



## **Assessment of Students' Learning Outcome and Competency through a Blend of Knowledge and Practical Ability**

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This study used Schneider's innovative design methodology and practices related to education to examine the impact of creative pedagogy toward students' learning process improvement and outcomes through a blend of knowledge and practical skills. The research question is centered on whether a blend of knowledge and practical- ability serve as a fundamental resource for improving students' learning outcomes, and a strong catalyst for educational innovation? The study was grounded on the theoretical framework of learning-oriented assessment (LOA), a type of students' learning outcomes (SLO) model. It used assessment data collected from undergraduates registered at Tecnologico de Monterrey Global Business School for the investigation. To this end, we applied the Independent-samples Mann-Whitney U test to determine the mean differences between the students' average grade and evidence 1 (Knowledge) and 2 (Practical- ability) by considering two groups of students (virtual vs in-person). Also, Multiple linear regression (OLS) and Multiple analysis of covariance (MANCOVA) were used to test whether Knowledge- and Practical- ability factors have an impact or are associated with final grades of the students, and whether the impact differs by the two groups. The results show that students require a blend of both knowledge and practicality to obtain quality learning/outcome.

**Keywords:** competency development, educational innovation, higher education, knowledge and practical-ability, learning assessment, learning outcomes, students

### **INTRODUCTION**

Empowering today's students to find innovative and enriching learning experiences, and to thrive in the modern educational and labour market, can bring about a deeper desire and need to develop competencies and skills for lifelong learning. Higher education is

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one of the sectors that have proved to play an important role in providing and fostering of such “knowledge-based or outcome-based education” by creating global citizens with the much-needed or new competences and skills (OECD, 2022; UNESCO, 2014, 2022). Students’ learning outcomes and assessments are conducted by many universities to determine whether the developed programs cover the materials needed or are stated in the learning goals. This includes whether students are learning the materials, the level of their competency and/or proficiency, and the impact on the students’ retention, including institutional accreditation (Le and Duong, 2021; OECD, 2022; UNESCO, 2022). Learning evaluation is also performed with the aim of providing the faculty with data that can be used to support or help the programs evolve and improve, such as the one done in this study. According to Jach and Troilan (2019), learning assessments include measures such as standardized tests or student coursework and competency/proficiency levels being rated by faculty members in order to assess the students’ learning outcomes.

Various models have been used to measure or assess the learning outcomes of students in higher education institutions. For example, Richard and Rodgers (2001) described a Conceive-Design-Implement-Operate (CDIO) model that focuses on the learning outcomes (what students are expected to be able to do, rather than what they need to study) and helps to develop a common framework that combines teaching, learning, assessment, and feedback mechanisms to cater to and address the academic disciplines’ demand for graduates with improved professional competencies (Karpe et al., 2011). Many of the higher education institutions (HEIs) are now developing educational/learning models that didactically incorporates the competency-based development or assessment modules, for instance, the TEC21 model (TEC, 2018) initiated by Tecnológico de Monterrey, a private university in Mexico. In 2019, Tec de Monterrey culminated the Tec21 model implementation, which began by advocating for college learning outcomes assessment and requiring faculties to gather information regarding the learning objectives and assessment results from the students during the learning process which also inspires the work done in this study. This was the first time the HEIs’ study plans or educational models incorporated competency-based innovative elements. The Tec21 Educational Model (TEC, 2018) is one of the most profound transformations of higher institutions of learning in the region (Okoye et al., 2021). It represents a new teaching model that reinvents the foundations of learning, since its structure is based on challenge-based learning, has a flexible structure, and combines academic experiences with enriched, inspiring, and unforgettable learning experiences both for the students and their faculties (TEC, 2018). The existing educational models (e.g., TEC21) have been modelled to take into account the competency of the students. For example, it is one of the recent and related models that considers the competency-based education and learning outcomes, such as the one done in this study. Such models prove to potentiate the educational quality of institutions, since it is centered on the student's relationship with the learning environment and their teachers. With this, students can develop personal and professional skills and competencies by solving real-world challenges and problems, alongside experiencing and gaining hands-on practical experiences and life-long learning skills from faculties. In this way, they complement

their knowledge and lead a personalized university path that allows them to explore, focus, and specialize in what they are most passionate about.

On the other hand, pedagogically or instructional -wise, to help learners reach their full potential, an understanding of how students learn and teachers teach has become one of the elements or core of the education policy and development (OCED, 2023). Recent report has shown that *skills* or *competency* development are central to achieving innovation-driven growth or learning outcomes, e.g., for students (OECD, 2023). And therefore, decisions about education, e.g, how or settings in which the students learn, should always be based on the best evidence possible (OECD, 2023, Okoye et al., 2021; UNESCO, 2022; Wicking, 2022), such as investigated in this study. As example, existing studies have highlighted the need for developing measures that give due weight to teaching and learning by defining or assessing the scope of the different tasks, and aiming to gain better information/understanding of what undergraduate students know and can do (Jach & Trolan 2019; Ku & Yan, 2021; OECD, 2022). Consequentially, this can contribute to the higher education institutions' knowledge of the impact of the teaching methodology or learning performance and assessment, and in turn, provide a tool for development and improvement, such as the one done in this study.

The aim of this study is to assess the higher education students' learning outcome and competency "through a blend of knowledge and practical ability" teaching methodology or learning intervention applied to the students within the classroom settings. The study uses the Schneider's innovative design in logistics-driven packaging methodology and practices related to education to study and provide creative pedagogy in teaching of the students and assessment through the blend of knowledge and practical skills and aggregates the current research in the fields by centering on the pedagogical implications and challenges of assessing students' learning outcomes (SLO). The implemented learning project or intervention, which focuses on designing a program of assessment and creating a cross-functional culture of assessment through the blend of knowledge and practical ability, investigates the larger objective of considering SLO assessment in different contexts, particularly applied to provide an understanding or awareness of how educators and practitioners think about assessing SLOs within the context of the Business and Education field. For the Business Schools' context in this study, it was important to identify and address the challenges to better learning outcomes by uncovering what confronts the stakeholders (educators, teachers, students, business managers) as they embark on creating effective programs and assessments. The authors strongly believe that the next steps in these directions are to identify best practices or key components of learning design and structure, to light the path forward, and to help in the design of programs of assessment more efficiently. Ultimately, we aimed to create and empower healthy assessment cultures that provide the space from which dynamic programs can be co-created and developed to improve the learning outcomes and experiences of the students, including life-long learning or yet what is called global citizenship education (UNESCO, 2014).

The research question of this study is as follows: Does a blend of knowledge and practicability serve as a fundamental resource for improving students' learning outcomes, and a strong catalyst for educational innovation?

The research hypothesis include: (#H<sub>0</sub>) Knowledge and practicability are not strong catalysts for educational innovation and improvement of students' learning outcomes, and (#H<sub>1</sub>) Knowledge and practicability are strong catalysts for educational innovation and improvement in students' learning outcomes.

The summary of the main findings and contributions of the study include:

1. It was found that a blend of knowledge and practicability serves as a fundamental resource for improving students' learning outcomes, and a strong catalyst for educational innovation.
2. It use Schneider's innovative design methodology and practices related to education to study and provide creative pedagogy for students' learning/outcomes through a blend of knowledge and practicability.
3. It aggregates current research by focusing on the pedagogical implications and challenges of assessing students' learning outcomes (SLO).
4. It provides awareness of how educators and practitioners think about assessing SLOs, particularly within the Business and Education fields, designing a program of assessment, and creating a cross-functional culture of assessment.

### **Literature Review**

#### **Assessment of Students' Learning Outcome and Competency in Higher Education**

To move toward development-oriented and creation of effective components for assessment of students' learning outcome (SLO), and what those can do or mean for the several higher institutions of learning and/or didactical practices; we note that there is a need to acknowledge and address the "competency-based challenges". Assessing students' comprehension, proficiency, and knowledge is now a global phenomenon and a top priority for most universities or institutions of learning (OECD, 2022; UNESCO, 2022). However, this is not an easy process and has been a challenge in higher education over the last two decades (Melguizo and Coates, 2017). There are several reasons for this. One fundamental reason is the number of players or stakeholders involved and the location of ownership. There has been a shift in the perception of education such that the mastery of academic content was once understood as being solely the learner's responsibility but is now seen as a shared responsibility between the students, teachers, and institutions (Cechová et al., 2019). Assessing students' learning outcomes is a shared responsibility. Indeed, academic programs or initiatives that require collaboration with multiple stakeholders can be inherently complicated.

In the following table (Table 1), the authors present an overview of the existing literature on students' learning assessment by examining their general focus, context of the studies, and their key findings or outcomes. The following criteria has been applied in selecting the relevant literature: The selected literature should address the assessment of learning outcomes and competency in higher education. Include recent publications to ensure that the research is up-to-date. Considers current trends and developments in higher education assessment. Include literature from reputable peer-reviewed journals that are known for their quality publications in the field of education and assessment. Select literature that employs rigorous research methodologies and designs to ensure the validity and reliability of the findings. Consider literature that utilizes established competency frameworks, as this provides a structured basis for evaluating student

outcomes. Include literature that highlights innovative assessment practices, technologies, or tools that enhance the evaluation of student competency. Include studies that have been cited and cross-validated by other researchers, indicating their influence and significance in the field.

Table 1

Overview of existing literature on assessment of students' learning outcome in relation to the scope of the study

Author, date	Journal	Context of the study	Main focus	Key findings/outcomes	Learning assessment? SLO, Knowledge, Practical- ability
(Ku, K. & Yan, R. 2021)	Anatolian Journal of Education	Process of learning outcome development	Connection between perceived value of knowledge and proficiency in critical thinking among university undergraduates.	Pointed to some important implications in terms of teaching and learning in higher Education. E.g., those who show more inclination tend to be stronger critical thinkers based on an assessment by a generic critical thinking test as well as an essay task illustrating hypothetical controversial social issue.	Learning assessment: Knowledge and practicality through critical thinking
(Ünal, 2021)	Anatolian Journal of Education	Theories, models and approaches of learning	Factors Affecting Study Habits in Higher Education	Results showed that there was a change in the students' study habits in higher education during the Covid-19 pandemic.	Learning assessment: student learning outcomes (SLO)
(Blummer and Kenton, 2018)	Performance Measurement and Metrics	Student learning outcomes	Examination of the literature on student learning outcomes and academic libraries.	Informs instructional librarians regarding creating and assessing student learning outcomes.	Learning assessment: Student learning outcomes (SLO)
(Le and Duong, 2021)	European Journal of Contemporary Education.	Student learning outcome in higher education	Student learning outcomes are a critical indicator of the quality of instruction and the competence of faculty members and students in higher education settings.	Assessment of educational outcomes plays an increasingly important role in higher education: in which accreditation organizations place growing importance on student academic Learning.	Learning assessment: SLO, Competency development
(Farizi et al, 2023)	Anatolian Journal of Education	Process of learning outcome development	This study aims to examine the effect of the Challenge based learning model on Critical thinking skills and learning outcomes.	Learning model positively affects student learning outcomes. The Challenge based learning model facilitates the collaboration of students to explore new ideas and assists the development of behavioural and cognitive strategies. Collaborative learning facilitates reflection, provides a variety of understanding and stimulating critical skills and higher-order thinking.	Learning assessment: Knowledge and Practicality element via critical thinking skills
(Neto et. al, 2022)	Assessment & Evaluation in Higher Education	Assessment methods in higher education	Examination whether a preference for specific Assessment methods in higher education is associated with learning and proficiency.	Students preferred Continuous assessment, and indicated in their view, the method is accurate and fair for measuring true ability.	Learning assessment: SLO in association to proficiency

As a common denominator in the overview of the literature in Table 1, we can say that the assessment of educational outcomes and proficiency plays an important role in higher education. This indication shows real case studies that place growing importance on students' academic learning by preparing the students not just for the labor force, but through the development of relevant skills and competencies that are expected or required by educators, accreditors, governments, and industry representatives. Therefore, the assessment of students' academic learning outcomes and competencies needs to be appropriately documented throughout the assessment process (OECD, 2023; UNESCO, 2022). For example, in this study, the authors have used the Schneider's innovative design methodology and practices related to education to examine the impact of creative pedagogy toward the students' learning process improvement and outcomes through a blend of knowledge and practical skills.

Furthermore, to explain the indicator of assessment of SLO, we note that the assessment of learning outcomes is based on the performance of specific tasks, which helps students attain both personal and professional skills. It also helps to create the learning tools and processes necessary for effective professional life integration. For example, the CDIO model (Richard and Rodgers, 2001) provides a comprehensive and specific guide on how to develop learning outcomes and curriculum frameworks, create a convenient academic environment, demonstrate an effective teaching method, and assess teaching and learning (Mustapa et al., 2017). There are potentially many ways that can be used to classify forms of assessment in education. Although, based on the CDIO model, the assessment of learning outcomes is often classified into two main types: formative assessment and summative assessment, also known as "assessment of learning" (Shute, Kim, 2014).

### **Blended Learning, Teaching Method, and Practices in Education**

The blended learning approach is gaining popularity because it has shown to be a successful method of teaching while enhancing the learning environment and outcomes e.g., by incorporating virtual materials (Zhang et al., 2022; Zaheer et al., 2022). Research on blended learning in higher education has also contributed to the existing literature in the field. Research articles published in related journals over the past 12 years were also analysed in this context (see Table 1). In recent evaluation of blended learning approaches and practices in education, studies have shown, especially in light of the recent COVID-19 pandemic, that blended learning is no longer optional for higher education (Okoye et al., 2021; UNESCO, 2022). After universities shut down unexpectedly, many faculty leaders were forced to rapidly adopt virtual learning platforms and instructional strategies to prevent further lapses in instruction. Consequently, it is now time to take a step back and develop evidence-based blended learning strategies or teaching methods, as uncovered in this study.

According to Zhang (2022), blended teaching in management courses is effective based on experiential practices. The results of their study proved that blended teaching that is based on experiential practice, can significantly improve the teaching effect of the courses. Moreover, the distribution of post-measured scores of different groups was compared in the study, and gender differences in effectiveness of the blended teaching

were discussed. Finally, the conclusion that carrying out blended teaching in management courses based on experiential practice can narrow the gender difference in terms of the learning effects of management courses was ascertained (Zhang et al., 2022).

According to Zaheer (2022), face-to-face learning was preferred and demanded by stakeholders compared to online and offline learning. The findings of the qualitative interviews of the principals and APOs endorsed the results of the quantitative survey. The study found that 61.5%, 20.75%, and 17.75% of the time should be allocated for face-to-face, online, and offline learning, respectively. It was also suggested that only two tasks be allocated to the training of participants for the independent learning phase of the training.

According to Germo (2022), a blended learning or teaching approach may use electronic technologies to create learning experiences. A common definition is also shared by Clark and Mayer (2016) as to which blended learning method is delivered through digital devices to support the learning itself. In the nexus of the modern age, technology is used in delivering education across the globe and befitting the emergence of blended learning approaches or yet the teaching methods. Additionally, cost reductions in training, education, and transformed higher education are assured.

Having said that, whereas this study has looked into the concept of blended learning as one of the learning approaches that combines both the face-to-face and remote learning modes. It is very important to mention that our approach and/or learning intervention considers the concept or notion of blending of Knowledge and Practical Ability as it concerns the teaching methodology. Based on our review of the available literature and research question, we hypothesised that students' learning through a blend of Knowledge and Practical Ability, as a learning method, would lead to more effective SLOs (see Introduction and Research Hypothesis). The authors anticipated a positive correlation between the students' learning outcomes and their academic experience or performance in Higher Education Institutions (HEIs) as discussed in detail in the following sections. We postulated that the more students are exposed to face-to-face learning, the more they learn throughout their academic careers. Hence, the knowledge- and practical- ability constructs measured in this study.

## **METHOD**

The study employed the participatory research design (Spinuzzi, 2005; Vaughn & Jacquez, 2020), a qualitative research methodology that involves collection, analyzing, and interpreting of data about the students' learning outcome and assessment within the higher education setting. The participatory design method included the process of monitoring and observation through the remote and traditional user-centered design, obtaining feedback and evidence about the skills and competency development of the students with regards to the learning outcomes.

### **Research Framework: Participatory Design**

For the participatory design, the study adopted the theoretical framework of learning-oriented assessment (LOA) a type of students' learning outcomes (SLO) model to

assess the students' learning outcomes and competencies through a blend of both knowledge and practicality. This was done using the case study of Schneider methodology that was taught to students at the Business School of Tecnológico de Monterrey, where this study was conducted. This theoretical model posits three pillars of LOA: learning-oriented assessment tasks, student engagement with feedback, and development of evaluative expertise (Wicking, 2022). The authors identified, selected, and appraised participatory research design within the classroom setting to assess the impact of the knowledge acquisition level and practical ability on students' learning outcomes and educational innovation. A multipart questionnaire was used to collect information about the students, obtain data regarding their educational experiences at the institution, and assess the learning outcomes. It is important to mention that the field data was collected from students registered in the International Logistics Operations course in the Business School during which the "FlexSet Schneider methodology" (Melgoza, 2022) was taught to them. We note that at each stage of the learning process, a total of three team members from Schneider and Teaching team monitored and reviewed the implementation of the learning intervention.

#### *Schneider methodology and Course context*

The ten-week course, which occurred from February to June 2022, introduced the students to general concepts in Transportation and Materials Management. The course had two lectures per week and included a weekly discussion section. The instructor assigned readings to every lecture along with a corresponding quiz, which was the day before each lecture. During the lectures, the instructor provided multiple in-class activities, Nearpod questions, and pop quizzes, that counted toward the students' grades. The course had two competencies (knowledge and practical), which were measured and aligned with the state-of-the-art learning models and approaches that purportedly address the need to use multidisciplinary or cross-functional learning interventions/components to infuse knowledge from relevant disciplines to improve students' learning outcomes and competencies (Arnab and Clarke, 2017; Buckley and Lee, 2018; Haruna et al., 2021; Jiang et al., 2017; Leandro Cruz and Saunders-Smits, 2021; Mursid et al., 2023; OECD, 2022; Okoye et al., 2021; Rieckmann, 2018; Santos et al., 2023; Silviariza et al., 2023 UNESCO, 2022).

Competency (knowledge and practical ability) was assessed cumulatively over a ten-week period. The final examination was also cumulatively assessed (after the week-1 and week-6 learning assessment periods) in week-10. The two pieces of evidence (which we referred to as knowledge- and practical-ability in this study) and the examinations (i.e., week-1, week-6, and final examination) were based on determining the impact of blend of the competencies (knowledge and practical ability) on students' learning and outcome using the case study of the Schneider's innovative design methodology (FlexSet) (Melgoza, 2022) that was taught to them. The project and teaching intervention consisted of design, development, and application (knowledge and practical- ability) of the packaging for a new modular electrical switchboard known as FlexSet.

### **Procedure**

During the first week of the class, the instructor informed the students that the course was part of a study examining the impact of the blended approach on students' learning outcomes and competency development. A start (week-1) and end-of-course questionnaire or milestone (week-6) were administered during the first and sixth weeks of the class, respectively, before their final exam and evidence (competency) evaluation in the tenth week (week-10).

### **Participants**

The study data sample consisted of 50 students from a large lower-division business school in a private research university in Mexico that enrolled more than 200 students. The students completed a start and end-of-block survey. The questionnaire was designed and administered to the students using an online google form. It is important to mention that not all the 200 plus students completely answered the administered survey questions accounting for 72.14% of the students in the course, with missing data ranging from five to nine participants. Thus, resulting to the total of 50 complete data samples we have analyzed, and deemed scientifically adequate for conducting the experiments and data analysis of this study (Roscoe, 1975). The reliability of the items in the survey and data was tested using Cronbach's alpha ( $\alpha$ ) test (Taber, 2018), and the results ( $\alpha = 0.807$ , ANOVA ( $F = 710.44$ ,  $p < 0.05$ )) were scientifically acceptable for conducting the analysis and investigations performed in this study (see Experimental setup and data analysis).

Describing the demographic information and descriptive statistics of the analysed data, we note that most of the students were third-year students. The majority were Mexicans (56%), followed by Americans (24%) and Europeans (20%). The sample was drawn from two groups of students, with group 1 that studied in virtual mode consisting of  $n=35$  students, and group 2 the in-person category consisting of  $n=15$  students. In group 1, 49% of the participants were female (17) and 51% were male (18). In group 2, 67% were female (10) and 33% were male (5). The analysed data ( $n=50$ ) consisted of numeric data about the grades and competencies (evidence 1 = Knowledge, and Evidence 2 = Practical- ability) of the students, measured between 0 and 100; where 0 means no knowledge or practical skills acquired and 100 signifies that the student achieved the proficiency, respectively.

### *Experimental Setup*

To conduct the data analysis, we designed the following tests or experimentation to answer the research question and hypothesis (see Table 2). In the table (Table 2), the authors also provide the rationale behind choosing the different specified methods or statistical analysis, and their appropriateness for the research question.

Table 2  
Experimental setup and rationale for choosing the different methods and statistical analysis

Measurement	Data description	Condition	Method/Test description
Method Effectiveness (Learning outcome)	Grades of the students (for Week-1, Week-6, and Final grade (week-10))	Two groups of independent variables or students' group (i.e., virtual vs in-person)	We conducted the independent samples Mann–Whitney U test to determine the mean differences between the average students' grades for Week-1, Week-6, and Final grade (week-10), and where the differences may lie, if any, by considering the two groups of students (virtual vs. in-person).
Competency development or acquired Skills level	Evidence 1 = Knowledge Evidence 2 = Practical- ability	Two groups of independent variables or students' group (virtual vs in-person)	Independent samples Mann-Whitney U test to determine the mean differences between the Evidence 1 scores (Knowledge-) and Evidence 2 scores (Practical- ability), and where the differences may lie, if any, by considering the two groups of students (virtual vs. in-person).
Correlation and association or effect that Evidence 1 (Knowledge-) and Evidence 2 (Practical- ability) have with the final grades	Evidence 1 = Knowledge Evidence 2 = Practical- ability vs Final grade (week-10))	Regression analysis (Correlation) and Analysis of variance by considering the multiple independent variables (Evidence 1 and Evidence 2) against the Final grade (dependent variable)	Multiple Linear Regression (OLS) and multivariate analysis of covariance (MANCOVA) with multiple comparisons (post hoc) tests to determine whether the Evidence 1 (Knowledge-) and Evidence 2 (Practical- ability) factors have an impact or are associated with the final grades of the students, and does the impact, if any, differ by the two groups (virtual vs. in-person).

## FINDINGS

The study used the non-parametric Independent-Samples Mann-Whitney U tests, Multiple Linear Regression (OLS), and multivariate analysis of covariance (MANCOVA) to perform the above experiments by considering the variance of the two groups of students in the data.

Thus, for the independent-samples Mann-Whitney U test, we determined the mean differences between the average students' grades for Week-1, Week-6, and the final grades (week-10) as shown in Figure 1 whereby the x-axis represents the frequency or the number of students that falls in each category of the grades, and the y-axis represents the grades achieved by the students measured between 0 to 100, respectively. In the results in Figure 1, we found that while there were no significant differences in the average grades or distribution across the two groups of students for Week-1 ( $p=.991$ ), Week-6 ( $p=.476$ ), and Final grades ( $p=.081$ ). We note, on the other hand, that there was a major increase in the mean scores from Week-1 (25.47), Week-6 (27.70), and Week-10 (31.00) for group 2 (in-person) students, as opposed to the decrease in the mean score observed for group 1 (virtual) students where Week-1 (25.51), Week-6

(24.56), and Week-10 (23.14), respectively (see Figure 1). Consequentially, whereas the students may have maintained a consistent pattern of scores for the two groups across the data by considering the lack of significant differences in the average grades or distribution, it can be said that the teaching method or intervention was more effective for group 2 (in-person) students than group 1 (virtual) students who did not didactically benefit from the method or decrease in the mean scores over the weeks (Figure 1).

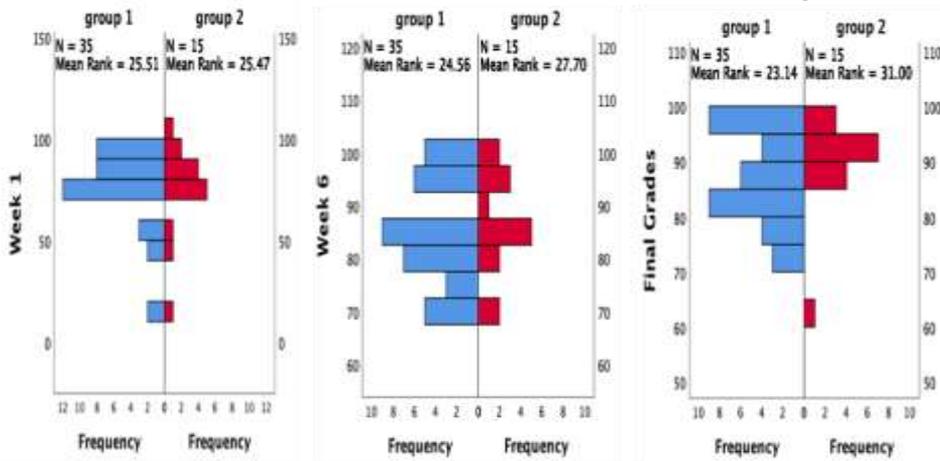


Figure 1 Results for mean rank of effectiveness of the learning intervention for the student groups (group 1 = virtual, group 2 = in-person) broken down by the weeks.

Furthermore, for the independent-samples Mann-Whitney U test we conducted to determine the mean differences for Evidence 1 (Knowledge-) and Evidence 2 (Practical- ability) scores or competency levels of the students (see Figure 2), we found that there were significant differences in the scores or distributions across the two groups, where Evidence 1 ( $p=.017$ ) and Evidence 2 ( $p=.001$ ), respectively. On the other hand, a similar pattern for the students' average week grades was also observed for the competencies (Knowledge- and Practical- ability), whereby a larger margin of the mean scores for Evidence 1 (Knowledge-, mean rank = 32.93) and Evidence 2 (Practical- ability, mean rank = 36.10) was observed for Group 2 (in-person) students as opposed to Group 1 (virtual) that showed a lower margin for Evidence 1 (Knowledge-, mean rank = 22.31) and Evidence 2 (Practical- ability, mean rank = 20.96), respectively (Figure 2). Therefore, from the results, it can be said that the applied teaching method or learning intervention was more effective for Group 2 (in-person) students than Group 1 (virtual).

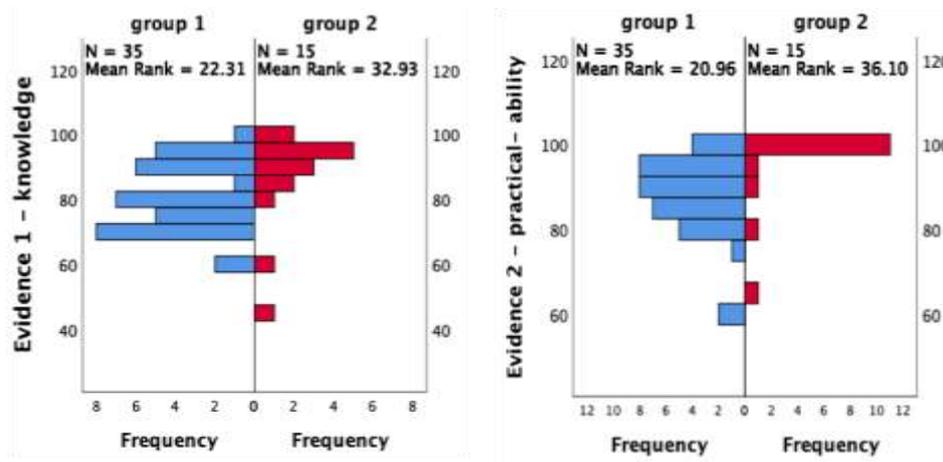


Figure 2

Results for mean rank of effectiveness of the learning intervention for the student groups (group 1 = virtual, group 2 = in-person) broken down by the evidence or competencies.

From the results reported in Figures 1 and 2, we concluded that the teaching method was effective and is important for successful students' learning outcomes. The two key factors for being more effective were modality and group size. For example, in-person attendance helped the instructors to build a taylor-made scenario to teach directly to each of the 15 students.

Lastly, we conducted the Multiple Linear Regression (OLS) and multivariate analysis of covariance (MANCOVA) with multiple comparisons (post hoc) to determine whether the Evidence 1 (Knowledge-) and Evidence 2 (Practical- ability) factors are associated or have an impact on the final grades of the students, and if those differ if any, by the two groups (virtual vs. in-person). As reported in Table 3, we note that both factors (Knowledge- and Practical) are related or correlated with the final grades of the students.

Table 3

Result of correlation between Evidence 1 and Evidence 2 vs Final Grades

Multiple Linear Regression: Evidence 1 and Evidence 2 vs Final grades

Competency (factor)	B	Std. Error	Beta	t	Sig.
Evidence 1 - knowledge	.284	.077	.420	3.693	.001*
Evidence 2 - practical- ability	.415	.092	.513	4.509	.000*

Note: Significance level ( $p \leq .05$ )

Following the results in Table 3, we further conducted a multivariate analysis of covariance (MANCOVA) with multiple comparisons (post hoc) tests to determine the marginal mean of the effects for the significant factors (Evidence 1 and Evidence 2) and where the significant differences may lie across the data. Table 4 presents the results.

Table 4

Test of between-subjects effect for Evidence 1 and Evidence 2 vs Final grades considering the grouping variable.

MANCOVA: Evidence 1 and Evidence 2 (ind. var) vs Final grades (dep. var)				
Factor	Mean Sq.	F	Pt. Eta Sq.	Sig.
Group	0.21	0.02	.001	.876
Evidence1 knowledge	31.58	3.75	.696	.006*
Evidence2 practical- ability	34.05	4.04	.643	.007*

Note: Significance level ( $p \leq .05$ )

As shown in Table 4, there were significant differences in the final grades achieved by the students in Evidence 1 – Knowledge ( $F = 3.752$ ,  $p = .006$ ) and Evidence 2 – Practical- ability ( $F = 4.04$ ,  $p = .007$ ). When considering the two groups of students (in-person vs. virtual) as covariates in the competencies, we note that there were no differences in the marginal means of effect ( $F = 0.02$ ,  $p = .876$ ) when taking into account the students' grades. In other words, Evidence 1 (Knowledge-) and Evidence 2 (Practical- ability) can be said to be important elements in the level or extent of learning outcomes by the students and can vary based on student-to-student profiles. Moreover, their (Knowledge- and Practical- ability) effectiveness or impact can be said to be applicable to both the in-person and virtual groups (Table 4).

## DISCUSSION

This study applied the participatory research design approach to assess the impact of *knowledge* and *practicality* (as constructs) on students' learning outcomes and/or competency development. The results (see Data analysis and results section) shows that a blend of both knowledge and practicability is a strong catalyst for educational innovation and an effective methodological approach to learning that is capable of improving the students' learning outcomes (#H<sub>1</sub>) (see Research Hypothesis – Introduction section). Therefore, we rejected the #H<sub>0</sub> which suggests that knowledge and practicability are not strong catalysts for educational innovation or improvement of students' learning outcomes, and accepted the #H<sub>1</sub> described above.

To explore the potential reasons for the research findings and observed differences between the virtual and in-person groups, and to discuss any limitations or factors that may have influenced the results, we explain the results/outcomes of the study as follows:

Regarding step 1 in our experiment, which explored the mean differences or learning progression of the students across the weeks (weeks 1, 6, and 10), evaluated for the two groups (virtual group 1 vs. in-person group 2); we found that the descriptive statistics of the dataset showed that the Group 1 average in week 1 was 73.43, with an improvement of 11.43 points at the end of week 6, with an average of 84.86. For group 2, the average mean score for week 1 was 73, with an improvement of 13.67 points at the end of week 6, with an average of 86.67. Therefore, it can be said that the delta improvement for group 2 was greater than that of group 1, with the in-person group performing 20% better than the virtual group. This result may be expected as other existing studies have

shown that while the remote or virtual mode of learning are effective and have exponentially increased over time, particularly accentuated by recent events such as the global pandemic, on the other hand, there have been speculations on the void (face-to-face interaction) that such learning setting have left (Okoye et al, 2021). Meaning that students who receive first-hand support or in-person interaction with their tutors, as suggested in the findings of this study, are more likely to learn the practical skills and competencies quicker than their online counterparts (Zaheer, 2022). Moreover, prior studies have also affirmed some of the main challenges that have emerged as a result of the recent digital learning transitions to include that it will be difficult to replicate the face-to-face learning experiences for the students online (Al-Maskari et al., 2021; Okoye et al., 2023; Zaheer, 2022) notwithstanding that the remote learning may be as good or better than in-person learning for those students who specifically choose it (Burke, 2020). However, it is also worthwhile to mention the fact that most of the higher institution are now implementing the hybrid models (virtual and in-person) for learning by allowing the students to choose the best mode of learning suitable for their learning needs or circumstances (Müller & Mildenerger, 2021, Okoye et al., 2021, UNESCO, 2022). Moreover, such flexibility in learning/approach can be perceived to help tackle the problem of rigidity of the curriculum that has also been identified in both the literature and in practice as one of the main educational problems or challenges (Laufer et al., 2021; Reisberg, 2019).

Similarly, in our second experiment that involved the test of knowledge (evidence 1) and practical ability (evidence 2) for the two groups (virtual group 1 vs. in-person group 2); group 1 average in evidence 1 was 80.34, whereas the average for Group 2 in Evidence 1 (Knowledge) was 86.47. For evidence 2, group 1 (virtual) presented a practical-ability performance of 87.7 and group 2 (in-person) presented a 95.33 performance. Therefore, based on the high average scores for the evidences or competencies, and aside the fact that the in-person group performance rate showed to be higher than their virtual counterpart; it can be said didactically that forming a favourable attitude toward innovation or learning and engaging in activities, in general, can lead to a positive or impactful choice to adopt educational innovation practices amongst the educators capable of improving students' learning outcomes, affirming also the study by Ku & Yan (2021) and Farizi et al, 2023 that highlighted the importance of Challenged-based learning models and critical thinking skills or practicality that positively affects the student learning outcomes, facilitates collaboration amongst the students to explore new ideas, and assists the development of behavioural and cognitive strategies.

Lastly, considering the third experiment in the study that involved the testing to determine whether the Evidence 1 (Knowledge-) and Evidence 2 (Practical- ability) have an impact or are associated with the final grades of the students, and whether the impact, if any, differs amongst the two groups (virtual vs. in-person). The average score of Group 1 in the final grades was 86.7. In group 2, the final average grade was 90.2. Thus, it can be said that the in-person group (group 2) performance was 4% better than the virtual group (group 1). This result also confirms the previous study by D'agostino (2005), therein, we can conclude that the proposed methodology of this

paper improves the learning outcomes of the students with a significant accuracy of 86%, representing a delta from week 1 to final grade of 13.3 points for group 1 and 17.2 points for group 2, respectively.

To summarise the results, the outcome of this study has shown that learning outcomes and competency development levels of the students were positively associated with the Knowledge- and Practical constructs that was applied in the teaching intervention or methodology, thus, we accepted #H<sub>1</sub>. The implications of the findings and discussions can be said to highlight and align itself with the existing literature and theories, that purported in order to help students reach their full potential, the stakeholders (educators, governments, policymakers, educational organizations) must recognize that learning goes beyond the ability to read, write or perform simple tasks, to include a range of competencies needed not only for improving the students' learning experiences and outcomes, but also important to understand what, when, where and how they learn (Okoye et al., 2021; UNESCO, 2022).

Instructional -wise, in modern teaching, where a student-centered approach is widely adopted and applied, the method of learning is greatly attributed to how the learning content or subject matter are thoroughly delivered. Therefore, in its entire domain, while the modern technology is replacing the traditional teaching methods, in effect, technology is harnessed as a guiding tool for efficient learning by assimilating teaching methods (of orderly fashioned learning resources) and techniques that stimulate cognitive absorption of knowledge and practicability, thus enabling continuous and smooth learning outcomes and retention, thus, the blend of knowledge and practical ability or teaching method described in this study.

Nonetheless, it is also important to discuss, according to Rogers (1995), "knowledge diffusion" as the process by which an innovation is communicated through certain channels over time among members of a social system, such as the university or learning settings. Given that decisions are not authoritative or collective, each member of the social system in question, such as educators, students, and teachers, faces their own innovation decision, which is represented as follow in a 5-step process:

- 1) Knowledge – becomes aware of an innovation and has some idea of how it functions.
- 2) Persuasion – forms a favorable or unfavorable attitude toward innovation.
- 3) Decision – engage in activities that lead to a choice to adopt or reject the innovation.
- 4) Implementation – puts innovation into use.
- 5) Confirmation – evaluates the results of an innovation-decision already made.

In this study, based on the above 5 steps process, the diffusion of a blend of knowledge and practicability in teaching can be said to follow a traditional diffusion pattern. This is evidenced by the fact that the in-person student group learned more effectively than the virtual group (see Data Analysis and Results). Thus, they were more aware of an innovation and had some idea of how it works, as demonstrated through the implementation of Schneider's methodology in the HEI setting. Therefore, questions

such as “Has the integrating of knowledge- and practical- ability competence into instruction and learning determined or improved the learning outcomes for the students?” can be established didactically (see the Research Hypothesis).

### **IMPLICATIONS**

Since students' learning outcomes (SLO) and learning-oriented assessments (LOA) are similar, and there is still debate about their effects on students' learning, there is a need to differentiate between them, especially in higher education. A crucial task for higher institutions is to provide innovative education for students who will enter the labor market in the future, as it raises their competitiveness and promotes the development of society in the long term (Crosling et al., 2015, UNESCO, 2014).

Regarding the implementation and confirmation of the learning innovation process, where students put educational innovation into use and evaluated the results of an innovative decision already made, we compared or determined the differences in outcomes between the two groups of students (in-person vs. virtual). Considering the results of the Experiments 1 and 2 (see Table 2), we determined that in-person students performed better after learning the Schneider methodology in both the knowledge and practicability constructs. In turn, the study demonstrates how students' learning and expected success rates can be improved during their academic careers using the presented model or teaching approach, especially in terms of the proficiency of identifying different types of materials or learning elements.

Consequently, this process of creating new knowledge and practical abilities allows students to test and achieve their ideas in the way they want, which in turn, promotes their innovative or innovation competence (Mursid et al., 2023; Santos et al., 2023; Silviariza et al., 2023). Thus far, we strongly believe it is necessary to encourage teachers in higher education to adopt the assessment of students' learning outcomes and competency through the blend of knowledge and practical ability.

### **Limitations and future directions for research**

This research contributes to filling the gap in the literature on assessment of students' learning outcomes and competencies, both in theory and in practice. However, the authors acknowledge it can come with some limitations. The primary limitation is that the data sampled in this study are from the field of business. Therefore, further research may consider collecting samples from other various higher education levels, disciplines, or contexts, including other factors that may have not been considered in this study, in order to obtain more empirical evidence on the impact of the competencies' acquisition and learning/teaching strategies on students' learning outcomes across the HEIs. For example, we intend to expand the scope of the research to other departments across the institution of study to obtain further empirical overview of the impact of the teaching methodology and/or approach described in this study in the different learning contexts.

Another limitation of the study is the data sample size and teaching modality, considering that the in-person group included 15 students from the 50 sample. Although we note that the sample of 50 from more than 200 individuals in the target student

population does not imply substantial self-selection in the study. The authors strongly believe that the parametric and non-parametric analysis conducted in this study has the statistical power to detect differences in the mean between the studied groups. Further studies can be conducted in the same or different learning settings with an updated, wider learning scenario. Further research can also examine the impact or whether differences in the gender of the students could affect the application of the knowledge transfer process.

Lastly, while this research suggests that educational impacts are experienced and modified as successful practices are found, the implications of this to policy making may present to be more challenging or needs further research to generalise. It is therefore hoped that the assessment of the students' learning outcomes done in this research would be useful for the educators, policymakers, experts, professional and learning managers, for example, at the different higher institutions of learning and industry, such as Schneider, to improve the level of the assessment in the process of designing the learning/training programs and curriculum. In addition, it is recommended that the improvement of key factors (e.g., knowledge and practicality) that have positive effects on students' learning outcomes, assessment, and competencies or skill development, should be encouraged across the different HEIs and the industry sector.

## CONCLUSION

This study investigates whether blending knowledge and practical ability is a strong catalyst for educational innovation or a fundamental resource for improving students' learning outcome and experiences through the participatory research design approach and series of statistical test and analysis done in this study. It found that teaching methods or learning intervention that includes a blend of the *knowledge-* and *practical-ability* constructs can provide creative pedagogy for the students and serve as a strong catalyst for educational innovation or fundamental resource for improving students' learning outcomes and assessments. This was experimented through a teaching method that involved teaching Schneider's innovative design methodology and practices related to higher education. Based on the results of the study, both competencies (Knowledge-and Practical) can provide expansive opportunities and value for learners, enabling them to impact and lead in the global workforce. This suggests that educational impacts are experienced and modified as successful practices are found. Besides, we conclude that the teaching method applied in this study is important for successful students' learning outcomes. Considering two key factors for being more effective: modality and group size. Also, we noted that knowledge- and practical-ability are correlated with the final grades of the students. In conclusion, it demonstrates how students' learning and expected success rates could be improved during their academic careers using the presented model or teaching methodology/intervention. Consequently, we strongly believe it is necessary to encourage teachers in higher education to adopt the assessment of students' learning outcomes and competency through the blend of knowledge and practical ability.

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