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Development and Evaluation of Design Thinking-based Learning Packets for Enhancing Innovation Skills

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Abstract

Innovation skills such as creativity, empathy, experimentation, communication and collaboration are vital for the 21st century learners. Hence, this study determined the effectiveness of design thinking-based learning packet in enhancing the innovation skills of grade 11 learners. Descriptive statistics and t-test were utilized to look at associations between the pretest–posttest and survey questionnaire. The pretest and posttest results measured the effectiveness of the learning packet in enhancing the innovation skills of the learners, whereas the survey results were utilized to describe the students' innovation skills. A content validation tool from the Department of Education was utilized to determine the level of acceptability of the learning packet before its usage. The findings indicated that the level of acceptability of the learning packet was very high which implies that the experts recommend its use. The survey results showed that students' innovation skill is high while the pretest and post-test showed a significant difference in all terms. The findings suggest the use of design thinking-based learning packet as a supplemental learning material in teaching Physical Science to enhance the innovation skills of learners.

Keywords: *design thinking approach, design thinking-based learning packet, innovation skills, constructivist learning theory*

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1. Introduction

As the face-to-face classes come in full blast on November 2022, teachers were able to assess and identify personally various educational gaps that the students had been facing which are the after effect of the latter distance learning that they went through during the period of the pandemic. With the use of the learning materials from the Department of Education (DepEd) which include the learning modules and different assessment materials for Science subjects, teachers were able to assess the level of innovation skills of the learners. During everyday assessments, teachers were able to identify that innovation skills among learners has a low level (Ludewig et al., 2022; Schult et al., 2022; San Luis. & Villafranca, 2022).), which is a component of the 21st century skills learners need to be globally competitive (Soderlund. 2020; Stehle et al., 2019; Ozturk, 2023). As supported by Lee and Benza (2015), innovation skill is a key driver of difference and competitive advantage in the in the 21st century's complicated and accelerating competitive environment.

As the competitive climate is growing in the changing and developing world, students cannot succeed in the real world by having knowledge alone. To survive in the current world, students must develop 21st century skills including problem-solving, creativity, innovation, collaboration and communication. Hence, teachers are challenged to provide materials and classroom environment that foster these skills (Bao & Koenig, 2019; Kong, 2021; Habók & Nagy, 2016; Ojetunde & Ramnarain, 2023; Agbo et al., 2023; Murillo-Zamorano et al., 2021; Smeda et al., 2014; Price, 2015; Fischer & Barabasch, 2023). While many of the previous studies focused on the use and integration of technology in the teaching and learning process, majority of the studies in the Philippines involved development of learning materials (Malipot, 2022; Tarrayo & Anudin, 2023) in response to the modular distance learning imposed in the educational institutions. For example, this study employed the developed design thinking-based learning packet for science subjects to fill the educational gaps brought about by the pandemic. While the learning packet follows the design thinking approach, it initiates the development of innovation skills among students. For instance, design thinking approach can provide teachers with a clear pedagogical process and tools to effectively instill innovation skills such as creativity, empathy, experimentation, communication, and collaboration (Lee & Benza, 2015). Rusmann and Ejsing-Dunn (2022) add that students learn

through tackling issues in the real world, which is the foundation of the innovative educational strategy.

This study evaluated the developed learning packets in Physical Science as a tool in enhancing the innovation skills of the students. As Jolly (2009) suggested teachers to engage learners, this learning materials expects students to interpret concepts and create new meanings, analyze the underlying patterns of their thought processes, and design experiences to change their beliefs so that they are consistent with the accepted scientific norms, which will foster innovation skills. While there are many studies that evaluated the developed learning materials in various subjects (Yongco & Del Valle, 2022; Estrellado, 2021; Origenes, 2021; Anives & Ching, 2022; Aquino & Ching, 2022; Arida et al., 2022; Lopez, 2021; Chozas & Cuenca, 2022; Reyes & Salvador, 2022; Malaluan & Andrade, 2023; Magpantay & Pasia, 2022; Aguilar & Panoy, 2022), this study also considered the academic performance of the students before and after the utilization of the learning packets.

2. Literature Review

2.1 Design thinking approach

Design thinking is a constructivist learning approach wherein students are expected to learn how to create from their own experiences (Trevors et al., 2016; Pande & Bharathi, 2020). According to Brown and Katz (2009) and Kisker (2021), the design thinking approach provides a method to frame the problem into a question, understand what people need, generate creative ideas, prototype those ideas and test and learn. In addition, this approach could help everyone practicing it to solve real-world problems by conceiving original and inclusive ideas, conduct research, do experimentation and then analyze the solution for the real-world problem (Malele & Ramaboka, 2020). Linton and Klinton (2019) add that it emphasizes a practical approach where students step outside the classroom to learn. Using this approach, students are motivated to explore, trust is built between student and teacher to provide confidence for self-exploration, and team competencies are fostered to allow students to express their opinions and share their knowledge (Scheer et al., 2012). The groundwork for the creation of design thinking approach was provided by Herbert A. Simon in 1969. Dam and Siang (2021) cited the seven-step procedure laid by Simon on the thinking process to find original solutions. However, the Hasso Platner Design Institute (Stanford University in the United States)

embraced the design thinking methodology with their own 5-step process, which comprises empathize, define, ideate, prototype and test (Vallis & Redmond, 2021).

For the past years, design thinking has been a topic of teaching, research, and practical application in practically every area of education, research, and industrial activity (Pande & Bharathi, 2020). Several research in the field of education have demonstrated that the standard of classrooms rises when teachers apply the design thinking methodology when developing lessons and lectures for students (Jamal, 2022). To date, several projects have been launched in K-12 classrooms to encourage and investigate design thinking as a modern learning paradigm or learning model (Barrie, 2006; Goldman and Zielezinski, 2016; Noel & Liub, 2017). It is now a popular framework that educators have applied in a variety of K-12 extracurricular contexts to bring more creativity into learning (Linton & Klinton, 2019).

2.2 Innovation Skills

Innovation skills is among the 21st century skill components which have been the center of attention and one of the most desired skills since they are the first requirements of job qualification in the 21st century (Soland et al., 2013; Demirkol-Orak & İnözü, 2021). According to Niruttimatee and Sanrattana (2022), innovation skill is significant in the 21st century society and teachers must focus on developing students' innovation skills in order for them to succeed in work and life. In a world that was developing quickly, the ability to think creatively and innovatively was among the most important. These abilities help people comprehend and address actual issues (Tiyaswati, 2021). As to Magulod (2018), innovation and originality are essential in 21st-century education. Niruttimatee and Sanrattana (2022) added that innovation skills are included in what are considered as ‘essential skills.’ In academic studies, innovation skills are usually accompanied by creative skills because innovation skills lead to the creation of new or different ideas or methods.

People with innovative concepts can do their work with full confidence and are willing to take risks in order to achieve their goals (Henderson, 2017). Hence, Amabile (1996) refers innovation to the successful implementation of creative ideas. According to Sawyer (2006), innovation is an outcome of an innovation process whereby collaboratively

created ideas are transformed into a single product or other end result, often through interactions with several stakeholders. As a cognitive process, Barak et al. (2013) viewed innovative thinking that leads to implementing new or significantly improved ideas. While Drucker (2007) believes that innovation has the ability to put different products out of the ordinary and commercialization, it requires thinking outside of the patterns in mind, go beyond the standard thinking style and develop original practical ideas with use-value (Çellek, 2002).

2.3 Learning Packet

A learning packet is a unit of study materials on a certain subject that enables the student to operate in some degree independently from their teacher. Most learning packets contain a self-assessment test to find out exactly where the student is with respect to a particular skill (Sincoff & Reid, 1974). According to the Department of Education, Dasmariñas (2020), learning packet is an instructional guide that learners can use in the absence of modules and or other learning materials while Sincoff and Reid (1974) call a learning packet as a range of combined multisensory exercises. While they ought to be created around performance goals, it needs to ensure consistency and organization of the foundational topics within a school.

According to Marzahi (2001), one method of communicating between a student and/or a small group of students and the instructor where the content of a particular topic or activity is explained is through the use of self-directed learning packet. For example, Barnhill (1998) developed the science learning activity packets (SciLAPs) where students find explicit directions to complete a specific science activity and what activities they should perform to acquire the knowledge and abilities expected from them. The packet approach inspires students to excel and shed their ingrained notions about education (Barnhill, 1998; Basho, 2005). Furthermore, students will be responsible for accomplishing a task in a specific amount of time. This instructional method promotes students to take the initiative to complete an activity and be able to utilize digital technology to learn more outside the class and continue working on completing the tasks designed in each packet. It also encourages them to work collaboratively with peers and may consult a resource person, as needed. If students experience difficulties, the instructor is available as a resource. When not serving as

a resource, the instructor continually monitors student progress (Barnhill, 1998; Basho, 2005).

The intent of the learning activity packets is to improve students learning performance as they further enhance their understanding as well as improve mastery level in problem-solving by taking enough time to repeatedly practice tasks. Galos (2022) emphasized that the use of learning activity packets as an intervention may be applicable to any subject area and would help teachers increase the subject literacy of their students in a self-directed manner.

2.4 Theoretical Framework

Constructivist Learning theory served as the basis for conceptualizing this study. It has its historical roots in the work of Bruner (1961) and Vygotsky (1962). Constructivist learning theory focuses on the social interaction occurring in the learning process within a certain environment through collaboration, encouragement, scaffolding, and mentoring (Amarin & Ghishan, 2013; Ayas, 2006; Chitanana, 2012; Gold, 2001; Rasha Essam, 2016). The view of constructivism learning theory is that learning is an active and constructive process (Bada & Olusegun, 2015; Goriss-Hunter et al., 2023). This theory looks at the classroom as a community where learners engage in problem solving activities, conversations, negotiations, and reflections (Karagiorgi & Symeou, 2005; Amarin & Ghishan, 2013; Rasha Essam, 2016). Meanwhile, Wilson (1996) and Shah (2019) describe constructivist learning environment as a place where learners may work together and support each other as they use a variety of tools and information resources in the guided pursuit of learning goals and problem-solving activities.

According to Sjoberg (2007), constructivist approach to learning is where knowledge is actively constructed by the learner, not passively received from the outside. For Sithara et al. (2017), constructivist teaching and learning theory advocates a participatory approach in which students actively participate in the learning process. Richardson (2003) calls constructivist pedagogy “the creation of classroom environments, activities, and methods that are grounded in a constructivist theory of learning, with goals that focus on individual students developing deep understandings in the subject matter of interest and habits of mind that aid in future learning.”

Moreover, constructivism is a paradigm that hypothesizes learning as an active, contextualized, or constructive process (Shah, 2019), which advances meaning-making and knowledge construction as its foremost principles (Crotty, 1998; Fosnot, 1996; Phillips, 1995). In applying the principles, individuals are assumed to construct their own meanings and understandings, which involve interplay between existing knowledge and beliefs and new knowledge and experiences (Richardson, 1997, 2003; Schunk, 2004). For VonGlaserfeld (1989), it puts forward two principles: "knowledge is not passively received but actively built up by the cognizing subject; and the function of cognition is adaptive and serves the organization of the experiential world, not the discovery of ontological reality."

Many teachers are hesitant to try the constructivist model because it requires additional planning and a relaxation of the traditional rules of the classroom (Scheurman, 1998). Teachers often feel as though they aren't doing their job if the students are working together and actively discussing the material instead of busily taking notes (Sprague & Dede, 1999). However, teacher-centered lessons can be less or non-productive, and in some cases, detrimental to the students' learning process (Zoller, 2000).

3. Methodology

This study used descriptive developmental research design since the purpose of the study is to produce a design thinking-based learning packet for enhancing the innovation skills of the learners. In addition, quantitative design was used to look at associations or relationship between variables.

The study utilized different instruments including survey questionnaire, a 60-item pre-test and post-test based on the learning competencies and innovation skills, with their corresponding table of specification, a validation tool for the learning materials developed and a lesson exemplar to guide the teacher in the whole process. The survey questionnaire was used to assess respondents' perception on the level of innovation skills and problem-solving skills. The pre-test was used to determine the level of innovation skills of the respondents before the use of the design thinking-based learning packets. The lesson exemplar used was developed in accordance to the K-12 Basic Education Curriculum Guide of the Department of Education. The post-test was conducted after the utilization of the design thinking-based learning packet to assess significant enhancement on the

innovation skills of the respondents. All the instruments used in the study undergone content validation, by the Education Program Supervisor (EPS), school head and six master teachers who were purposely chosen based from their specialization. A validation tool was utilized to determine to what extent the teacher-made research instruments were contextualized. The validators' comments and recommendations were integrated in the revision of the research instruments. The instruments also passed the validity and reliability test using the Cronbach's alpha coefficient. The reliability test performed on the assessment of the level of innovation skills of the learners in terms of creativity skills, empathy skills, experimentation skills, communication skills and collaboration skills are 0.724, 0.765, 0.741, 0.728, 0.713, interpreted as acceptable.

The researcher developed the learning packet following the most essential learning competencies of Grade 11 Physical Science reflected in the K to 12 curriculum guide, under the third quarter of the school year 2022-2023. The learning packet was validated by the experts, using a validation tool that was adapted from the Department of Education's assessment tool for a learning material. The variables evaluated by the experts during validation include content, format, presentation and organization and accuracy and up-to-datedness of information. Their comments and suggestions were incorporated in the final copy.

Participants of the study were 50 grade 11 students from the heterogeneous section of an Integrated High School in the Philippines. They were chosen as the respondents of the study as they experienced distance learning in 2020 and were identified to have low innovation skills on classroom-based assessments. Respondents' profile was assessed which includes the age, gender, and socio-economic status.

The following statistical treatment used were: descriptive statistics such as percentage and frequency distribution and mean and standard deviation; and inferential statistics such as t-test.

4. Findings and Discussions

Table 1 shows the result of the survey on the students' level of innovation skills in terms of five categories namely: creativity skills, empathy skills, experimentation skills, communication skills and collaboration skills.

The table presents creativity skills with lowest mean of 4.43 that implies learners think they possess lesser than the others. Although it has the least mean, still it has a high verbal interpretation. This implies that learners think they have the ability to think outside the box, to approach problems from multiple perspectives and to apply imagination to find new and original solutions in the most creative way. According to Palupi et al. (2020), creativity skills involve the activities of complex skills and cognitive abilities, personality factors and motivations, styles, strategies, and metacognitive skills.

Table 1

Students' Level of Innovation Skills

Innovation Skills	Mean	SD	VI
Creativity Skills	4.43	0.39	High
Empathy Skills	4.57	0.33	Very High
Experimentation Skills	4.45	0.38	High
Communication Skills	4.49	0.29	High
Collaboration Skills	4.47	0.37	High
Overall	**4.48**	**0.04**	**Very High**

Legend: 4.50 – 5.00 Strongly Agree (Very High), 3.50 – 4.49 Agree (High), 2.50 – 3.49 Moderately Agree (Moderate), 1.50 2.49 Disagree (Low), 1.00 – 1.49 StronglyDisagree (Very Low)

Empathy skills got the highest mean of 4.57 showing students are very empathic and always thinks of the benefit of other people when they create or do something. According to Yuksel (2015) and Gokap and Inel (2022), it is a skill that plays an active role in helping individuals establish a healthy communication with self and others, helps them to socialize and get along with others better. Therefore, good empathy skills help learners to be more aware of the situation of other people around them, this will enable them to understand other people better.

The overall mean is 4.48, which implies very high level of innovations skills. With high innovation skills, students are expected to have a good creativity skill, identify a problem when things arise, they are able to make hypothesis and they are able to organize ideas and analyze facts. In addition, they are able to convey information clearly and effectively through various mediums, including spoken, written and non-verbal means, a good trait of a learner who has good communication skill (Velentzas, 2014). They have the

ability to work together to achieve common goals, the description of someone with good collaboration skills (Handajani & Pratiwi, 2018; Boyraz, 2021).

Table 2

Level of Acceptability of the Design Thinking-Based Learning Packet

Level of Acceptability	Mean	SD	VI
Content	3.81	0.17	VS
Format	3.75	0.22	VS
Presentation and Organization	3.73	0.21	VS
Accuracy and Up-to-datedness of information	4.00	0.00	VS
Overall	**3.82**	**0.10**	**VS**

Legend: 3.50 – 4.00 Very Satisfactory, 2.50 – 3.49 Satisfactory 1.50 – 2.49 Poor, 1.00 – 1.49 Not Satisfactory

Table 2 presents the experts' perceived level of acceptability of the design thinking-based learning packet. It is composed of four categories namely: content, format, presentation and organization and accuracy and up-to-datedness of information.

For the content, the table presented a mean of 3.81 and SD = 0.17 with a verbal interpretation of very satisfactory since it was based on the present K-12 curriculum of the DepEd. The objectives of the said learning packet were based on the present learning module used by the DepEd as well as with the subject matter Physical Science. The activities provided elicit higher order thinking skills, and innovation skills such as creativity skills, empathy skills, experimentation skills, collaboration skills and communication skills.

As for the format, it gained a mean of 3.75 and SD=0.22 with a verbal interpretation of very satisfactory. For a learning material to have a very high rating in terms of format, it should follow the guidelines of the DepEd in making a good learning material. In this study, the researcher used an evaluation tool for a learning material from the DepEd following the indicators: clear and nice prints, accurate and vivid illustrations, appropriate design and layout and paper and binding. As per experts' evaluation using the learning material evaluation tool, the result implies that it was able to meet the necessary requirements and highly acceptable and highly recommended for use. Gray and Diloreto (2020) emphasized that good format will help the students to be more interested or engaged in the lesson that needs to be tackled.

As for the category presentation and organization, the table presents a mean of 3.73 and SD = 0.21 with a verbal interpretation of very satisfactory. A good learning material rated to have a very satisfactory level in terms of presentation and organization according to the DepEd's evaluation tool for a learning material should meet the following indicators: presentation should be engaging and understandable; there should be logical and smooth flow of ideas; vocabulary level is adapted to target reader's likely experience and level of understanding; length of sentences is suited to the comprehension level of the target reader; and sentences and paragraph structures are varied and interesting to the target reader. According to the validation and evaluation of the experts, result implies that the packet is highly acceptable and recommended for use. DepEd emphasized that good presentation and organization promotes engagement and supports understanding by the target user. Presentation stimulates active rather than passive learning.

Lastly, the accuracy and up-to-datedness of information gained a mean of 4.00 and SD=0.00, with a verbal interpretation of very satisfactory. According to the DepEd's evaluation tool for a learning material, indicators for accurate and up-to-date information include: no obsolete information found; no grammatical errors: and no factual errors.

In summary, the design thinking-based learning packet has a very high acceptability rate as per experts' evaluation in terms of content, format, presentation and organization and accuracy and up-to-datedness of information and is highly recommended for use.

Table 3 shows the scores of the students on the pre-test and post-test in innovation skills in terms of creativity, empathy skills, experimentation skills, communication skills and collaboration skills. The pre-test scores revealed that most of the respondents are in the average level. After the implementation of the strategy and the use of the design thinking -based learning packet, the post-test scores show that most of the respondents fall under closely approximating mastery level.

In terms of creativity skills, among the 50 student-respondents in pre-test scores 76% got 79-83% points which has an interpretation of average mastery level. Meanwhile, on the post-test scores, most of the learners accounting to 38% got a score of 91-95% which has a verbal interpretation of closely approximating mastery. In terms of empathy skill, among the 50 student-respondents in pre-test scores, 80% got 79-83% points which has an interpretation of average mastery level.

Table 3
Pre-test and Post-test scores of students exposed to the use of Design Thinking-based Learning Packet

Range of Scores	Pre-test		Post-test		Interpretation
	Frequency	Percent	Frequency	Percent	
			Creativity Skills		
96-100%	--	--	2	4%	Mastered
91-95%	--	--	19	38%	Closely Approximating Mastery
84-90%	5	10%	17	34%	Moving Towards Mastery
79-83%	38	76%	12	24%	Average
71-78%	7	14%	--	--	Low Mastery
			Empathy Skills		
96-100%	--	--	2	4%	Mastered
91-95%	--	--	18	36%	Closely Approximating Mastery
84-90%	1	2%	18	36%	Moving Towards Mastery
79-83%	40	80%	12	24%	Average
71-78%	8	16%	--	--	Low Mastery
66-70%	1	2%	--	--	Very Low Mastery
			Experimentation Skills		
96-100%	--	--	17	34%	Mastered
91-95%	--	--	18	36%	Closely Approximating Mastery
84-90%	4	8%	12	24%	Moving Towards Mastery
79-83%	33	66%	3	6%	Average
71-78%	8	16%	--	--	Low Mastery
66-70%	4	8%	--	--	Very Low Mastery
60-65%	1	2	--	--	Absolutely No Mastery
			Communication Skills		
96-100%	--	--	22	44%	Mastered
91-95%	--	--	26	52%	Closely Approximating Mastery
84-90%	15	30%	2	4%	Moving Towards Mastery
79-83%	18	36%	--	--	Average
71-78%	13	26%	--	--	Low Mastery
66-70%	4	8%	--	--	Very Low Mastery
			Collaboration Skills		
96-100%	--	--	12	44%	Mastered
91-95%	--	--	20	40%	Closely Approximating Mastery
84-90%	1	2%	11	22%	Moving Towards Mastery
79-83%	30	60%	7	14%	Average
71-78%	14	28%	--	--	Low Mastery
66-70%	5	10%	--	--	Very Low Mastery
Total	**50**	**100**	**50**	**100**	

Legend: 0-1 Absolutely no mastery, 2 Very low mastery, 3 Low mastery, 4-5 Average, 6 Moving towards mastery, 7 Closely approximating mastery, 8 Mastered

However, on the post-test scores 36% of the learners got a score of 91-95% having a verbal interpretation of closely approximating mastery. As for the experimentation skill, in the pre-test scores, 66% got 79-83% points with an interpretation of average mastery level and on the post-test scores most of the learners, accounting to 36%, got a score of 91-95% having a verbal interpretation of closely approximating mastery. As for communication skill, 36% got 79-83% points in the pre-test having an interpretation of average mastery level while 52% got a score of 91-95% on the post-test which has a verbal interpretation of closely approximating mastery. Lastly, in terms of collaboration skills, in pre-test scores 60% got 79-83% points which has an interpretation of average mastery level while on the post-test scores most of the learners accounting to 40% got a score of 91-95% which has a verbal interpretation of closely approximating mastery.

In summary, results imply that the learning material used helped the learners in enhancing their creativity skills, empathy skills, experimental skills, communication skills and collaboration skills, since most of the results showed that they had improved their scores from having an interpretation of an average level in the pre-test results to having closely approximating mastery level on the post-test results. Improvement of their scores with the use of the design thinking-based learning packet was possible since the learning materials was highly recommended as per experts' evaluation of very high acceptability rate.

Table 4

Test of Difference between the Pre-test and the Post-test Scores

INNOVATION SKILLS	Pre-test		Post-test		T	df	Sig. (2-tailed)	95% Confidence Interval of the Difference	
	Mean	SD	Mean	SD				Lower	Upper
Creativity	8.30	1.92	12.56	2.37	-24.248	49	.000	-4.613	-3.907
Empathy skills	7.56	1.98	12.40	2.18	-24.880	49	.000	-5.231	-4.449
Experimentation skills	3.84	1.13	6.98	1.04	-22.911	49	.000	-3.415	-2.865
Communication skills	6.08	1.38	10.18	1.16	-26.999	49	.000	-4.405	-3.795
Collaborations skills	3.72	0.93	6.70	0.97	-33.857	49	.000	-3.157	-2.803

$p \leq .01$, significant; $p > .05$, Not significant, Df = 49

Table 4 presents the test of difference between the pre-test and the post-test scores of the learners exposed in the design thinking-based learning packets. There is a significant difference between the pre-test and the post-test scores of the learners who were exposed to the use of the design thinking-based learning packets. All the variables present a p-value < 0.01 which indicates that there is a significant difference in all of the innovation skills which are creativity skills, empathy skills, experimentation skills, communication skills and collaboration skills.

The creativity skills show a significant improvement with a t-value of 24.248 at p < 0.01. This means that the learning material used was effective in developing the creativity skills described by Lee and Benza (2015) with creative thinking skills such as ideation, problem solving skills and flexibility. Similarly, empathy skill has t-value of 24.880 at p < 0.01 implying high level of empathy associated positively with the ability to perceive, express, understand, use and manage emotions (Eisenberg et al., 2003 cited by Salovey & Detweiler, 2008; Gulec, 2020). As for the experimentation skills, there is a significant difference in the scores as manifested by the t-value of 22.911 at p < 0.01 upholding Nguyen et al. (2019) that students can make logical reasoning to find out what to investigate. For the communication skills (t-value of 26.999 at p < 0.01), most of the activities are group activities promoting communication that affirms with Sabbah et al. (2020). Lastly, collaboration skills (t-value of 33.857 at p < 0.01) affirm Davidsen et al. (2020) and Ilma et al. (2022) on working productively, showing respect, compromise, and responsibility.

5. Conclusion

The results of this study showed a significant difference between the pre-test and the post-test scores of the Grade 11 learners exposed to the design thinking-based learning packets. This means that the innovation skills of the learners such as creative thinking skills, empathy skills, experimentation skills, communication skills and collaboration skills were enhanced through the use of the design thinking-based learning packet. Hence, the study recommends the use of the design thinking-based learning packet. The findings of this research may help the teachers to customize their teaching approaches, methodologies, strategies, and techniques to suit the students' needs.

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