructional framework thus is integrated as part of designing the materials for the course, as explained in the methodology.

In terms of interactive videos, their positive impact on learning, when well designed, has exceeded expectations [23]. Cattaneo et al. [23] note "control features, hyperlinks and exchange options" (p.1) as potential affordances. Evidence of a positive response to an interactive video content and its format has also been corroborated through a questionnaire disseminated to 101 participants from a French University [24]. Moreover, use of an interactive video in a quasi- experimental study consisting of 12 participants at King Abdulaziz University KSA pointed to learning gains in reading comprehension [25]. However, while all of the previous studies considered interactivity as 'interaction' with the materials, the current study aims to integrate quizzes and questions as an integral part of the video: correct answers allow participants to proceed while incorrect answers prompt the video to be replayed.

There are also concerns raised related to the lack of underlying pedagogical framework [26]. Indeed, an effective ADDIE based interactive video is required to meaningfully guide students' performance. Andrist et al. [26] raised the concerns on how different studies have been initiated as course specific and with insufficient grounding in pedagogical principles. This therefore fails to offer sufficient guidance to the teaching community. Nevertheless, when this obstacle is overcome, positive outcomes can occur. Zhang et al. [27] compared results of performance of four groups: interactive video, non-interactive video, without video, and traditional teaching. They reveal that the group learning by interactive video exceeds the other groups in performance and satisfaction. This success may be attributed to the newly improved interface which incorporates more interactivity, intermittently pausing to pose questions and offer feedback. Upon correct response the video will continue and upon failure the video shall repeat the information. Previously, studies rarely focused on continuous comprehension checks of the videoed materials. Therefore, two key constructs related to students' performance – namely engagement and designing skills – will be tested experimentally. Given the review of interactive video above; two hypotheses are proposed:

H1 There will be statistically significant differences at ($\alpha \leq 0.05$) between the mean scores of the experimental group and that of the control group in the post Developing E-Portfolio Design Skills checklist.

H2 There will be statistically significant differences at ($\alpha \leq 0.05$) between the mean scores of the experimental group and that of the control group in the post learning engagement checklist**.**

3. Methodology

Research Questions

(1) Are there statistically significant differences at ($\alpha \leq 0.05$) between the mean scores of the experimental group and that of the control group in the post Developing E-Portfolio Design Skills checklist?

(2) Are there statistically significant differences at ($\alpha \leq 0.05$) between the mean scores of the experimental group and that of the control group in the post learning engagement checklist?

Research Design

To test the hypotheses, the independent variable of interactive video was introduced to an experimental group, while a control group was involved in traditional teaching methods.

There are three variables, one of which is an independent variable which is an interactive video. The other two are the dependent variables: developing E-Portfolio Design Skills, and learning engagement. The experiment was conducted over a period of fourteen days. Both groups were taught by the same teacher, one of the researchers in this study.

Learning environment of Interactive video

In this research, the ADDIE model was adopted to design an Interactive video environment using EDpuzzle Software. As depicted in Figure 1, ADDIE is an educational design model that guides the development process toward an end product that serves different needs of the learner as well as the instructor [18,22,28].

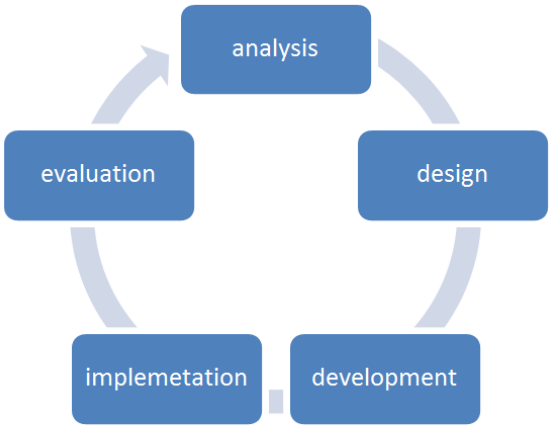

Figure 1. ADDIE instructional framework

- **Analysis:** During analysis, the researchers identified learners' characteristics, goals, learning objectives, learning problems and learners' existing knowledge.
- **Design:** In this stage, learners' needs and educational goals are defined, and an interactive video design scheme is outlined
- **Development:** The researchers used Articulate storyline2 software to create interactive videos as follows: 1. Recording different videos about how to create digital portfolio using wix website. 2. Converting the recorded video into interactive video using the EDpuzzles website. 3. Adding interactive questions into video which must be answered correctly to proceed or replayed.
- **Implementation:** The researchers implemented a pre-achievement test as a diagnostic test. Then, researchers gave the students a training session about how to use the interactive videos correctly. Participants were allowed to watch videos in their homes using their PCs; the researchers then monitored students' interaction, comments, feedback, and assignments on the interactive videos. At the end of the implementation stage, the researchers implemented the post- achievement test, and engagement checklist to explore the progress in students' performance after the intervention.
- **Evaluation:** In this study, the effect of interactive video in terms of the benefits to the students was assessed through gathering results and evaluating effectiveness.

Sample

The sample of the study consisted of 64 students distributed into two groups; the experimental group which consisted of 32 students and the control group which included another 32 students. The sample of the study was chosen purposively from fourth year students enrolled at the Instructional Technology department, Faculty of Education, Mansoura University (see Table 1).

Table 1. Sample size

Groups	Learning environment	Group size
Group (1)	Experimental group use interactive video via flipped classroom	32
Group (2)	Controlled group use the traditional face to- face classroom	32

Instrumentation

The researchers used the following instruments to achieve the aims of the study:

- E- portfolio skills checklist.
- Engagement in learning checklist.

To test the validity of the two checklists [28], the researchers consulted a group of specialists including university professors and experts, in educational technology and methodology, whose comments were taken into consideration to referee the checklist.

Statistical analysis procedures

The data were collected and computed by using statistical package for social sciences (SPSS) to control the intervening variables and to measure the statistical difference in means between the two groups according to the study variables.

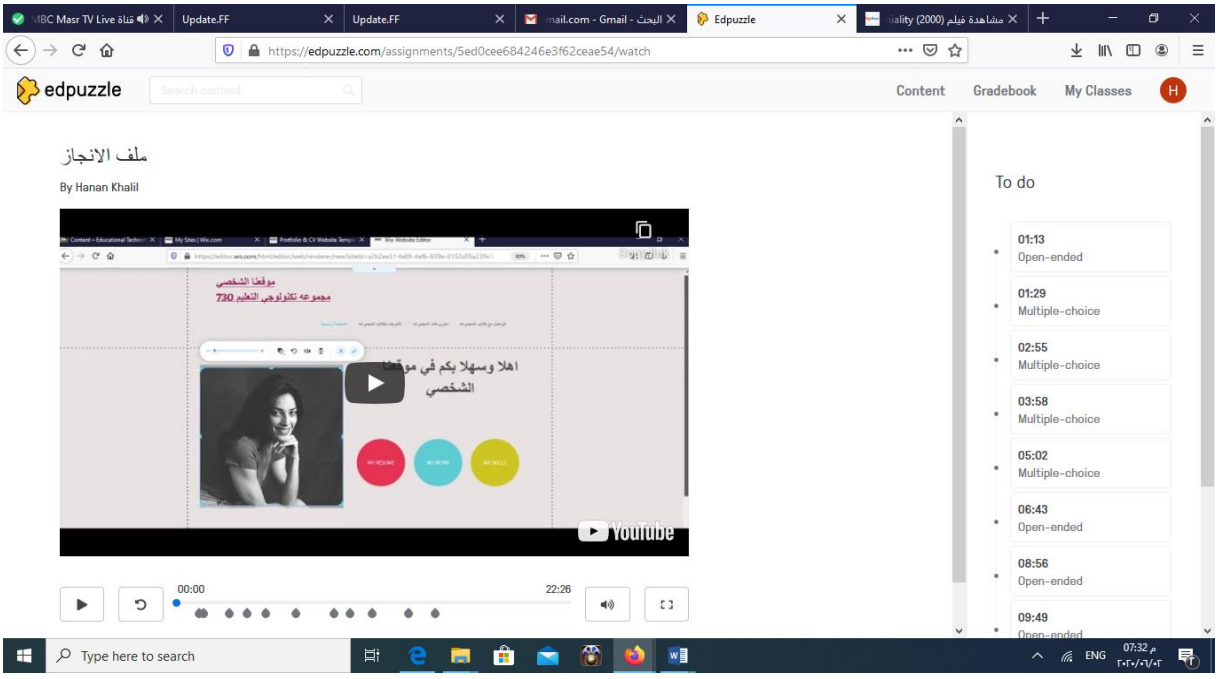

Figure 2. Screenshot of an interactive video

4. Data Analysis

Testing 1st Hypothesis

The first question was formulated as follows: Are there statistically significant differences at ($\alpha \leq 0.05$) between the mean scores of the experimental group and that of the control group in the post Developing E-Portfolio Design Skills checklist? To answer this question, the researchers test the following hypothesis: There are no statistically significant differences at ($\alpha \leq 0.05$) between the mean scores of the experimental group and that of the control group in the post developing e-portfolio design skills checklist.

To examine the first hypothesis, means and standard deviations of both groups' results on the post-test were computed. Independent samples T-test was used to measure the significant of the differences, see Table 2.

As shown in Table 2, the T-computed value is larger than T-table value in the test, which means that there are significant differences at ($\alpha \leq$) in the total average score of the post-test between the experimental and control group in favour of the experimental group. This result indicates that using interactive video is more effective than the traditional method in developing designing e- portfolio skills checklist. In addition, the study applied the "Effect Size" technique. The researcher computed "²η" using the following formula:

$$\text{Eta}^2 = \frac{t2}{t2 + (N-1)}$$

Table 3 shows the effect size of interactive video is higher on students' e-portfolio designing skills. This means that the effect of interactive video is significant. This large effect may be due to the assessment and techniques, which are used in interactive video to develop students' e-portfolio designing skills**.**

Testing Hypothesis 2:

The second question was formulated as follows "Are there statistically significant differences at ($\alpha \leq 0.05$) between the mean scores of the experimental group and that of the control group in the post learning engagement checklist?" To answer this question, the researchers tested the following hypothesis: there are no statistically significant differences at ($\alpha \leq 0.05$) between the mean scores of the experimental group and that of the control group in the post learning engagement checklist**.**

To examine the second hypothesis, means and standard deviations of both groups' results on the post-test were computed. Independent samples T-test was used to measure the significant of the differences, as can be seen in Table 2.

As shown in Table 4, the T. computed value is larger than T. Table value in the test, which means that there are significant differences at ($\alpha \leq$) in the total average score of the post-test between the experimental and control group in favor of the experimental group. The results indicate that using interactive video is more effective than the traditional method in developing learning engagement.

Table 5 shows that the effect size of interactive video is larger on students' learning management. This means that the effect of interactive video is significant. This large effect may be due to the assessment and techniques, which are used in the interactive videos to develop learning engagement.

Table 2. T-test independent sample results of differences in the post designing e-portfolio skills checklist

A cope	Group	N	Mean	Std. Deviation	t	Sig. value	sig. level
E-portfolio skills checklist	experimental	32	29.9688	2.15433	17.701	0.05	significant
	Control	32	19.5625	2.53345			

Table 3. The effect size of interactive digital videos strategy on the experimental group in the post-test

Acope	t value	η2	Df
E-portfolio skills checklist	17.701	0.90	62

Table 4. T-test independent sample results in the post engagement checklist

A cope	Group	N	Mean	Std. Deviation	t	sig. value	sig. level
Engagement checklist	experimental	32	184.44	12.6232	4.221	0.05	significant
	Control	32	159.032	31.6199			

Table 5. The effect size of interactive digital videos strategy on the experimental group in the post-test of engagement checklist

A cope	t value	η 2	df
Engagement checklist	4.221	0.36	62

5. Findings

Based on the statistical analysis, it is confirmed that:

(1) There are statistically significant differences at ($\alpha \leq 0.05$) between the mean scores of the experimental group and that of the control group in the post Developing E-Portfolio Design Skills checklist.

(2) There are statistically significant differences at ($\alpha \leq 0.05$) between the mean scores of the experimental group and that of the control group in the post learning engagement checklist**.**

6. Discussion

Affordances of interactive videos are rarely highlighted which has repercussions regarding lack of applications and pedagogical development [6]. Nevertheless, circumstances arising from the COVID-19 pandemic have given significant impetus to making progress in this area. As advanced in this study, positive results in H1 and H2 can be attributed to the affordance of the pause-answer-get immediate feedback. This feature of interactivity to receive feedback on 'understanding' implies actions of reflection wherein students would explicitly evaluate their comprehension within learning prior to accumulating more knowledge. However, research into the area of immediate feedback is still lagging behind [29]. This immediacy of feedback has the affordance of raising conscious attention to the curriculum content at instant and alarming the student that the video repeats the content. Again, repetition of a content is an affordance that has pedagogical implications in terms of additional opportunities to comprehend missed information. The benefits appear to be threefold: mental feedback, instancy of feedback, and raising alert of their own processing – consequently allowing for adaptation and higher levels of mental process such as attention. Clearly, these affordances are less likely to be enjoyed in the traditional teacher-students dyad given the difficulties in tailoring feedback to meet every students' individual needs at every learning stage. Indeed, the manner in which the interactive videos are integrated with summative activities would allow the teacher as well as the student to observe their cognitive development. Notably, the findings of this study chime with the positive outcomes noted in previous studies which incorporated interactive videos.

Therefore, in address the current needs of education, pedagogical tools which are dynamic and responsive to students' should be recognized as critical to future educational process. With increasing calls for self-directed learning and student empowerment, innovative ways to scaffold cognitive processes and develop skills beyond the traditional classroom are needed. Instant feedback though quiz-integrated interactive videos has been put put forward as one agenda to address this gap in the research.

7. Conclusions

The study strived to experimentally test the utility of quiz-based interactive video as an enhancement for PLE on students' design skills of e-portfolio and student engagement. It verifies that there is a significant difference in two variables: learning engagement and design skills. It can be said that elements of face-to-face teaching are indeed irreplaceable; yet with more robust designs that compensate for teachers' direct presence such as integrating quiz with interactive video as deployed in the current design, teaching is not only transformed but also pushed towards the zone of students' learning, allowing learning but at the learners' rhythm. It has been emphasized that extending resources is critical now in the aftermath of COVID-19 in order to afford students opportunities to reflect on their progress and refocus on content which has not yet been understood. This can allow multiple opportunities for students to develop at their own pace without getting left behind as content advances. Therefore, this paper urges that more research and development of PLEs be conducted. Needless to say, for success in this area, educators – the holders and conveyers of pedagogical knowledge – must be actively involved in designing interfaces that integrate pedagogies with technology to achieve better outcomes.

REFERENCES

[1] Tang K.Y., Chang C.Y., Hwang G.J., "Trends in artificial intelligence-supported e-learning: a systematic review and co-citation network analysis (1998–2019)," Interactive Learning Environments, ahead of print, pp.1-19, 2021, doi: 10.1080/10494820.2021.1875001.

[2] Hwang G. J., "Definition, framework and research issues of smart learning environments-a context-aware ubiquitous learning perspective," Smart Learning Environments, vol.1, no.1, 2014, doi.org/10.1186/s40561-014-0004-5. https://is.gd/0036lO.

[3] Tomljenovic Z., "An interactive approach to learning and teaching in visual arts education," CEPS Journal, vo.5, no.3, pp.73-93, 2015, doi: 10.25656/01:11406.

[4] Yakovleva N. O., Yakovlev E. V., "Interactive teaching methods in contemporary higher education," Pacific Science Review, vol.16, no.2, pp.75-80, 2014. https://www.sciencedirect.com/science/article/pii/S1229545014000175, https://doi.org/10.1016/j.pscr.2014.08.016.

[5] Xu J., Ren T. F., Wang Y. H., "Identification and Evaluation for Key Factors of Innovative Education in Universities Based on Grey Relational Model," Eurasia Journal of Mathematics, Science and Technology Education, vol.13, no.12, pp.8313-8321, 2017, https://doi.org/10.12973/ejmste/80791.

[6] Li Y., Zhao S., Ma Q., Qian C., Lin Q., "A feature analysis of regional classroom teaching in the trend of interactive instruction," Interactive Learning Environments, vol.27, no.2, pp.137-162, 2019, https://www.tandfonline.com/doi/epub/10.1080/10494820.2018.1474230?needAccess=true

[7] Bahari A., "Computer‐mediated feedback for L2 learners: Challenges versus affordances," Journal of Computer Assisted Learning, vol.37, no.1, pp.24-38, 2021, https://doi.org/10.1111/jcal.12481.

[8] Patrick S., Kennedy K., Powell A., "Mean what you say: Defining and integrating personalized, blended and competency education," International Association for K-12 Online Learning (iNACOL), 2013, https://doi.org/10.1002/cae. 21924.

[9] Hamada M., Hassan M., "An interactive learning environment for information and communication theory," Eurasia Journal of Mathematics, Science and Technology Education, vol.13, no.1, pp.35-59, 2013, https://doi.org/10.12973/eurasia.2017.00603a

[10] Yürüm O. R., "An intervention framework for design and development of interactive video lectures based on video viewing behaviors: A learning analytics approach," PhD thesis, 2021, https://open.metu.edu.tr/bitstream/handle/11511/93046/Ozan_Rasit_Yurum_Doktora_Tezi.pdf.

[11] Balakrishnan B., "Motivating engineering students learning via monitoring in personalized learning environment with tagging system," Computer Applications in Engineering Education, vol.26, no.3, pp.700–710, 2018, doi.org/10.1002/cae.21924.

[12] Kim M.C., Hannafin M.J., "Scaffolding problem solving in technology-enhanced learning environments (TELEs): Bridging research and theory with practice," Computers and Education, vol.56, pp.403–417, 2011, doi: 10.1016/j.compedu.2010.08.024

[13] Giorgdze M., Dgebuadze M., "Interactive teaching methods: challenges and perspectives," International E-Journal of Advances in Education, vol.3, no.9, pp.544-548, 2017, http://ijaedu.ocerintjournals.org/en/download/article-file/390165.

[14] Podržaj P., Finžgar M., Pirnar Ž., Ljubic S., Lanzetta M., Pollini L., Budai, C., "An Erasmus+ project: Interactive Course for Control Theory (ICCT)," In IECON 2021–47th Annual Conference of the IEEE Industrial Electronics Society, 2021, pp.1-6, IEEE, DOI: 10.1109/IECON48115.2021.9589744.

[15] Wang X., Wang J., "Implementing an interactive approach in translator education," Interactive Learning Environments, pp.1-17, 2021, https://doi.org/10.1080/10494820.2021.1879871.

[16] VanLehn K., "The relative effectiveness of human tutoring, intelligent tutoring systems, and other tutoring systems," Educational Psychologist, vol.46, no.4, pp.197-221, 2011, https://doi.org/10.1080/00461520.2011.611369.

[17] Zhu X., Sun B., Luo Y., "Interactive learning system "VisMis" for scientific visualization course," Interactive Learning Environments, vol.26, no.4, pp.553-565, 2018, doi https://doi.org/10.1080/10494820.2017.1371197

[18] Peterson C., "Bringing ADDIE to life: Instructional design at its best," Journal of Educational Multimedia and Hypermedia, vol.12, no.3, pp.227-241, 2003, https://www.learntechlib.org/p/2074/.

[19] Davis, A. L., "Using instructional design principles to develop effective information literacy instruction: The ADDIE model," College & Research Libraries News, vol.74, no.4, pp.205-207, 2013, https://doi.org/10.5860/crln.74.4.8934.

[20] Vučić M.M. Šimunović J. Stankov S., "Studio Based Learning of Instructional Design in an Online Environment," 2021 International Conference on Software, Telecommunications and Computer Networks (SoftCOM), pp.1-6, 2021 doi: 10.23919/SoftCOM52868.2021.9559110.

[21] Almelhi A. M. "Effectiveness of the ADDIE Model within an E-Learning Environment in Developing Creative Writing in EFL Students," English Language Teaching, vol.14, no.2, pp.20-36, 2021, URL: https://doi.org/10.5539/elt.v14n2p20, doi: 10.5539/elt.v14n2p20.

[22] Branch R. M., "Instructional design: The ADDIE approach," vol.722, 2009. Springer Science & Business Media.

[23] Cattaneo A. A. P., van der Meij H., Aprea C., Sauli F., Zahn C., "A model for designing hypervideo-based instructional scenarios," Interactive Learning Environments, pp.1–22, 2018, doi:10.1080/10494820.2018.1486860.

[24] Queroue M., Pouymayou A., Pereira E., Tzourio C., González-Caballero J. L., Montagni, I., "An interactive video increasing French students' mental health literacy: a mixed-methods randomized controlled pilot study," Health Promotion International, 2021, https://doi.org/10.1093/heapro/daab202.

[25] Najmi A. H., "A Framework for Formative Assessment within Interactive Video Lectures and its Relation to Reading Comprehension Skills," Life Science Journal, vol.18, no.3, 2021, http://www.lifesciencesite.com/lsj/lsj180321/08_37118lsj180321_32_41.pdf.

[26] Andrist L., Chepp V., Dean P., Miller M. V., "Toward a Video Pedagogy. Teaching Sociology, vol.42, no.3, pp.196–206, 2014, doi: 10.1177/0092055x14524962.

[27] Zhang D., Zhou L., Briggs R. O., Nunamaker Jr J. F., "Instructional video in e-learning: Assessing the impact of interactive video on learning effectiveness," Information & management, vol.43, no.1, pp.15-27, 2006, https://doi.org/10.1016/j.im.2005.01.004.

[28] Gagné R. M., Wager W. W., Golas K. C., Keller J. M., Russell J. D., "Principles of instructional design," Performance Improvement, vol.44, no.2, pp.44–46, 2005,

doi: 10.1002/pfi.4140440211.

[29] Sedrakyan G., Jonna M., Katrien V., Sanna J., Paul A. K., "Linking learning behavior analytics and learning science concepts: Designing a learning analytics dashboard for feedback to support learning regulation," Computers in Human Behavior, vol.107, 2020, https://doi.org/10.1016/j.chb.2018.05.004.