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Relevancy of Blending Theory in Science learning during COVID-19 pandemic situation

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Abstract

This paper focuses on the learning interventions that are traditionally classified as either objectivist or constructivist and there has been an increased predisposition for practitioners to use elements of both paradigms as a blending theory. The previous thinking was that they are opposite to each other. But in the initial phase, the Cronje developed it as the mutual exclusive form. He developed a four-quadrant model and put constructivism and objectivism in a triangular vertex of four theories such as immersion, injection, construction and integration. But later he compared it with learning context such as chaos, complex, knowable and known form with the connecting methods and valuing that use of technology as the blending theory which was supported by wang's model for use of science teaching. Cronje's latest study found that the high use of objectivism/behaviourism and constructivism is an interaction point and is considered as the high study achievement in the present pandemic context of science learning. The finding of this study indicates that if the new instructional model developed by Cronje and Wang can connect with the socio-cultural context of rural students by blending theory, methods and creative technology, it would reduce the educational harm in this pandemic context.

Keywords: Blended learning, knowledge construction, constructivism, objectivism, technologies

Introduction

"Blended learning designates the range of possibilities presented by combining Internet and digital media with established classroom forms that require the physical co-presence of teacher and students" (Friesen, 2012, p. 1).

Natural science is seen as developed with the world view of positivist paradigm and guided by the behavioural theory. Skinner and Watson were the two major developers of the behaviourist school of thought which believes that only observable, measurable, outward behaviour is worthy of scientific inquiry (Weegar & Pecis, 2012). After passing time different theories were developed to make science teaching effective. Constructivism was developed as the epistemological practice of science teaching to solve the social reality and was seen as a new paradigm after 1990. Piaget and Vygotsky were strong proponents of constructivism which viewed learning as a search for meaning and described elements that helped predict what students understand at different stages. They believed that knowledge is constructed by the learner and they develop their own understanding through experience (Weegar & Pecis, 2012). The earlier perception was that they are competing for paradigms to each other (Cronje, 2006).

However, in science teaching positivism which is based on objectivist epistemology plays a crucial role in the enhancement of natural science in society. So out of different theories, the most situated theory that Johannes Cronje proposed integrating two seemingly opposing pedagogical approaches into a single model is the objectivist and constructivist idea and that these approaches are complementary rather than the oppositional recognized as the Blending theory (Cronje, 2006). It supports the integrating elements of both paradigms in a single event (Elander & Cronje, 2016). Bellefeuille (2006) also opined his view saying Blending of constructivism and objectivism design supports the creation of a learning environment based on the application of technology.

However, Zhong and Feng (2019) argued somehow differently is that "Basic Knowledge—Self-testing—Theme Learning—Self-creation—Summary Reflection form of learning activities are considered as Blended learning mode for ample teachers who use online, offline and thematic exchange based teaching approaches for effective learning" (p. 1765). He further argued that the online blended learning model has become a trend, its effect has already become the important direction of teaching reform in the education field (ibid). So he called the present teachers "Apple Teacher". It means who help teachers master the way to acquire digital information resources, apply modern teaching methods to classroom teaching activities, and ultimately find innovative ways of classroom teaching. But in the COVID-19 Pandemic, Apple Teachers of our schools and university should be able to add the modern approaches of teaching with the technology combing the different teaching paradigm. But they focus only on offline and online teaching rather than the teaching paradigm of science teaching. The figure1 presented below shows reflective teaching by combining both offline, online learning.

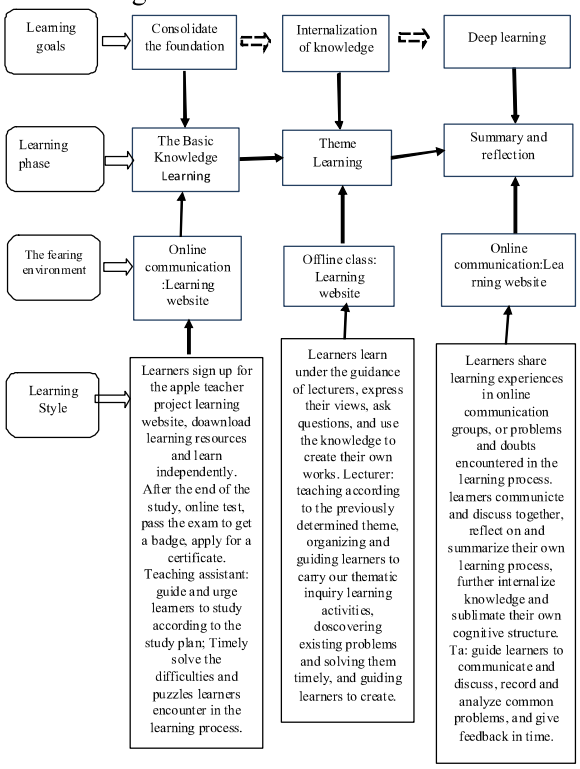

Figure 1. The blended learning model of the "Apple Teacher" program (Zhong &Feng, 2019, p. 1766)

However here is given the main focus on the use of two teaching paradigms such as constructivism and objectivism/behaviourism and their use in science teaching. The contrasting views between the objectivism and constructivism paradigm and its relevancy in present science teaching are prescribed by Cronje (2006) is given below.

Category	*Objectivism*	*Constructivism*
The real world…	has entities that can be categorized on the basis of their properties and relations.	Is structured by our individual minds on the basis of our interactions (this limits what we can know about the real world).
Reality is…	fully and explicitly structured in a way that is shared by all who perceive it. Because of this commonality, reality can be modeled and shared with others.	Local (personal) to ourselves in a universe of multiple realities. Our realities are modeled by the way in which we personally construct them.
Symbols are..	Representation of reality, and are only meaningful to the degree that they correspond to reality.	Products of culture that are used to construct reality.
The human mind….	Processes abstract symbols and fashions them so that they mirror nature.	Perceives and interprets the world by creating symbols.
Human thoughts is…	Symbol-manipulation and is independent of the human organism.	Is imaginative, and develops out of perception, sensory experiences, and social interaction.
Meaning…	exists objectively and independently of the human mind-and is external to the knower.	is a construction that is the end result of an interpretive process that depends on the experience and understanding of the knower.

Figure 2. Contracting views of objectivism and constructivism (Cronje, 2006, p. 390)

In this vein, the arguments of this theory are based on the constructivist approach to instructional design for good students achievement which was not opposed towhat has been called traditional, instructivist, objectivist or even behaviourist approach (Cronje, 2006). In this context, it is evident that the four-component instructional design model does not fit into an objectivist or constructivist paradigm (Elander & Cronje, 2016) and it is found to be blended with each other and seen effective for science teaching in the present COVID- 19 Pandemic.

Mostly, learners are prepared for the written examination by an objectivist approach, and the practice by a constructivist approach (Cronje, 2020). The success of the integrated approach lay in the speed with which learners moved from knowledge to evaluationon Bloom's taxonomy (Cronje, 2006). The integrated approach also draws on the strength of both: "while behaviourist theory supports the effective transfer of knowledge, constructivist theory increases the rate at which knowledge is assimilated and internalized by the participant" (Muuren, 2003, cited in Cronje, 2006, p. 410).

In the present scenario of science teaching, the previous laboratory use of computers is for drill and tutorial group work was not encouraged (Cronje, 2006) students interactive laboratory supports for graphic work knowledge creation and critical creation of new ideas where learners were encouraged to work in groups because this enabled them to experiment and to learn from one another but students need third laboratory computer for supportive and constructive science teaching (ibid). In the course of such work, they might need to consult the Internet for information, use a spreadsheet to calculate and generate charts, and use a word process or to write up the information that they had generated (Cronje, 2006). So my primary concern of this study is how the instructional designers can integrate the Behaviourist/ objectivist and constructivist epistemology at college and university level science teaching in the context of this Pandemic situation and how blending model can be effective for online mode science teaching. To obtain the answer to these research questions the different models developed by educationists are reviewed below.

Learning Model and Science Teaching

In this Pandemic situation how to achieve scientific knowledge and what could be the better model to achieve the science concept was prescribed by Cronje in four-quadrant where the objectivism and constructivism are not in linear form but they are arranged in vertical/ triangle form and seen most effective in the present pandemic situation for science teaching effectively. So, Cronje designed that the original drill-and-tutorial laboratory functions in the instruction quadrant.The project-based computer-skills workshop functions in the construction quadrant but the immersion quadrant is seen blank indicates that it is not relevant for technological learning due to consisted in the low level of objectivism and constructivism (fig.3). The new laboratory, for which both curriculum-based instruction and concept exploration are envisaged, should fit into the integration quadrant (Cronje, 2006). So in this Pedantic situation highly integrated quadrant that carries the high-level objectivism as well as constructivism knowledge is relevant for science teaching.

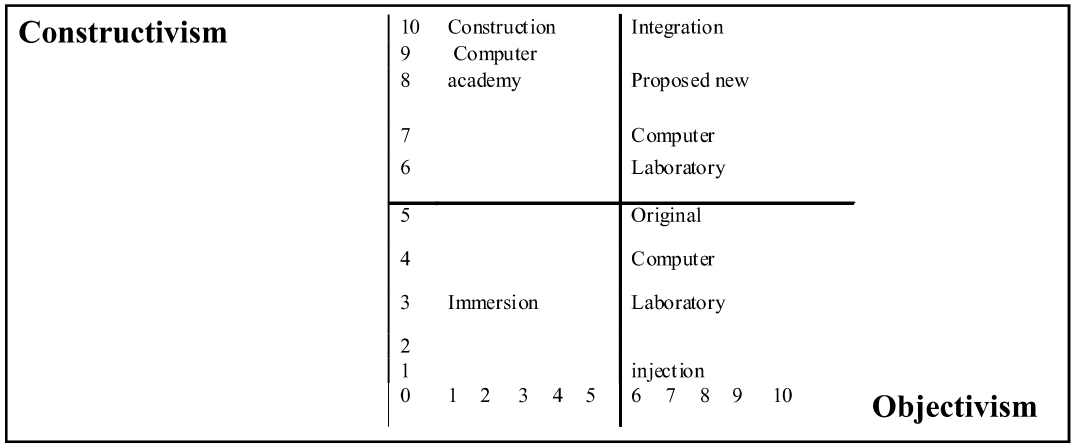

Figure 3.The laboratories in their quadrants (Cronje, 2006)

The above ideas developed that objectivism refers to teaching, whereas constructivism is originally a way of understanding how people learn (Cronje, 2006). The word 'blend' means combining things and learning denotes assimilation of new knowledge. To combine any form of instructional technology (e.g., videotape, CD-ROM, Web-based training, film)

with face-to-face instructor-led training, the combined or mix modes of Web-based technology (e.g., live virtual classroom, self-paced instruction, collaborative learning, streaming video, audio, and text) support to accomplish an educational goal of institutions (ibid). To mix or combine instructional technology with actual job tasks create a harmonious effect of learning and working (Driscoll, 2002). He purposed 10 ways of making online classes effective which are seen as relevant to this Pandemic situation. If we apply Driscoll's rule in our learning activities in this situation, it will support indirectly blend the learning theories as said by Cronje. If we combine various pedagogical approaches (e.g., constructivism, behaviorism, cognitivism), it plays a supportive role to produce an optimal learning outcome with or without instructional technology (Cronje, 2020). However Friesen (2012), who points out that, from the outset, the term has been plagued by ambiguity, and concludes Blended learning, in other words, is almost any combination of technologies, pedagogies and even job tasks. So pedagogical approaches combined with technology are seen as relevant for the instruction of our institution arguing with Wang (2019). In the above, we found to consist of four quadrants. Out of four quadrants, construction, which is high in constructivist and low in behaviorist/objectivist elements, focus on practice and drill (Cronje, 2021), an injection which is high in behaviorism but low in constructivism, where the "combination of these two learning styles" is highest (Cronje, 2020), which is verified by Shipley (2017) saying that mostly in training programme both constructivist and behaviorist approach are highly useful and the immersion quadrant, which is low in overt evidence of either, and where "it is safe to conclude that the majority of our learning occurs informally" (Cronje, 2020, p. 118). But integration quadrant consists at the highest level of both constructivism and objectivism and is found highly applicable in the construction of new knowledge. As said by Shipley (2017) and Seegar and Pecis (2012), behaviouristic is better applicable for practical science teaching as well as work as the teaching machine for computer programing in our present context. In the linear context, they are never met each other so that Cronje (2006) said that constructivism and objectivism consist in the opposite direction to each other. However, they do not only consist as a complementing form but as the mutual exclusive in science teaching whenever they exist in the linear direction (Cronje, 2020). The linear relationship between constructivism and objectivism is shown below.

Objectivism 5 4 3 2 1 0 1 2 3 4 5 Constructivism

Figure 4. Objectivism and constructivism are seen as mutually exclusive (Cronje, 2006, 2021)

According to Cronje (2020), these two paradigms consist of four other paradigms/ theory and they are consistent as the four-quadrant form and consist as the relational way so it is called blending theory as said by Cronje (2006). But later he combined it with the technological use which is explained later. The relational context of each paradigm in the four-quadrant is given in the figure and prescribed below in detail.

Constructivism	10 9 8 Construction 7 6	Integration	
	5 4 3 Immersion 2 1 0 1 2 3 4 5	Injection 6 7 8 9 10	**Objectivism**

*Figure 5***.** The integration of two learning paradigms (Cronje, 2006, p.392)

Elander demonstrated that the majority of instructional designers worked mainly in an objectivist/behaviorist paradigm, but that there were substantially more designers who took an integrated, and therefore blended approach(Cronje, 2020) is seen in the context of the present science teaching. His experiment indicated that most of our science teaching is found concentrated in integration and injection quadrants rather than the immersion and construction quadrants. It indicates that still now the role of behavioral or objective epistemology is seen as crucial for the science teaching of our school and university level. A large quantitative study conducted by Elander and Cronje (2016) shows a real learning scenario of blending of two epistemologies as a paradigm of integration and injection which is seen applicable in the context of science teaching.

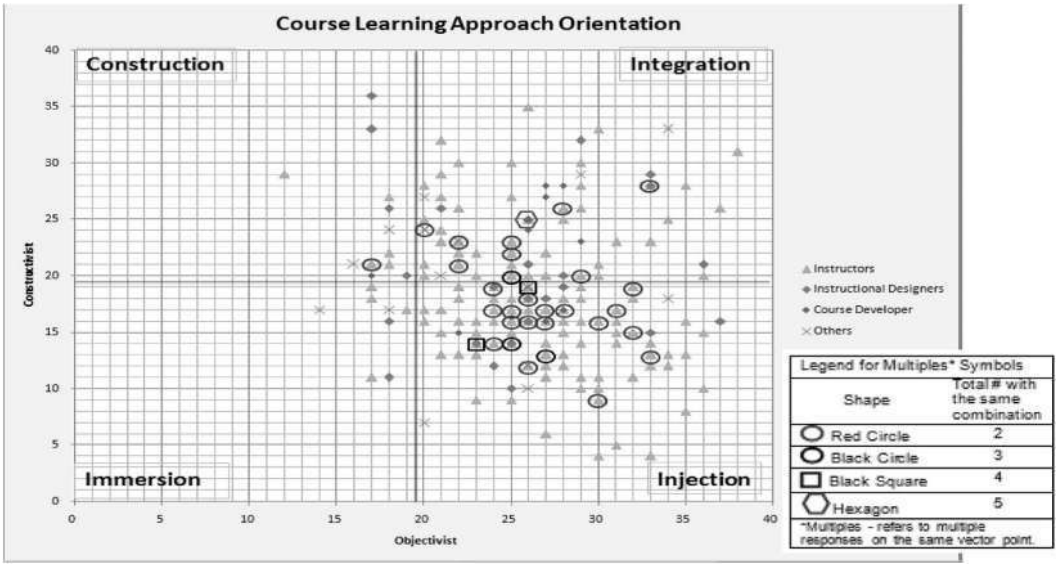

*Figure 6***.** Four quadrants of blended learning demonstrated by (Elander & Cronje, 2016, p.399)

A large-scale quantitative study done by Elander (2012) showed that a significant number of instructional designers did, indeed, blend behaviorist and constructivist learning and that many learning designs fell in the integration quadrant. Figure 6 shows that the majority fell quite high in the injection quadrant, suggesting that lecturers still prefer a high dose of direct instruction in their blends (Cronje, 2021). It shows that science teaching is still dependent on the behavioristic or objectivist paradigm. However, there is found a debate about the use of this paradigm in contextual science teaching. So Cronje (2020) connected it with the constructivism paradigm focusing on integrated knowledge rather than immersion and injection. According to Cronje, the construction of knowledge is seen as very challenging. The relational pedagogical dimension between these two paradigms is given below.

Category	**Extremes on the continuum**	
Epistemology	Objectivism	Constructivism
Pedagogical philosophy	Instructivist	Constructivist
Underlying psychology	Behavioral	Cognitivist
Instructional sequencing	Reductionist	Constructivist
Goal orientation	Sharply focused	Unfocused
Role of teacher/instructor	Authoritarian/Didactic	Egalitarian/Faacilitative
Experiential value	Abstract	Concrete
Program flexibility	Teacher-proof	Easily modifiable
Value of errors	Errorless learning	Learning from experience
Motivation	Extrinsic	Intrinsic
Structure	High	Low
Learner control	Non-existent	Multi-faceted
User-activity	Mathematic	Generative
Accommodation of individual differences	Non-existent	Multi-faceted
Co-operative learning	Unsupported	Integral
Cultural sensitivity	Non-existent	Integral

Figure 7. Pedagogical dimensions (Cronje, 2006)

The figure 7 indicated the pedagogical practices of both learning paradigm i.e constructivism and objectivism epistemology. There are so many differences between these two epistemologies. However, for the construction of scientific knowledge both could be appropriate whenever they are used as the integrated quadrant so that this model could support combining the knowledge and demise the accusing of constructivism providing only knowledge without any skills. So integration of both constructivism and objectivism paradigm support

for the combination of both knowledge and skills; and minimizing the polarity dilemma consisted between them (Cronje, 2006) which are required for science learning as a form of blending theory. The data given in figure 6 is plotted on the four quadrants and figure 5 show the possibility to answer the four sub-questions of the main question: how many elements would befound in each of the four quadrants (immersion, construction, integration and injection)? The Elander and Cronje (2016) study report indicated that only two of thirteen responses (6.3 %) plotted in the construction quadrant. However, if one looks beyond the construction quadrant to general constructivist orientation and included integration quadrant courses, there are 87 courses (42.3 %) that scored above the mid-point on the constructivist axis, and none of the courses containing constructivist elements scored at or below 10 % on the objectivist axis and 111 courses (53.8 %) located in the injection quadrant (ibid). Additionally, if the question were broadened to objectivist orientation ingeneral the total including the integration quadrant courses was 185 courses (89.8 %) that scored above the mid-point on the objectivist axis, and none of the courses containing constructivist elements scored on or below 10 % on the objectivist axis (ibid). Will there be integrated courses reported where objectivist and constructivist approaches are being used equally, fitting the integration quadrant? Seventy-Four courses (36 %) were in the integration quadrant (Elander &Cronje, 2016, pp. 398-339) of two dimensions at right angles to produce a matrix of four paradigms. The above figure that is proposed here is a blend of two learning theories, Constructivism and Behaviourism. Cronje (2021) puta somehow different view about the four quadrants. He argues that the immersion quadrant is so-called because the learner is thrown into the deepend. There is no evidence of clear behaviorist objectives or a design of contiguous stimulusand response. Neither is their evidence of a constructivist outcome, nor scaffolding, prompting and fading (ibid). One might argue that no learning can take place under such circumstances, yet it is the domain not only of trial and error but also of experiential and informal learning. It is where we learn to walk and to talk. The injection quadrant is named for a desireal most to by pass the brain by putting pre-digested learning directly into the head (Cronje, 2020). The construction quadrant is the domain of the learning task. It draws on constructivist learning theory and its chief method lies in constructionism, where learners come to knowledge and understanding by constructing artifacts and learning in the process (ibid). Finally, the integration quadrant represents scenarios that are high in both behaviorism and constructivism simultaneously. It is the domain of the concert pianist or the ballet dancer where relentless drill and practice integrate with a constructed understanding of the deeper meaning of what is being learned (Cronje, 2021). The figure below indicates the present science learning scenario. In the context of Nepal also, it is still found focusing on the highly practised behavioristic/objectivist teaching-learning paradigm rather than integration of constructivist and cognitivist learning epistemologies.

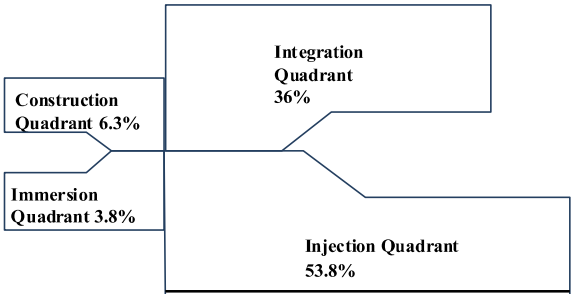

Figure 8. Value of four-quadrant (Elander & Cronje, 2016)

The construction quadrant, with a constructivist orientation, contained 6.3 % of the main study results. The integration quadrant, with high levels of both objectivist and constructivist elements, contained 36 % of the main study results. The injection quadrant, which has an objectivist orientation, contained 53.8 % of the main study results. The immersion quadrant, with low levels of objectivist and constructivist elements, contained only 3.8 % of the main study results (Elander & Cronje, 2016).

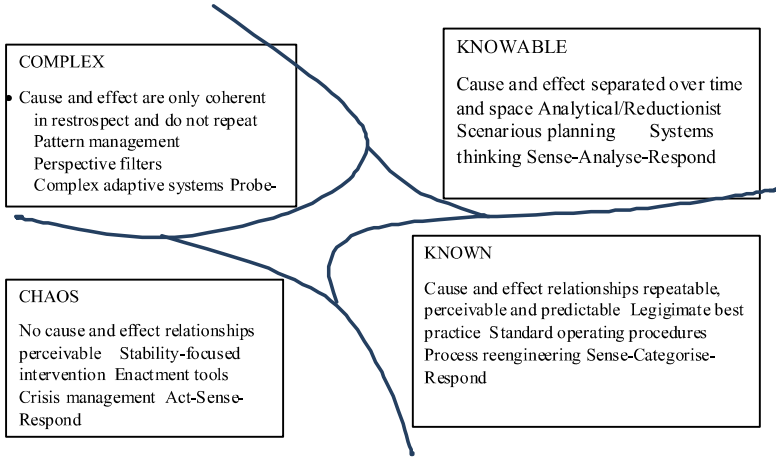

Figure 9: Cronje framework of abductive reasoning (2020, 2021)

This model is mostly based on constructivism learning. Construction of tasks, problem-based learning and open-ended learning environments would be appropriate here. In a low-technology environment, physical puzzles would be useful and in a high-technology environment spread sheets and other information-processing tools would be recommended (Cronje, 2020). Cronje's abductive model is further blending with the immersion, integration, construction and injection and their two-way relationship and its blending with the use of present technology is seen as relevant in the context of the present COVID- 19 Pandemic situation.

Context (Kurtz & Snowden)	Theory (Cronje)	Methods	Technologies
Known	Injection	Tutorial	Lecture
		Drill	Book
			Video
Complex	Construction	Construction	Open-ended learning environments
		Exploration	Construction kits and tools
			Spreadsheets
Knowledge	Integration	Puzzle	Games
		Discussion	Discussion tools
		Debate	
Chaos	Immersion	Experience	Blogs
		Field trip	Logbooks
		Apprenticeship	Assessment tools

Table 1. *Blended Learning Decision*

New illustration of blended learning model developed by Cronje (2020). The learning context, Cronje's theory, methods developed for the application of theory and techniques of knowledge construction is given in the above table in the relational matrix. If appropriately used this model supports both online and offline learning effectively in the Pandemic situation

Findings and Discussion

The table above shows Cronje's blending learning model which has a focus on four contexts of learning as known, complex, knowable and chaos and their relation with theories such as injection, construction, integration and immersion. It is related to methods such as a tutorial, drill, construction, exploration, puzzle, discussion, debate, experience, field trip, apprenticeship. Not only that its relationship is found with technologies such as lecture, book video, open-ended learning environments, construction of kits and tools, spreadsheets, games, discussion tools, blogs, logbooks and assessment tools respectively. The above justify that the appropriate use of a mix of context, theories, methods and technologies to optimize learning in a given context (Cronje, 2020). The finding of the research definition of blended learning should be built around learning theory and should refer to a blend of direct instruction and learning-by-doing. The paper reports on research conducted to validate a model that puts behavioral and constructivist learning at right angles and considers if the two can occur simultaneously (Cronje, 2020). For the present context of COVID-19 Pandemic, considering the context of network capacity of rural Nepal, both online and offline programmes could be moved forward. For this process, as mentioned by Wang (2019) we should follow the model for effective teaching and learning both at the university as well as the school-level activities. In the present context, the evaluation system also moves forward both written, group work and progress report systems. The conceptual framework developed by Wang is a very powerful model in our present contents of teaching. This model given below provides the new direction for solving the present context of arousing questions about what types of learning are appropriate. So the Blending of both offline and online mode with a multidimensional model could be better to use considering the geographical and networking situation of Nepal.

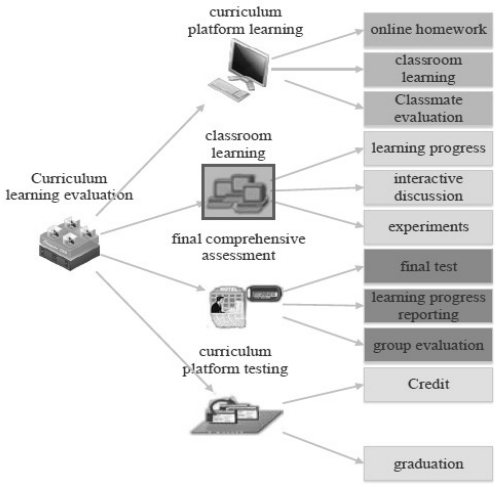

*Figure 10***.** Course assessment system of blending learning model developed by Wang (2019)

Conclusion

In conclusion, blended learning moves away from being a mix of face-to-face and technology, and rather becomes the appropriate use of a mix of context, theories, methods and technologies to optimize learning in a given context (Cronjé, 2020). It is also clear that the traditional distinction between behaviorism and constructivism in teaching and learning is rapidly being blurred as practitioners select from both paradigms based on the outcomes they wish to achieve. The proposed blended learning decision matrix is provided as an example only. It is recommended that practitioners use the matrix in developing their own blend. Further research is required to develop heuristics that might inform these choices (Cronje, 2021). Not only that it is believed that the blending learning modelis based on network space, but teachers also need to change from dominant role to resource organizer, use more efforts to guide and cultivate students' learning habits so that they can develop the habit of self-discipline and continuously learn with rich learning resources in network learning space (Wang, 2012). Moreover, as Driscoll (2002) recommended the four types of blending learning which are seen as appropriate for the present context of science teaching are given below.1. To combine or mix modes of web-based technology (e.g., live virtual classroom, self-paced instruction, collaborative learning, streaming video, audio, and text) to accomplish an educational goal.2. To combine various pedagogical approaches (e.g., constructivism, behaviourism, cognitivism) to producean optimal learning outcome with or without instructional technology.3. To combine any form of instructional technology (e.g., videotape, CD-ROM, web-based training, film) with face-to-face instructor-led training.4. To mix or combine instructional technology with actual job tasks to create a harmonious effect oflearning and working.

All these arguments conclude that Blending theory is not only based on the pedagogical approaches, it is the combined practices of context, theory, pedagogy, creative technology as mentioned by Cronje (2020). Moreover, it is interactive as well as mixed these all with the day to days job professions as learning and working. If we combine all the prescribed models,

technology and practices in the present COVID-19 Pandemic context, science teaching of both school as well as university-level learning can move smoothly. Moreover, if we are able to add cultural context within teaching as a multidimensional model, it will support more exploration of the new knowledge, ideas and skills to minimize the educational harm of our rural students. The new matrix that has been shown by Cronje and Wang are related to training and strategic planning for junior school administrators. It should still be tested in other circumstances, such as in informal learning, school teaching, and even teaching and learning at college or university level (Cronje, 2006). Not only the modes of teaching strategies are applicable in the geographical and economic condition of Nepal, both offline and online strategies combining with an integrated learning approach could be better to implement in the present context of our learning.

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