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Development of A Learning Model for Blended Collaborative Knowledge Construction in Vocational Education

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Abstract: Vocational Education readies students for specific careers and industries. A robust learning approach is crucial to meet modern workforce demands and foster knowledge exchange. This article introduces the origination of a Learning Model for Blended Collaborative Knowledge Construction in Vocational Education. This model merges methods from blended learning with collaborative strategies for constructing knowledge, fuelling student engagement, skills acquisition, and shared knowledge creation. The research utilizes the Delphi method to accumulate convincing proof for learning models prioritizing blended collaboration in knowledge generation. The sample pool comprises 60 students spanning two Zigong Vocational Training Institute classes, gathered via selective sampling. Data collection involved pre and post-testing of the student's performance in the experimental and control groups, reinforced by the satisfaction survey from the experimental group. Data analysis employed statistical tools like percentages, means, standard deviations, and the t-test for related samples. The study found that pretest scores and SPSS data analysis showed that the f-test significant value is .702, which exceeds .05. This implies that, under the assumption of equal variance, the mean equivalence t-test findings for the first row of data, as shown in the table above, show that the experimental class averages 81.02 and the control class 81.05. The experimental and control groups' pretest scores are not significantly different, as the computed p-value of .984 is larger than .05. Thus, teaching practice is reasonable. The experimental group's student satisfaction measure averaged 4.27, ranging from 4.10 to 4.43, indicating that students are content with their academics. The control group's student satisfaction measure averaged 2.87, ranging from 2.50 to 3.10, indicating low satisfaction with learning. Students in a vocational education setting were compared using a hybrid collaborative knowledge creation learning model, demonstrating its potential to enhance student satisfaction and outcomes.

Keywords: vocational Education, blended learning, collaborative learning, blended collaborative knowledge construction, learning model.

1. INTRODUCTION

The landscape of Vocational Education has undergone a profound transformation in recent years, fueled by the dynamic interplay of technological advancements and the evolving demands of the modern workforce. Where traditional vocational education models once centered predominantly on imparting technical proficiencies, a paradigm shift has emerged, necessitating a broader spectrum of competencies encompassing critical thinking, problem-solving, and collaborative prowess (Dahalan et al., 2023). In this dynamic milieu, the development of innovative pedagogical approaches assumes paramount significance. This dissertation embarks on a journey into Vocational Education, unveiling a pioneering perspective through the proposition and exploration of a blended collaborative knowledge construction learning model.

The infusion of technology into the educational sphere has precipitated a revolution in acquiring and disseminating knowledge. Blended learning, characterized by the harmonious fusion of in-person instruction and online modalities, emerges as a promising avenue to address the multifaceted exigencies of vocational Education (Viswanathan, 2021). Concurrently, the principles of collaborative learning have gained prominence for their potential to catalyze profound understanding and holistic skill maturation (Efilti & Gelmez, 2023).

Moreover, the underpinning concept of knowledge construction accentuates the pivotal role of active engagement and the iterative construction of meaning within the learning process (Sezen-Barrie et al., 2020; Feyzi et al., 2020). Against this backdrop, the focal intent of this dissertation crystallizes as the formulation of an all-encompassing blended collaborative

2371

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knowledge construction learning model meticulously tailored to the distinctive contours of Vocational Education. By synergizing the potent attributes of blended learning, collaborative methodologies, and the tenets of knowledge construction theory, this model aspires to empower learners with an adaptive, holistic skill repertoire harmonizing with the demands of the contemporary vocational landscape.

This study navigates a multifaceted trajectory guided by several pivotal objectives. Firstly, a comprehensive examination of existing literature will lay a robust groundwork, unveiling the intricate tapestry of blended learning, collaborative methodologies, and knowledge construction within the precincts of Vocational Education. Secondly, the embryonic stages of the proposed learning model's development and design will be meticulously delineated, offering insights into the organic convergence of each constituent facet to cultivate a stimulating and immersive learning milieu. Thirdly, the subsequent chapters will illuminate the model's execution and evaluation, spotlighting its efficacy in amplifying knowledge assimilation, problem-solving understanding, and collaborative adeptness amidst vocational learners.

Essentially, this study aspires to etch indelible imprints on both the theoretical and practical dimensions of Vocational Education. By offering an intricately crafted blended collaborative knowledge construction learning model, a pantheon of educators, institutions, and policy architects shall glean invaluable insights, paving the way to foster a pedagogical ecosystem that transcends the mere transmission of technical skills, nurturing vital attributes such as critical cogitation, collaborative prowess, and adaptive resilience-quintessential facets for triumphant navigation through the contours of the modern vocational terrain.

2. LITERATURE REVIEW

Blended collaborative learning is an innovative approach that combines face-to-face interaction with online learning tools to facilitate knowledge construction among vocational education students (Jalinus & Others, 2021; Singh et al., 2021). This literature review explores the existing research on the implementation and effectiveness of blended collaborative learning models in Vocational Education, focusing on how this pedagogy fosters knowledge construction and enhances learning outcomes.

Blended Learning in Vocational Education

Worldwide research on integrating blended learning in Vocational Education reveals noteworthy findings (González-Pérez & Ramírez-Montoya, 2022). A significant theme is flexibility, with scholars pointing out the potential for vocational students worldwide to access course content and interact at a convenient pace (Gamage et al., 2022; Ashraf et al.,

2021; Ghimire, 2022; Jebbour, 2022). This customized learning approach enhances participation and caters to individual learning styles (Xie et al., 2019). Evidence from numerous countries emphasizes that blended learning bolsters engagement by merging in-person interactions and digital elements (Chigbu et al., 2023; Almusaed et al., 2023; Guillaume et al., 2022). Interactive tools, dialogues, and joint projects create a vibrant learning environment (Collina et al., 2019; Palmgren-Neuvonen et al., 2021). Studies also point out that merging theoretical concepts and practical application is especially significant in vocational training as it prepares students for real-world occupations. Blended learning is identified globally as fostering crucial digital literacy skills required in today's tech-driven workplace (Hong et al., 2023; Al et al., 2023). Furthermore, the personalized nature of blended learning and the distinct experiences it provides comply with a wide array of vocational learners, prompting researchers to explore effective planning and execution (Pelletier et al., 2022). Scholars have discussed the collaborative exercises facilitated by digital platforms, granting vocational students the chance to collaborate, exchange experiences, and collectively solve issues (Singh et al., 2021).

Collaborative Learning Strategies

A synthesis of research perspectives on collaborative learning strategies worldwide reveals a consensus on their significant benefits. Studies across various countries consistently highlight how collaborative learning fosters active engagement, critical thinking, and interpersonal skills among learners (Chen, 2021; Bassachs et al., 2020). Researchers universally acknowledge that collaborative learning promotes deeper understanding and knowledge construction through peer interactions and discussions. Moreover, findings suggest collaborative learning transcends cultural boundaries, effectively enhancing learning outcomes across diverse student populations (Colomer et al., 2021). The global research consensus underscores the role of collaborative learning in preparing learners for teamwork, communication, and problem-solving in real-world contexts, making it a valuable pedagogical approach in Contemporary Education.

Knowledge Construction in Blended Learning

There is a common agreement in research that blended learning is an effective tool for knowledge building. This collective view highlights how blended learning enables students to develop and use knowledge through conversations, engagements, and solving real-world challenges (Ustun & Tracey, 2020). The ubiquitous role of blended learning in nurturing significant learning experiences is well-documented, ultimately preparing learners to create and apply knowledge in various situations.

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Literature Review Summarization

Despite its numerous benefits, blended collaborative learning also poses certain challenges. Research suggests the imperative need for efficient teacher training, technical aid, and well-structured course design to amplify the advantages of this learning model(Malik et al., 2023; Cobo-Rend O N et al., 2022). The scholarly community agrees that the blended collaborative knowledge construction learning model holds extensive promise in vocational Education (Oke & Fernandes, 2020; Shu & Gu, 2023). Consistent research, resource commitment, and educator professional development are essential to tackle such challenges and wholly exploit blended and collaborative learning models' potential in Vocational Education. By fusing in-person and virtual interactions, employing cooperative learning tactics, and incorporating technology, students are enabled to build substantive knowledge, cultivate teamwork, and hone vital vocational skills. However, triumph in implementation demands tackling obstacles and adopting exemplary practices to guarantee genuinely reformative learning experiences for vocational students. Forthcoming research should persistently investigate the efficacy and adaptability of this progressive teaching approach in diverse vocational scenarios.

The Delphi Method

The Delphi technique is a method used by experts to gather and synthesize their opinions through a series of anonymous questionnaires.(Hsu et al.; B. A., 2019). The Delphi methodology is an iterative approach to gathering and refining expert or stakeholder opinions. It involves participant selection, creating a questionnaire, and collecting anonymous responses. The process involves initial rounds of responses, where participants analyze and revise their responses. The process continues until a consensus is reached and the final report is written. This method is powerful in decision-making, problem-solving, and forecasting, as it taps experts' pooled wisdom while minimizing biases and group dynamics. The Delphi technique involves seventeen experts participating in rounds to gather feedback and contribute to a consensus-building process, enhancing forecasting, decision-making, and problem-solving by leveraging collective expertise and mitigating biases. Delphi is a valuable tool that harnesses collective wisdom, providing valuable insights for decision-making and problem-solving. Its value lies in its ability to reduce biases, adapt to changing circumstances, and promote consensus (Sangsawang, T., 2020).

3. METHOD

This study employed the Delphi method, conducting four rounds of consultations with 17 learning theory experts skilled in Gagné's theory, constructivism, and constructionism (Young & Collin, 2004) and blended collaborative knowledge construction in Vocational Education. This process relied on subsequent data to substantiate the indicators' validity, reliability, and consistency. The research utilized a questionnaire survey, mathematical and statistical analysis, and SPSS software to confirm the integrity of the results. The first round involved a brainstorming session, culminating in Questionnaire I, based on 17 experts' insights regarding cognitive processes, experiential learning, and social contexts in Gagné's theory, constructivism, and constructionism. The second round involved expert opinion assessment via a five-point Likert scale, utilizing the results to construct Questionnaire II. In the third round, we reassessed the responses to Questionnaire II, employing the collated results to formulate Questionnaire III. In the final round, viable concepts were identified, considered, and documented. We addressed any remaining issues and reported the findings, creating a robust framework for a blended collaborative knowledge construction learning model in Vocational Education (Li et al.; K., 2023).

4. RESULTS AND DISCUSSION

Synthesis through four rounds of expert opinion identified the blended collaborative knowledge construction learning model in Vocational Education. Principles, teaching-learning environments, teaching-learning activities/strategies, and teaching-learning models are classified as these.

Table 1. Questionnaire I: Results of Experts' Opinions on Teaching Principles, Environments, Strategies, and Models

Main Term	Questionnaire	M	Opinion of Experts	SD	IQR	Consensus
Gagné's theory (mental processes)	Questionnaire List 1	4.76	Strongly Agree	<.5	1	Congruence
	Learners.	4.29	Moderately Agree	0.47	1	Congruence
Constructivism (learning by doing)	Questionnaire List 2	4.68	Strongly Agree	<.5	1	Congruence
	Questionnaire List 3	4.4	Moderately Agree	<.5	1	Congruence
Constructionism (social context)	Questionnaire List 4	4.71	Strongly Agree	<.5	1	Congruence
	Questionnaire List 5	4.28	Moderately Agree	<.5	1	Congruence

From Table 1: The table lists the views of 17 experts on the principles of Gagne's theory (mental processes), constructivism (learning by doing), constructivism (social context), teaching and learning environments, and teaching and learning models, and the table shows how strongly and moderately the experts agree (Sangsawang et al., P., 2011).

In the table, Questionnaire List 1 contains: Instructors use teaching procedures that have suitable systems, regulations, and elasticity; Instructors create organizational knowledge from experience; Stimulate and control interests; Give helpful advice

2373

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in learning; Assess practice; Arrange their learning to be transformed to the new one; Transfer; Instructors; Signals learning; Chaining; Verbal association; Discrimination learning; Concept learning; Rule learning; Problem-solving; Creative thinking, reflective, thinking, and thinking initiatives. Questionnaire List 2 contains: Learners 'self-knowledge' should be developed according to their competence and previous experience; Learners create a body of discovery knowledge through procedures; Activate pre-knowledge; Instructors; Learners; Self-learning. (simulation and games). Questionnaire List 3 contains: Learners use the knowledge that has already been learned; Find and select questions; Instructors use a teaching method called the learning cycle to encourage learners to ask questions that require thinking and stimulate learners to exchange opinions; Learners emphasize a child-centered model of self-controlled learning. Questionnaire List 4 contains: Construct experiences through practical and problem-solving with their instructors. Both learners and instructors work on one

task together until they understand it completely: Knowledge Transfer, Instructors, Learners, Sharing Construction, Presentation, Learning Assessment, and Modify Actions. Questionnaire List 5 contains: Activate pre-knowledge; Learners learn by practicing or building up skills; Learners link ideas to help create the meanings of the things to be learned; When learning new things, learners should have teacher support in creating concrete examples that help them to gradually develop themselves to be experts in learning, and to be able to choose the thinking models that are most suitable for themselves. The results of the resolutions and reports of the 100 teachers on the relevance of identifying and developing a blended collaborative knowledge-building learning model for Vocational Education, based on a questionnaire determined by the opinions of 17 experts and then collected, are presented in Table 2.

Table 2. Questionnaire IV: The Result of the Resolution and Report of 100 Instructors

Domains	Confirmation (Percentage)	Disconfirmation (Percentage)	Reject (Percentage)
a. Principles			
1. Creating situations and building experiences by using concept maps.	88.0	11.0	1.0
2. Stimulating learners to learn by using music and images.	96.0	4.0	.0
3. Creating an atmosphere suitable for exchanging opinions using social media for instruction.	75.0	24.0	1.0
4. Linking learners' ideas by using.	70.0	27.0	3.0
5. Creating experiences for learning new things before teaching new content.	93.0	2.0	5.0
6. Activating pre-knowledge of oneself through entry examinations, participation in games/activities, and questioning.	89.0	10.0	1.0
7. Exchanging ideas and correcting mistakes through final examinations, answering, and chatting on bulletin boards.	55.0	42.0	3.0
8. Building bodies of knowledge through comprehension, memorization, analysis, and application by using supplementary activities and doing exercises after lessons.	70.0	29.0	1.0
9. Creating creativity, reflective thinking, and initiating ideas by inventing a piece of work, summarizing and designing, and inventing.	93.0	4.0	3.0
B. Teaching-Learning Environments			
The components of teaching-learning management are learners and instructors.	88.0	6.0	6.0
C. Teaching-Learning/ Activities Strategies			
1. Stimulating attention.	80.0	16.0	4.0
2. Activating prior knowledge.	96.0	4.0	.0
3. Informing the learners of expected outcomes.	93.0	7.0	.0

2374

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Domains	Confirmation (Percentage)	Disconfirmation (Percentage)	Reject (Percentage)
4. Manipulating and stimulating conditions to gain attention.	92.0	7.0	1.0
5. Providing learning guidelines.	76.0	22.0	2.0
6. Searching for answers and exchanging knowledge.	92.0	6.0	2.0
7. Reflecting, memorizing, analyzing, and applying knowledge.	88.00	10.0	2.0
8. Learning through self-discovery.	87.0	10.0	3.0
D. Teaching-Learning Models			
1. The term 'dependent learning' means that instructors design learning.			
1.1 Drill-and-practice instruction.	70.0	21.0	9.0
1.2 Test instruction means a series of test items to help students to enhance learning.	82.0	16.0	2.0
1.3 Games-based instruction is an example of dependent learning.	65.0	28.0	7.0
2.'Independent learning' means students design learning.			
2.1 'Collaborative learning' and 'team-based learning.'	84.0	7.0	9.0
2.2 'Project-based learning' is an example of independent learning.	82.0	10.0	8.0
2.3 'Group process learning' is an example of independent learning.	80.0	12.0	8.0

Table 2 presents the results of the fourth round of resolution and report. By this round, feasible ideas have been identified. Questionnaire IV covers instructors' opinions of selected psychology theories, namely Gagné's theory, constructivism, and constructionism. All three theories focus on mental processes, learning by doing, and social context, classified by teaching-learning models. Most experts strongly agreed with Gagné's theory on teaching-learning models. Most experts strongly agreed with Gagné's theory on teaching-learning models. The study involved 100 Vocational Education instructors who developed electronic media like WBI, CAI, e-books, and eLearning in fields such as electrical engineering, electronics, civil engineering, and mechanics. Most experts in their opinions regarding the development of electronic media have identified the blended collaborative knowledge construction learning model in Vocational Education. These were classified by principles, teaching-learning environments, teaching-learning activities/strategies, and teaching–learning models. Based on the experts' opinions, a model of the blended collaborative knowledge construction learning model in Vocational Education was identified and developed. The model was created from psychology theories, namely Gagné's theory (mental processes), constructivism (learning by doing), and constructionism (social context) (Alammary, 2019), as shown in the figure.
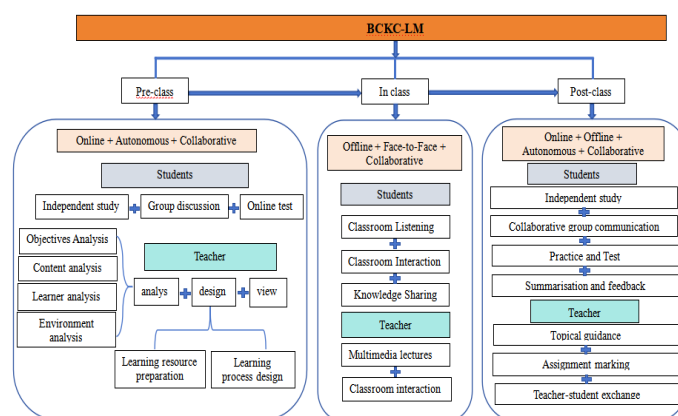

Figure 1. Blended Collaborative Knowledge Construction Learning Model in Vocational Education

The present model amalgamates online and offline components, taking into comprehensive account the learning trajectory, instructional design, pedagogical strategies, and collaborative elements. Knowledge construction and learning outcomes are achieved through blended collaboration.

Subsequently, this model was implemented in an empirical study. The study participants included students from two distinct classes of the same grade and major at Zigong Vocational and Technical College, with 30 individuals constituting the experimental group and an equivalent number comprising the control group. The experimental group engaged with the blended collaborative knowledge construction learning

2375

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model, while the control group adhered to the conventional
face-to-face instructional model.

Table 3. Statistical Analysis of Academic Proficiency Pretest Results of Learners in Experimental Group and Control Group

Group Statistics

	Average	Cases	Standard Deviation	Standard Error Average
Experimental Group	81.02	30	9.172	1.237
Control Group	81.05	30	8.907	1.180

Table 4. Independent Sample Test comparing pretest results in experimental and control groups

		Levine's Test of Variance Equivalence		Mean Equivalence T-Test			
		F	Significance	T	Freedom	Significance (Two-Tailed)	The Average Difference In Value
Pretest Scores	Assuming Equal Variance	.147	.702	-.020	110	.984	- .034
	Not Assuming Equal Variance			-.020	109.532	.984	-.034

From Tables 3 and 4, it is evident that upon analyzing the pretest scores and conducting SPSS data analysis, the results indicate that the significance value of the F-test is .702, which exceeds the threshold of .05. This implies that, under the assumption of equal variance, the mean equivalence t-test results for the first row of data, as presented in the table above, reveal that the average score of the experimental class stands at 81.02, while the average score of the control class is 81.05. The calculated p-value of .984 is also greater than .05, signifying that The pretest scores of the experimental and control groups did not differ significantly. This suggests that teaching can proceed without concerns.

Table 5. Statistical Analysis of Final Examination Scores of Experimental and Control Groups

	Groups	Number of Cases	Average Value	Standard Deviation	Mean, Standard Error
Mark	Experimental Group	30	84.87	12.13513	1.63630
	Control Group	30	74.16	8.14553	1.07890

Table 6. T-test for Student Achievement in Control and Experimental Groups

		Levine's Test of Variance Equivalence		Mean Equivalence T-Test						Difference 95% Confidence Interval	
		F	Significance	T	Freedom	Significance (Two-Tailed)	Mean Difference	Standard Error Margin		Lower Limit	Limit
Mark	Assuming Equal Variance	3.210	.076	-5.504	110	.000	-10.715	1.947		-14.573	-6.857
	Not Assuming Equal Variance.			- 5.467	94.023	.000	1.947	1.960		- 14.606	-6.823

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From Tables 5 and 6, the independent samples T-test was conducted in SPSS on the final exami nation results of the experimental and control groups, and the results of the analysis are shown in the table above. The significance result of the F-test is .076, .076>.05, that is, assuming that the variances are equal, the results of the independent samples T-test of the variances are correct, and the significance P-value of the T-test is 0 < .05, which means that after the implementation of the experiment of the mixed collaborative knowledge construction learning model, the There is a significant difference between the academic performance of the students in the experimental group and the control group. The experimental data confirm that the blended collaborative knowledge construction learning model improves academic performance better than the traditional learning approach.

The results of the study showed that the mean value of the student satisfaction measure in the experimental group was 4.27, with a minimum mean value of 4.10 and a maximum mean value of 4.43, which comprehensively indicates that the learners are satisfied with their studies. The mean value of the student satisfaction measure in the control group was 2.87, with a minimum mean value of 2.50 and a maximum value of 3.10, which indicates that the learners' satisfaction with learning is not good.

5. CONCLUSION

This work proposes a comprehensive learning model and a design methodology for incorporating blended collaborative knowledge building in Vocational Education. The model's execution entails a labyrinth of stages, factoring in varied information domains, notions' development, underpinnings of psychology, and meticulous appraisal of the system environment. The investigation further validated that the successful concoction of a learning model for blended collaborative knowledge construction entails considering all components, including virtual and physical settings, pulling together resources, applying field-specific expertise, theoretical concepts, and psychology theories, and thoroughly evaluating the design process. The Blended Collaborative Knowledge Construction Learning Model is a significant tool for upgrading vocational learning outcomes. It synthesizes blended learning, collaboration in knowledge creation, and practical skills cultivation, thereby priming students for prosperous careers in their selected fields. Future scrutinies and ongoing evaluations will ensure the model's competence in catering to the changing demands of vocational education and grooming professionals prepared to add value to the workforce and society. Blended learning, a combination of online and communication technologies, offers students a flexible and effective way to learn. This study focuses on the implementation and assessment of blended learning at two Indian universities, examining the benefits and challenges of this approach (Zhang et al., P., 2023).

The study highlights the importance of using tools like Blackboard, CodeTantra, and G Suite to enhance students' learning experience and ensure the timely completion of academic activities during the pandemic times (Kumar et al.; M., 2021). They are blended learning, a model that integrates direct instruction and learning-by-doing, focusing on learning theory. The model is validated and placed within a knowledge management framework, resulting in a comprehensive definition that includes context, theory, methodology, and technology.

REFERENCES

[1] Al Husseiny, F. A., & Abdallah, M. H. (2023). Higher Education in the Post-Pandemic Era: Implications and Future Prospects Innovations in Digital Instruction Through Virtual Environments (221-235). IGI Global.

[2] Alammary, A. (2019). Blended learning models for introductory programming courses: A systematic review. PLoS One, 14(9), e221765. http://doi.org/10.1371/journal.pone.0221765

[3] Almusaed, A., Almssad, A., Yitmen, I., & Homod, R. Z. (2023). Enhancing Student Engagement: Harnessing "AIED"'s Power in Hybrid Education-A Review Analysis. Education Sciences, 13(7), 632.

[4] Ashraf, M. A., Tsegay, S. M., & Meijia, Y. (2021). Blended learning for diverse classrooms: Qualitative experimental study with in-service teachers. Sage Open, 11(3), 1915363935.

[5] Bassachs, M., Ca N Abate, D., Serra, T., & Colomer, J. (2020). Interdisciplinary cooperative educational approaches to foster knowledge and competencies for sustainable development. Sustainability, 12(20), 8624.

[6] Chen, R. H. (2021). Fostering students' workplace communicative competence and collaborative mindset through an inquiry-based learning design. Education sciences, 11(1), 17.

[7] Chigbu, B. I., Ngwevu, V., & Jojo, A. (2023). The effectiveness of innovative pedagogy in the industry 4.0: Educational ecosystem perspective. Social Sciences & Humanities Open, 7(1), 100419.

[8] Cobo-Rend O N, R., Bruna Jofre, C., Lobos, K., Cisternas San Martin, N., & Guzman, E. (2022). Return to University Classrooms with Blended Learning: a possible post-pandemic COVID-19 scenario.

[9] Collina, L., Gerosa, G., Manciaracina, A., Mazzarello, M., Vergani, F., & Others. (2019). Designing innovative learning experiences. An experimental project to support education facilities.

[10] Colomer, J., Ca N Abate, D., Stanik U Nien E, B., & Bubnys, R. (2021). Formulating Modes of Cooperative Learning for Education for Sustainable Development (13, pp. 3465): MDPI.

[11] Dahalan, F., Alias, N., & Shaharom, M. S. N. (2023). Gamification and Game Based Learning for Vocational Education and Training: A Systematic Literature Review. Education and Information Technologies http://doi.org/10.1007/s10639-022-11548-w

2377

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[12] Efilti, P., & Gelmez, K. (2023). A deep dive into the impacts of empathy on design learning and teaching. International Journal of Technology and Design Education http://doi.org/10.1007/s10798-023-09835-9

[13] Feyzi Behnagh, R., & Yasrebi, S. (2020). An examination of constructivist educational technologies: Key affordances and conditions. British Journal of Educational Technology, 51(6), 1907-1919.

[14] Gamage, K. A., Gamage, A., & Dehideniya, S. C. (2022). Online and hybrid teaching and learning: Enhance effective student engagement and experience. Education Sciences, 12(10), 651.

[15] Ghimire, B. (2022). Blended Learning in Rural and Remote Schools: Challenges and Opportunities. International Journal of Technology in Education, 5(1), 88–96.

[16] González-Pérez, L. I., & Ramírez-Montoya, M. S. (2022). Components of Education 4.0 in 21st Century Skills Frameworks: Systematic Review. Sustainability, 14(3), 1493. http://doi.org/10.3390/su14031493

[17] Guillaume, D., Troncoso, E., Duroseau, B., Bluestone, J., Fullerton, J., & Others. (2022). Mobile-Social Learning for Continuing Professional Development in Low-and Middle-Income Countries: Integrative Review. JMIR Medical Education, 8(2), e32614.

[18] Hong, C., Calleja, J. J., Clark, R., & Mui, L. S. (2023). Applied Education Futures and the Shape of Things to Come Applied Degree Education and the Shape of Things to Come (1-26). Springer.

[19] Hsu, C., & Sandford, B. A. (2019). The Delphi technique: making sense of consensus. Practical assessment, research, and evaluation, 12(1), 10.

[20] Jalinus, N., & Others. (2021). Developing a blended learning model in vocational Education based on 21st-century integrated learning and Industrial Revolution 4.0. Turkish Journal of Computer and Mathematics Education (TURCOMAT), 12(8), 1239–1254.

[21] Jebbour, M. (2022). The unexpected transition to distance learning at Moroccan universities amid COVID-19: A qualitative study on faculty experience. Social Sciences \& Humanities Open, 5(1), 100253.

[22] Kumar, A., Krishnamurthi, R., Bhatia, S., Kaushik, K., Ahuja, N., Nayyar, A., & Masud, M. (2021). Blended Learning Tools and Practices: A Comprehensive Analysis. IEEE Access, 9, 85151-85197. https://doi.org/10.1109/ACCESS.2021.3085844.

[23] Li, Y., Sangsawang, T., & Vipahasna, K. (2023). Utilizing the Delphi Technique to Develop a Self-Regulated Learning Model. Journal of Applied Data Sciences, 4(3), 254-263. doi:https://doi.org/10.47738/jads.v4i3.124

[24] Malik, N. K., Al-Hattami, A., Elmahdi, I., & Abusin, A. (2023). Hybrid Education and Institutional Readiness.

[25] Oke, A., & Fernandes, F. A. P. (2020). Innovations in teaching and learning: Exploring the perceptions of the education sector on the fourth industrial revolution (4IR). Journal of Open Innovation: Technology, Market, and Complexity, 6(2), 31.

[26] Palmgren-Neuvonen, L., Littleton, K., & Hirvonen, N. (2021). Dialogic spaces in divergent and convergent collaborative learning tasks. Information and Learning Sciences, 122(5/6), 409-431.

[27] Pelletier, K., McCormack, M., Reeves, J., Robert, J., Arbino, N., Dickson-Deane, C., Guevara, C., Koster, L., Sanchez-Mendiola, M., Bessette, L. S., & Others. (2022). 2022 EDUCAUSE Horizon Report Teaching and Learning Edition: EDUC22.

[28] Sezen-Barrie, A., Stapleton, M. K., & Marbach-Ad, G. (2020). Science teachers' sensemaking of the use of epistemic tools to scaffold students' knowledge (re) construction in classrooms. Journal of Research in Science Teaching, 57(7), 1058-1092.

[29] Shu, X., & Gu, X. (2023). An empirical study of A smart education model enabled by the edu-metaverse to enhance better learning outcomes for students. Systems, 11(2), 75.

[30] Sangsawang, T., Jitgarun, K., and Kiattikomo, P.(2011). "An internet based Instructional Design Framework for vocational education," International Journal of Soft Computing, vol. 6, no. 4, pp. 119–127, 2011. doi:10.3923/ijscomp.2011.119.127

[31] Sangsawang, T. (2020). An instructional design for online learning in vocational Education according to a self-regulated learning framework for problem-solving during the COVID-19 crisis. Indonesian Journal of Science and Technology, 5(2), 283-298.Singh, J., Steele, K., & Singh, L. (2021). Combining the Best of Online and Face-to-Face Learning: Hybrid and Blended Learning Approach for COVID-19, Post Vaccine, & Post-Pandemic World. Journal of Educational Technology Systems, 50(2), 140–171. http://doi.org/10.1177/00472395211047865

[32] Ustun, A. B., & Tracey, M. W. (2020). An effective way of designing blended learning: A three-phase design-based research approach. Education and Information Technologies, 25(3), 1529–1552.

[33] Viswanathan, G. (2021). Blended Learning New Normal at Institutions of Higher Learning: A Case Study from Singapore [Doctoral dissertation, The University of Western Australia].

[34] Xie, H., Chu, H., Hwang, G., & Wang, C. (2019). Trends and development in technology-enhanced adaptive/personalized learning: A systematic review of journal publications from 2007 to 2017. Computers \& Education, 140, 103599.

[35] Young, R. A., & Collin, A. (2004). Introduction: Constructivism and social constructionism in the career field. Journal of Vocational Behavior, 64(3), 373–388.

[36] Zhang, Y., Sangsawang, T., & Vipahasna, P. (2023). Assessing Factors and Simulating Innovation: A Study of Innovative Capacities Among Data Science Professionals in China. Journal of Applied Data Sciences, 4(3), 213-228. doi:https://doi.org/10.47738/jads.v4i3.123

2378