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Effectiveness of Backward Design Lesson Planning in Teaching and Learning Physics: A Case Study

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Abstract— *Lesson planning through backward design was introduced in the schools in one of the Dzongkhags in eastern Bhutan to enhance students' learning since 2017. This study was undertaken to find out the effectiveness of backward design lesson planning in teaching and learning physics. A qualitative case study approach implementing semi-structured interviews, classroom observation, and document analysis was used. A purposive sampling method was used to select eight physics teachers from four schools. The study found that lesson planning using backward design significantly influences students' understanding of the concept and promotes purposeful classroom engagement through realistic classroom learning. As the assessment is planned separately in this design, it provided teachers with an improved understanding of students' learning, the achievement of learning standards and, subsequently, scaffolding them to achieve greater learning performance. The other benefits include improved academic achievement and increased confidence of teachers. Some challenges were limited evidence of transferring students' learning to their everyday lives; more time requirements in the planning phase; teachers' limited knowledge in setting instructional goals; and developing reliable assessment tools and essential questions. This study recommends conducting similar studies in other subject areas involving more participants to offer richer perspectives on the effectiveness of the backward design.*

Keywords— ***Backward design, desired result, assessment evidence, learning plan, transfer of learning.***

I. INTRODUCTION

Education is an essential human virtue, a necessity of society, the basis of a good life, and a sign of freedom (Bhardwaj, 2016). Today we have education on every aspect of life, which paves the way for the holistic development of the individual, society, and nation. It is, of course, a boon for human life. But it is equally true that education should not only focus on learning specific content if the purpose is to produce good citizens. Our curriculum should ensure that more emphasis is given to conceptual learning (Abell & Lederman, 2007) as it enables students to understand the relevance of the book knowledge to the real world. Hence, the teachers play an essential role. According to Sikdar and Balwaria (2013), the quality of education is directly linked to how well teachers are prepared for teaching. A good lesson plan is the main foundation of the educational structure, and it is the core of promoting quality education (Nesari & Heidari, 2014). It is at the heart of being an effective teacher, as it helps the teacher to structure the teaching and learning process.

Over the last few years, the Royal Government of Bhutan and the Ministry of Education (MoE), Bhutan, have taken several initiatives to enable teachers to develop the knowledge and skills needed to enhance the quality of education. However, students' learning in schools has come under increased public scrutiny as the knowledge and skills they have acquired are said to be inadequate to meet the new challenges. MoE (2014) reported that Bhutanese students are unable to understand core concepts and apply knowledge to real-life situations across different subjects and grades. A growing gap is prevalent between the current and quality of learning outcomes from the classroom practices, school processes, and education

system. Further, the pupil performance report of schools under Trashi Yangtse Dzongkhag shows that mean marks in science are low and have decreased over the years. For instance, in the Bhutan Certificate of Secondary Education (BCSE) examination, the Dzongkhag mean scores for class X science were found to have decreased for three consecutive years. The mean scores in science for the years 2013, 2014, and 2015 are 52.4%, 50.8%, and 49.7%, respectively (Bhutan Council for School Examination and Assessment [BCSEA], 2013; 2014; 2015).

Dolma (2016) reported that teachers in Bhutan still follow the conventional lesson planning template introduced during teacher training colleges. As teaching moves further into the 21st century, more focus should be given to the output of the instruction rather than activities and instructions. Our lesson planning and delivery should make sure that students can expand their learning experience to include meaningful learning. The lesson planning approach using backward design leads to a deeper understanding of the content and enables students to connect it to new situations (Wiggins & McTighe, 2005). It allows teachers to plan and teach towards the end goal. At its core, backward design has three main stages: (i) identifying the desired results, (ii) determining the assessment evidence, and (iii) planning instruction and experiences to meet the results (Wiggins & McTighe, 2011).

The Dzongkhag Education Office (DEO) of Trashi Yangtse took the special initiative to train a total of 335 teachers on designing and delivering lessons using backward design in 2017. Since then, teachers in the Dzongkhag use backward design to plan and deliver lessons in the classroom. Till date, no study has been undertaken to understand its effectiveness in enhancing students' learning. Therefore, this study aims to find the effectiveness of backward design in planning and delivering physics lessons in the Trashi Yangtse Dzongkhag.

II. LITERATURE REVIEW

Backward design, or Understanding by Design (UbD), is a teaching approach developed by Wiggins and McTighe. It utilizes a performance-based pedagogical approach focused on students' learning (Kulla-Abbott, 2007). In this design, the teacher thinks of the most important lesson followed by the most appropriate assessment to measure those objectives, and then develops relevant activities (Florian & Zimmerman, 2015). The backward design process in lesson planning consists of three general stages, as shown in figure 2.1.

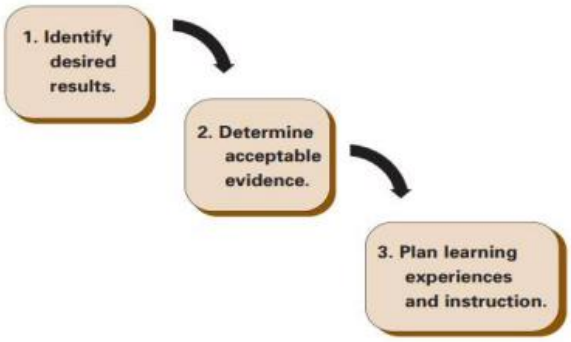

Fig.2.1 Three key stages of backward design

Note: adopted from G. Wiggins and J. McTighe (2005, p18).

According to Wiggins and McTighe (2011), transfer of learning in backward design refers to the ability of students to apply knowledge and skills learned to a new situation or other contexts. Students are said to have fully understood the concept if they can apply it to other contexts. Transfer of learning takes place when other existing knowledge, abilities, and skills affect the learning or performance of new skills or tasks (Subedi, 2004). A study by Burson (2011) found that when the learning standards of the lessons are achievable and realistic, transfer of learning seems to take place. Further, motivation, learning environment, and realistic learning goals have a significant influence on the transfer of learning (Renta-Davids et al., 2014).

Backward design benefits teachers by shifting their teaching from content-centered to learning-centered courses, which actively engage students in active learning (Davidovitch, 2013). Further, Jozwik et al. (2017) stated that backward design focuses on teaching and assessing students to encourage understanding of main ideas and transfer of knowledge through authentic performance. When lessons are planned and delivered using backward design, it broadens students' understanding with long-term transfer of understanding (Graff, 2011).

Students' understanding and transfer of learning will also depend on framing activities around the essential questions (Childre et al., 2009). Essential questions provide a conceptual lens through which students are best engaged through realistic understanding and make real-life connections to the concepts taught (Davila, 2017; McTighe & Thomas, 2003). The findings of Acar et al. (2019) showed that students find classroom learning enjoyable, amusing, and interest-arousing when backward design is used.

Assessment plays an important role in backward design. According to Childre et al. (2009), students' evidence of understanding in backward design is tested

through assessment tools such as oral questions, quizzes, observations, tests, performance tasks, and informal dialogues. Although both formative and summative assessment are substantial to measure learning outcomes, formative assessment is more widely used in backward design (Black et al., 2003; Whitehouse, 2014).

Lesson planning using backward design is found to be significant in improving the academic achievements of students on tests and examinations. According to Kelting-Gibson (2003), lesson instruction delivered through backward design helps students to attain higher levels of academic performance. The study by Hosseini et al. (2019) found that backward design has a positive effect on students' academic achievement. Similarly, Kulla-Abbott (2007) reported that students' achievement scores were significantly higher in lessons delivered through a backward design approach.

The kinds of activities integrated using backward design have a greater impact on students' learning. Reynolds and Kearns (2017) found that implementing this design in the classroom helps teachers to prioritize content delivery to students and enhances the creative flow of ideas, which ultimately enhances students' comprehension. The focus of teaching is on what students will be able to do with the content they learn. It is by asking essential questions that the learners can explore the key concepts, themes, theories, issues, and problems that reside within the content, perhaps as yet unseen. A key aspect of implementing the backward design stressed by Reynolds and Kearns (2017) is that it helps teachers to prioritize content delivery to students.

Although research has shown the positive effectiveness of backward design in planning and instructional delivery (Hosseini et al., 2019; Kelting-Gibson, 2003; Kulla-Abbott, 2007), it is still not a popular approach to lesson planning. Backward design is a more popular approach in curriculum development (Cooper et al., 2017; Michael & Libarkin, 2016; Ornstein & Hunkins, 2018; Wiggins & McTighe, 2005). Teachers spend more time developing assessment strategies prior to the development of the instructional activities (Song, 2008). Furthermore, Davidovitch (2013) reported that planning a lesson using backward design undoubtedly requires extensive thinking, time, and effort. In backward design, there is no room for spontaneity, so teachers should be acquainted and be patient to plan each lesson effectively. Jozwik et al. (2017) reported that teachers do not have competent knowledge and skills for planning lessons using backward design. They require more training on how to align, collaborate, and improve the components of the backward design framework (Herro, 2018).

III. METHODS

A qualitative case study approach was used to get an in-depth insight into lesson planning design. Data was collected through semi-structured interviews, classroom observation, and document analysis. Data were collected from four schools in the Trashi Yangtse Dzongkhag: two middle and two higher secondary schools. A purposive sampling method was used to select eight Physics teachers. Face-to-face interviews and classroom observations were carried out with all teachers. Lesson plans were used for document analysis. Member checking was carried out to enhance the trustworthiness of the study. The data sources from document analysis, classroom observation, and interviews were triangulated.

IV. RESULTS

The themes generated as a result of data analysis are:

Backward design as a transfer of learning;

Assessment evidence in backward design;

Benefits of using backward design and

Challenges of using backward design.

4.1 Backward design as a transfer of learning and understanding

Almost all the teachers agreed that backward design is an important aspect in connecting classroom learning to real-life experience and transferring learning. For example, T3 said:

> Backward design lesson planning is the most effective plan as it primarily focuses on students' learning and understanding. Students are somehow made to think critically and make real-life connections with the concepts that they are learning. Thus, enhancing students' comprehension of the concept leads to the transfer of learning.

Similarly, teachers (T1, T4, and T5) stated that the lesson planning format they use in the school has greater benefits in terms of learning transfer.

In the objective section of the lesson plan, distinct goals that cover knowledge, understanding, and skill competencies help teachers to design lessons that prepare students to use classroom learning in new learning situations (T1). The analysis of the teachers' lesson plans revealed that all the teachers set specific goals under each competence. When teachers were asked to cite examples or narrate situations where students were found applying classroom learning, their (T1, T3, T6, T8) examples were mostly based on experiments and model preparation done by students. However, document analysis revealed little evidence on how learning is transferred.

Document analysis revealed that all the teachers design one or two essential questions. To the questions raised on the significance of essential questions, all the teachers mentioned that essential questions can influence students to relate and learn concepts through real-life situations. Essential questions ensure realistic classroom learning because these questions are not just fixed to remembering and understanding under Bloom's Taxonomy, but they demand more competency-based questions that are higher-order thinking questions (T4, T7). Therefore, learners are somehow made to be more critical, analytical, creative, and able to relate to real-life situations (T7). Classroom observation supported teachers' view that discussion about essential questions can, in fact, make classroom learning more realistic. For example, in the classroom observation of T1, it was found that students were coming up with examples of the application principle of hydraulic machines. Students' learning was found to be enriching and purposeful when the teacher asked questions related to the application of hydraulic machines. However, not all the essential questions were open-ended, thought-provoking, and something that helped them connect with their daily lives. The teachers' lesson plan analysis showed that essential questions designed by T3 and T8 were more of remembering and directly extracted from the textbook. When asked about this, they said that students' ability to make connections with real-life situations depends on the nature of the topics and the types of learning goals they set. This was evident from the teacher's quote:

> When the concepts of the lessons are built around what seems to be related to their everyday lives, I have seen students' excitement towards their learning and essential questions also trigger students' minds. They come up with more examples in the lessons, which can easily link them with their experiences. However, when we teach topics that are abstract, we end up designing essential questions that call for students to remember or just to test the concept only. (T5)

The classroom observation also revealed that discussion around the essential questions makes classroom learning interactive, engaging and students upscales their knowledge through active learning.

4.2 Assessment evidence in backward design

Assessment is an important component in backward design because it provides comparative data on how well students are learning. Interview data analysis showed that teachers consider assessment in backward design as an important component and should be authentic in evaluating students' learning (T1, T3, T5, T7). For example, T7 said, "Assessment plays a significant role in backward design because it is one of the three major components of this design. The assessment tools we design give evidence of students' ability to insightfully interpret their learning". Assessment also gives the teacher a way to collect data that reflects how close students are to meeting the learning standards and allows students to demonstrate their knowledge, understanding, and skills through the learning activities designed in stage three (T1).

On the assessment practices, four teachers (T2, T4, T5, T7) confirmed that they employ both formative and summative assessment. According to T2, embedding both assessment methods gives them an in-depth understanding of students' learning. However, the analysis of teachers' lesson plans and classroom observations showed that all teachers use only formative assessment tools in their teaching and learning process. Teachers expressed that the use of formative assessment tools requires less time and helps them to give immediate support to improve students' learning (T1, T6). Numerical problem solving, discussion, questioning, and informal dialogue were common assessment tools used by all eight teachers. For example, T6 remarked:

During the classroom teaching and learning process, I frequently use assessment tools such as group discussion, questioning, numerical problem solving, and observations to assess my students' learning. The rationale behind using these tools is mainly based on my competency and familiarity with using the assessment tools.

When assessments were planned separately, it helped the teacher identify students' learning abilities and support them accordingly (T1, T7). For instance, T7 said:

> Since backward design focuses more on assessment, my focus in the class is on students' learning through assessment. Through various assessment tools, I get to know students' understanding of the concept better. Thus, with immediate and appropriate scaffolding, I am able to take their learning to a greater level.

In order to enhance, encourage, and enable students' learning, they are given more support by the teachers based on the information derived from the assessment. For instance, in the classroom observation of T3, the teacher supported students' understanding through the answers shared by students on the experiment conducted on the Archimedes principle. It encouraged more participation. However, the analysis of teachers' lesson plans did not reveal when, how, and where these assessment tools would be used in the learning activities. On inquiry, a teacher expressed that time was not enough to plan detailed learning plans (T8).

4.3 Benefits of using backward design

On the positive aspects of backward design, besides strengthening students' conceptual understanding and realistic learning experiences, teachers have expressed many other benefits. The majority of the teachers, except T3, mentioned that this design was a better approach for enhancing the academic achievement of students. For example, T1 said,

> Since students know how to relate their classroom learning to new situations, scoring higher marks on tests and examinations has not been a problem for my students through my experience of using this lesson planning for the last two years.

Another teacher (T2) pointed out that this design gives them a better opportunity to evaluate and monitor students' learning processes in the classroom, which significantly adds to higher academic performance. Although there were no other data sources to draw conclusions on academic achievements other than teacher interviews, most teachers agreed that this design promotes higher academic achievement.

The study also revealed that a teacher's lesson planning has a direct impact on enhancing their confidence level in the classroom. Except for one T3, all teachers expressed that lesson planning through backward design boosts their confidence in the classroom. One of the reasons pointed out was that the teacher spent more time on planning, thereby executing the plan in the classroom became easier and more organized (T5, T7). Another reason for increased confidence levels was that when teachers have clarity and a vision of what they want their students to achieve at the end of the lesson, everything becomes effective and successful in the classroom (T7). The classroom observations also revealed that teachers were confident in implementing the plan and carrying out the activities. However, a teacher said that delivering lessons through backward design does not influence the confidence level in the classroom due to limited knowledge and experience of the design (T3).

Teachers pointed out that backward design is aligned with the National School Curriculum (NSC), now called the New Normal Curriculum (NNC) framework developed by the Royal Education Council (T1, T2, T4, T5, T7). In an attempt to engage and continue students' learning during the school closure in response to the COVID-19 pandemic, NSC was implemented by the Ministry of Education at the beginning of the 2021 academic year across all subjects. The NSC frameworks are premised on competency-based education that emphasizes students' development and application of knowledge, skills, and attitudes to new and challenging situations (REC, 2021). The NSC allows teachers and students to explore and go beyond what is in the textbook to get information on what they are learning. Teachers have a choice to select the resources and learning materials other than the list of references outlined (T1, T4, T5). In doing so, teachers can design enriching and purposeful learning experiences, which is parallel to the intent of backward design (T5).

4.4 Challenges in using backward design

Despite the numerous benefits of using backward design, several implementation barriers are experienced by the teachers, which, according to them, hinder effective teaching. The major challenges that the teachers expressed were time requirements, teachers' competency in designing assessment tools, and essential questions.

All the teachers mentioned that planning lessons using the backward design is time-consuming, which has implications for completing the syllabus on time (T1, T3, T4, T7). The content of the prescribed textbook is said to be bulky and the teachers face challenges in completing the syllabus on time, which then results in less time for planning (T1, T4). This is self-evident from T4's quote:

> Teachers' roles in schools are not only confined to the teaching and learning process. Besides this, we have so many other responsibilities. When we have minimal free periods to plan our lessons, using this design is another hectic task for us. We need to invest lots of time in setting the instructional goals, planning assessments, and aligning different components with the limited time we have.

Similar opinions were shared by T5 and T6. They used conventional methods when they didn't get enough time to plan lessons using backward design.

Teachers are also confronted with difficulties in planning and selecting the right assessment tools (T1, T3, T4, T5). In particular, when the assessment has to be planned before learning activities, teachers use the same assessment tools. For instance, T5 said, "Since I am generally used to thinking about assessment only after learning activities, it is hard to conceptualize assessment evidence. Thus, I end up using easy and common assessment tools like questioning and discussion more frequently". Similarly, the document analysis and classroom observation revealed that all the teachers are accustomed to using common assessment tools like questioning and discussion.

A teacher must be competent and well-informed about every component of lesson design. Nonetheless, the findings of the study showed that all teachers are not competent at planning lessons using backward design. According to T3:

> Unlike my other colleagues, I did not attend the workshop on this approach conducted by the DEO back in 2017 since I joined this Dzongkhag recently. My very limited understanding of this design comes solely from my own readings and a short professional development program provided by the school. Whenever I encounter problems, I discuss them with my friends, but no one really seems to be proficient with this design.

The statement demonstrates the inadequate knowledge and skills of the teacher, which led to ineffective delivery and limited effective learning in the classroom. Teachers also revealed that they struggle with framing the essential questions that can foster realistic learning in students (T3, T6, T8). Further, classroom observations and document analysis revealed that teachers (T3, T6, T8) have insufficient knowledge and skills in designing essential questions. In the classroom observation of T8, the teacher did not create any learning opportunities that could help students connect their classroom learning to real-life experiences. The concepts taught in fluid mechanics are basically focused on giving definitions and solving numerical problems, which otherwise would have made students' learning experiences more enriching and promoted further exploration.

V. DISCUSSION

When learners understand the underlying concepts and principles, it becomes easy to use them in new contexts (Wiggins & McTighe, 2005). A study by Davidovitch (2013) reported that teachers perceive lesson planning through backward design as an effective way to shift their teaching from content-centered to learning-centered courses, which ultimately upholds the transfer of learning. These findings corroborate the result of the present study, which shows that teachers view backward design as an important aspect in enhancing students' understanding and transfer of learning.

Teachers expressed that when the learning standards of the lessons are achievable and realistic, the transfer of learning seems more evident. Similar findings were reported by other researchers (Burson, 2011; Renta-Davids et al., 2014). Although lesson planning using backward design emphasizes more on the transfer of learning, it does not materialize practically as expected. In reality, there is limited evidence for the transfer of learning. The evidence shared by a teacher was basically from practical classes and model making, which are also rarely done. These findings were not in line with other literature where lesson planning using backward design widens the transfer of learning (Graff, 2011; Jozwik et al., 2017; Wiggins & McTighe, 2011). One of the reasons why the transfer of learning does not occur could be attributed to the content of the curriculum. The other possible reason could be the nature of the topics integrated in the textbooks.

While this study did not indicate much on the transfer of learning, it was revealed that this design enhances students' understanding through realistic classroom learning. In particular, the essential questions that teachers embed in the lesson had a greater influence on this. Teachers in the class built the discussion around essential questions, involving students in thoughtful learning that successively made them understand better and develop more realistic examples of the concept taught. Thus, further strengthening students' curiosity, motivation, and exploration towards learning. This complements other literature findings (Davila, 2017; McTighe & Thomas, 2003).

When learning is the ultimate goal, the assessment evidence has to convey the meaning of students' learning successfully instead of merely recalling the content. This study indicates that teachers regularly employ formative assessment tools during the classroom teaching and learning process. Similar findings are reported by other researchers (Black et al., 2003; Whitehouse, 2014). The use of formative assessment tools helps teachers to give immediate support to improve students' learning in the classroom. To understand students' learning of the concepts taught, teachers use common assessment tools such as group discussion, questioning, numerical problem solving, and observations. Use of these assessment tools is primarily based on the familiarity and competency of teachers. According to Makkonen and Jaquet (2020), using the same assessment tools in different contexts is unlikely to assess the specific goals and understanding of students' learning. When teachers repeatedly use the same assessment tools in the classroom, their appropriateness and authenticity in measuring students' learning outcomes can be arguable. The use of assessment tools like rubrics, checklists, tests, and quizzes is found to be effective in improving students' academic achievement and learning progress across different subjects (Suah & Ong, 2012; Veloo et al., 2016). Therefore, this study found a need for teachers to use a variety of assessment tools to facilitate the different learning needs of students, encourage a comprehensive understanding of the concepts taught, and make learning more exciting to ensure the transfer of learning.

According to Tomlinson and McTighe (2006), lesson planning using the backward design primarily focuses on students' learning and understanding, which can conclusively lead to higher academic achievements. In line with this, the findings of this study revealed that students' academic achievements are enhanced when teachers plan

and deliver the lessons using backward design. There were two reasons for the improved academic achievements of students. Firstly, the teaching approach was mainly student centered, which enhanced students' understanding of the content as it was taught through interactive and realistic learning experiences. Secondly, it was due to the assessment evidence used by teachers to understand students' learning. When teachers focus on assessment in classroom teaching, it provides a better opportunity to evaluate and scaffold students' learning that significantly adds to higher academic performance. These findings are consistent with previous studies (Hosseini et al., 2019; Kulla-Abbott, 2007; Kuntari et al., 2019).

Confidence is one of the most important traits of teachers in the classroom. Teachers enter the class with varying confidence levels in their ability to deliver the instructions to the students (Turley et al., 2012). According to Broughton et al. (2002), a teacher with a plan is a more confident teacher. The present study revealed that lesson planning through backward design has a more significant influence on boosting the teachers' confidence level. This finding corroborates the ideas of Wiggins and McTighe (2005), who claimed that backward design is based on the principle of beginning the task with a clear vision of the end result, where the teachers' prospects for the end result are apparent, which is necessary for teacher confidence.

The findings of the study also revealed that backward design is closely aligned with the National School Curriculum (NSC). Using online resources like videos, simulations, and other learning materials, students' understanding of subjects is amended through realistic learning situations. Teachers view that the overarching principle of the NSC and backward design are very much related to the objectives of backward design. Therefore, these findings provide a possible research-based theoretical foundation for a backward design principle for the teaching and learning process. This can contribute towards the aspiration of REC (2021) to transform education from the teaching of "What" to the learning of "How" and "Why", towards empowering transversal competencies and 21st century skills to facilitate deep learning and preparing students to be lifelong learners in line with recent NSC.

This study showed that there were numerous challenges associated with backward design. The most prominent challenge was related to the time teachers had to spend on planning the lesson. The content of the prescribed textbook is said to be bulky, which has an impact on time. The rigidity and expansiveness of the Bhutanese curriculum have been reported in previous studies (Tshogay & Giri, 2021; Schuelka, 2013). The findings of this study are consistent with the previous studies (Davidovitch, 2013; Song, 2008). Although teachers communicated about receiving professional development programs in 2017, they are still confronted with some difficulties. They have inadequate knowledge and skills to plan lessons on this design. Specifically, teachers expressed their troubles with designing the essential questions that are gateways for understanding, exploration, and transfer of knowledge through realistic learning experiences. Similarly, the study by Herro (2018) found that teachers were not competent in designing lessons using backward design. One of the reasons why teachers are confronted with these difficulties is the nature of the topic they have to teach. For instance, when the topic of the lesson is based on derivation concepts, the essential questions embedded are mostly centered on facts and figures, which confine students to relating classroom learning with their real-life experiences. Therefore, in-depth, realistic, and transferable learning is not always evident as expected when using backward design (Davidovitch, 2013).

Another hindrance to the effective implementation of this design is the lack of teachers' competencies in planning and employing the right assessment tools. Findings from this study showed that teachers often use the same assessment tools to assess students' learning on the content taught in the class. It is certainly challenging for teachers to select the right assessment tools for a particular lesson when assessment tools have to be planned before designing the learning activities. This impels teachers to spend more time developing assessment tools, which is in agreement with the previous findings (Davidovitch, 2013; Song, 2008). As a result, most of the time, teachers end up using common assessment tools in almost all the lessons, which has the implications of not assessing the reliable learning of students for the specific instructions. Similar findings were reported by Burson (2011).

VI. CONCLUSION

The findings of this study confirmed that lesson planning through backward design plays a significant role in transforming teaching from content-centered to student-centered instruction. This paradigm shift ultimately promotes a deeper understanding of the content taught and upholds the transfer of learning. However, in reality, there were limited evidence of the transfer of learning. The school curriculum demands a minimal platform for students to apply their learning. Specifically, the current physics textbooks are content-focused with few examples and applications from everyday life, making it difficult for students to relate classroom learning to real context.

Backward design promotes students' understanding through realistic classroom learning. The essential questions that teachers embed in their lessons greatly influence realistic classroom learning. This study also indicated the practice of both formative and summative assessment strategies in the class. However, teachers more regularly employ formative assessment tools in the classroom teaching and learning process. The assessment in backward design plays a significant role in students' learning and understanding of the concepts taught.

This lesson design is closely aligned with the National School Curriculum framework developed by the Royal Education Council in response to the COVID-19 pandemic, where students' learning is mostly enthralled through competency-based and experiential learning. However, there are challenges associated with planning a lesson using the backward design framework, such as time constraints and teacher competencies. These are the barriers to the effective implementation of backward design in the teaching and learning of physics lessons.

VII. RECOMMENDATIONS

This research has provided an understanding of the effectiveness of backward design lesson planning on the teaching and learning of physics. Based on the findings, the study derived the following recommendations:

The study recommends teachers to plan detailed learning activities that provide a comprehensive understanding of what, when, and how to carry out the learning activities. Additionally, this study recommends the need to employ more authentic and reliable assessment tools like rubrics, checklists, tests, and quizzes that are found effective in providing a better understanding of students' learning and scaffolding them to achieve greater learning performance.

The study recommends relevant stakeholders to ensure that teachers receive relevant workshops, seminars, and training to enhance their knowledge and classroom practices. Similarly, the content of textbooks could include more examples related to applications to improve students' ability to relate their learning to everyday experience.

The study recommends to carry out similar kinds of studies in other subject areas covering a larger population to offer richer perspectives on the effectiveness of the backward design.

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