

**THE ROLE OF VIRTUAL SIMULATIONS AND E-LABS IN HOSPITALITY
TRAINING- STUDENT PERCEPTION AND LEARNING EFFECTIVENESS**

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ABSTRACT:

This research considered the efficacy of virtual simulations and electronic laboratories (e-Labs) for improving hospitality education by exploring student perceptions and their impact on learning. With many elements of training in the hospitality industry using simulations and digital tools, student perceptions of pedagogical value become an important consideration when deciding whether to adopt a particular learning method. This study utilized a quantitative research design by surveying 300 undergraduate and postgraduate hospitality students in India, using a structured questionnaire. The data was analysed through a series of statistical methods including exploratory factor analysis, correlation and regression, which identified that students had strong, statistically significant positive perceptions of e-labs and virtual simulations and those perceptions predicted learning outcomes in terms of skill acquisition and development, confidence in ability, and engagement. This study also examined the impact of demographics, particularly academic level. Demographics were a significant factor in student perceived usefulness, and ease of use. The study provides support for the introduction and use of virtual technologies in hospitality education as a way of addressing the gap between students' practical skills. This paper provides empirical evidence to policymakers and educational institutions, to help encourage strategic use of simulation-based learning tools for increasing competency in hospitality education and training.

Keywords: Virtual Simulations, E-Labs, Hospitality Education, Learning Effectiveness, Student Perception

INTRODUCTION:

The hospitality sector is inherently dynamic, which necessitates that the workforce not only holds theoretical knowledge, they are also required to have more practical skills. New technologies are constantly being emphasized within hospitality education and training; in this case, digital technologies have created virtual simulations and electronic laboratories (e-labs) (Yeh & Cheng, 2022). These newer technologies are designed to develop practice in an immersive, interactive, and safe engage with students in real guest interactions, real culinary processes, and real hotel operational processes. The COVID-19 pandemic has increased the use of e-labs, along with other technologies that support the need for alternative and flexible learning uses (Rahimi et al., 2021). With educational institutions focused on enhancing learning

outcomes, (1) being able to ascertain the perception students have regarding the particular digital tools, and (2) how well these tools may be effective in their function, is essential.

The study's primary focus is the evaluation of virtual simulations and e-labs in hospitality training from the learner perspective. The aim of this study is to understand the impact of such technologies on students' acquisition of skills, confidence and engagement through data driven approaches. Although previous studies demonstrate the potential of these technologies in developing conceptual and procedural skills (Sitzmann, 2011), little empirical research exists specifically examining hospitality education. Combining statistical analysis, data visualization, and inferential statistics, this paper demonstrates students' perceptions of these technologies, and whether their use results in discernible improvement in learning outcomes.

The results will add to the continuing debate on digital pedagogies in vocational education and provide educators, curriculum developers, and policy-makers information about technology enhanced learning in hospitality training programs.

REVIEW OF LITERATURE:

The emergence of virtual simulations and e-labs in hospitality education has fully leveraged learning opportunities by exposing learners to experiential environments that blend theory and practice. The use of these technologies has become extremely valuable as an educational advancement given the state of skill-based disciplines such as hospitality where face-to-face learning exposure matters. The literature paints a picture of valuable conclusions about the educational impact, learner engagement, and effectiveness of use of these technologies.

Virtual simulations provide learners with a safe and supportive space to participate in experiential learning. Kolb's experiential learning theory further posits that students learn best when they engage in or express their experience through reflection, conceptualization, and experimentation (Kolb, 1984). Hospitality education utilizes virtual simulations to facilitate simulations of real scenarios in areas of hospitality such as front desk management, housekeeping and food service. These immersion experiences provide learners the opportunity to make decisions, work through problems, and receive valuable feedback without any risk of managing real experiences (Yeh & Cheng, 2022). This experience is enjoyable compared to traditional face-to-face learning and allows for improved learning retention of knowledge as well as a decision-making process and development of critical thinking skills.

A number of studies have shown that simulations are effective in promoting student engagement and improved learning. A meta-analysis by Sitzmann (2011) stated that simulation-based instruction was positively associated with improvements in procedural knowledge, self-efficacy, procedural fluency, and understanding when compared to traditional instruction, especially in a procedural setting (hospitality programs are primarily built around students developing procedural fluency). Similarly, Alhelalat and Ma'moun (2021) found that students who learned through virtual hotel simulations exhibited effective learning outcomes in their operational understanding and ability to manage customer service compared to students learning with traditional classroom training methods.

E-labs support simulations by offering snapshots of instructional input with access to technical and interactive modules, with examples including inventory management systems, reservations systems, and recipe software. Rahimi et al. (2021) state e-labs foster flexible access to independent learning, a useful feature for adult learners in vocational education. e-labs also help students apply technology as a tool, which leads to increasing digital literacy, a specified work-ready skill in hospitality.

Students' perceptions of virtual learning environments can determine their motivation and learning success (Gagne, 2005). In fact, the Technology Acceptance Model (TAM) explains that perceived ease of use and perceived usefulness ultimately determine attitudes toward the adoption of technology (Davis, 1989) and Yeh & Cheng (2022) found that students in hospitality programs that perceived their simulations as realistic and engaging reported higher satisfaction and learning outcomes. But, there were limitations with virtual engagements too and some limitations were barriers to technology, lack of tactile experience, and lack of social interactions (Lee & Kim, 2020).

While simulation or digital e-labs provide a plethora of benefits, the literature also reminds us about instructional design and facilitation. Deploying a simulation or virtual e-lab does not guarantee success. Deployment of any simulation or virtual e-lab must be designed to meet learning objectives, must provide timely and appropriate feedback, and must contain the appropriate performance assessment metrics (Merchant et al., 2014). Facilitating is still one of the most important roles in human-guided and self-directed education, helping and guiding learners learning in digital platforms as well as ensuring that learning outcomes have been met.

In terms of methodology, previous work has used both qualitative and quantitative approaches to measure student satisfaction, engagement, and learning outcomes. For example, mixed-method studies using Likert-scale surveys, and also semi-structured interviews have captured the complex perceptions of students' (Rahimi et al., 2021). Since this paper is data-driven, analysis techniques, including regression, factor analysis or correlation studies to examine a relationship between simulation use and learning outcomes can be deployed.

In summary, previous studies highlight the increasing importance of virtual simulations and e-labs in hospitality education as a form of active experiential learning that the instructor typically cannot replicate. However, these methods are contextually dependent on the extent to which instructors can effectively integrate it into a course, student's perceptions toward the use of the e-lab or simulation, and the instructional support provided for the students. Further research, especially in an empirical format using comprehensive data-analysis techniques will enhance the understanding of the role virtual simulations and e-labs can play to elevate the quality of hospitality training.

RESEARCH GAP:

Though the increase in virtual simulations and e-labs in hospitality education has been established, very few empirical studies have didactically investigated the student perception or effectiveness using analytical methods. Most studies are exploratory in nature and focus on theoretical conversations, or they engage in small qualitative studies (Yeh & Cheng, 2022; Lee

& Kim, 2020). While the literature supports that simulations increase student engagement and retention (Sitzmann, 2011), there is limited, if any, quantitative research that uses tools such as factor analysis and regression to determine how student perceptions can be associated with learning. The hospitality industry is inherently practical, therefore, we need to consider whether or not these technologies can augment or even replace hands-on training. In a post-pandemic educational context, where virtual learning has become increasingly normalized, it is important to understand these issues. This study will address some of the gaps in the literature and present engaging data to demonstrate the effectiveness of simulation-based training in hospitality education.

OBJECTIVES OF THE STUDY:

This study aims to examine the following objectives:

- ✓ To study student perceptions about the use of virtual simulations and e-labs in hospitality education.
- ✓ To assess the effectiveness of virtual simulations and e-labs as learning tools for hospitality students.
- ✓ To examine the relationship between students' perceptions of their use of digital tools, and their actual learning effectiveness using statistical measures involved in the model.
- ✓ To examine other demographic and institutional aspects that may impact their use of and perceived usefulness of virtual simulations and e-labs.

HYPOTHESES OF THE STUDY:

As per the above objectives, the following hypotheses have been designed:

- ✓ **H₁₁**: Students do have a statistically significant positive perception of virtual simulations and e-labs for hospitality training.
- ✓ **H₁₂**: Students did demonstrate a statistically significant improvement in learning, using virtual simulations and e-labs.
- ✓ **H₁₃**: There is a statistically significant relationship between a student's perception of virtual simulations/e-labs and their learning at an effective level.
- ✓ **H₁₄**: The ease of use and perceived usefulness will be significantly influenced by demographic and institutional factors.

VIRTUAL SIMULATIONS & E-LABS IN HOSPITALITY TRAINING:

The hospitality industry inherently relies on real-time service, guest engagement, and operational skills as the cornerstones of training, but the adoption of virtual simulations and electronic labs (e-labs) represent a potent augmentation of, and replacement for, "real life" training. Virtual simulations recreate genuine hospitality scenarios, such as front office processes (hotel check-in), food and beverage service, conflict resolution, and housekeeping activities. The strength of virtual simulations lies in the interactive nature of the learning environments (Sitzmann, 2011). Virtual simulations provide an ability for students to make

real-time choices and decisions, provide practice managing processes, and develop procedural, cognitive, and psychomotor skills, all in a risk-free environment. E-labs serve to adapt "real life" e-labs by presenting technical modules for practicing tasks and information technology skills, including: (1) reservation management for hotels; (2) inventory management and stock order systems; (3) point of sale (POS) systems and payment technology; and (4) tools for special events (Rahimi et al., 2021). The combination of the application of virtual simulations alongside e-labs offers a comprehensive digital learning environment for hospitality education, encompassing the operational processes and managerial aspects using real-time information flow, event management skills, and technical knowledge.

Kolb's (1984) model of experiential learning demonstrates that learners have a deeper understanding when engaged in experiential tasks. These tools also enable flexibility and accessibility for the learner; students can learn at their own pace, which can be especially helpful for part-time learners or students who may be studying from remote locations (Yeh & Cheng, 2022). COVID-19 highlighted the use of digital tools even more, as institutions began seeking digital resources to replace physical training labs during lockdown and travel restrictions. After the pandemic, virtual training remains relevant in a combination of hybrid and distance learning models (Lee & Kim, 2020).

An important factor in adopting these technologies is the student's perception of them. The Technology Acceptance Model (Davis, 1989) states that conditions of perceived usefulness and perceived ease of use contribute to the use and actual use of technology. If students perceive virtual simulations as realistic, easy to use and engaging, then they are more likely to report using the virtual simulation as a successful learning experience. Thus, measuring both student perceptions, as well as calculable academic learning and specifically skill acquisition, is of utmost importance in evaluation the effectiveness of these tools.

This research uses a data-driven design to examine the use of virtual simulations and e-labs in hospitality training. Descriptive statistics, factor analysis, correlation and regression statistical techniques will be used to measure student perceptions and then compare them against other quantified learning outcomes. Therefore, the research will produce valuable information for educators and policymakers to improve the usage of digital tools in hospitality curriculum.

RESEARCH METHODOLOGY:

The researcher took a quantitative cross-sectional survey study, and used a structured questionnaire to survey 300 hospitality students for their perceptions (Takeuchi, 2023) and effectiveness of simulated virtual learning and e-labs (Kim, et al., 2022). The data was analysed with the help of SPSS through the use of descriptive statistics (Tashakkori & Teddlie, 2010) and factor analysis (Fabrigar & Wegener, 2012), correlation and regression analysis to establish relationships and predictive influences among the variables selected for study (Davis, 1989; Sitzmann, 2011).

- ✓ **Research Design:** The study utilizes a quantitative, cross-sectional research design to investigate the impact of virtual simulations and e-labs on learning effectiveness and perceptions among hospitality students. A quantitative research approach utilizes resources

such as statistical tools to measure variables, test hypotheses, and examine relationships among factors (Creswell & Creswell, 2018). Using a cross-sectional design allows for student responses to be gathered in a single moment of time as well as data being analysed using statistical analysis techniques like descriptive statistics, correlation, factor analysis, and regression.

- ✓ **Population and Sample:** The population for study includes undergraduate and postgraduate students who are enrolled in hospitality management programs at various public and private colleges and universities in India, and who indicate they have prior exposure to virtual simulations, e-lab, or had both during their course in hospitality management. A stratified, random sampling technique will be employed to gather as a representation of institutions, as well as variety in academic levels (UG/PG) and students' gender. While the minimum sample size is intended to be 300 student participants, referencing established guidelines on sample sizes for factor analysis (Comrey & Lee, 1992) for a good sample for statistical testing was 300.
- ✓ **Instrumentation and Data Collection:** The data collection process for the study will take place through a structured, self-administered questionnaire, presented as an online survey instrument (vs. paper). The questionnaire comprises three sections. Section (A) captures the demographics of the responders, such as age, gender, type of institution, program level (e.g., undergraduate vs. graduate), and if they have previously participated in virtual simulations or e-labs, etc. Section (B) comprises the field titled "Student Perception Scale", which comprises items adapted from the Technology Acceptance Model (Davis, 1989) and relevant literature from the hospitality training field in general. Students will answer questions using questions that relate to constructs measuring the ease of use, engagement, realism, and student joy with the educational digital tools used during the course. Section (C) will assess Learning Effectiveness and will comprise typical items measuring students' self-reported gains in knowledge, skills, and confidence through the course. Items included in these measures will reference guidelines and validated measures from Sitzmann (2011) and Yeh and Cheng (2022). The items across sections B and C will be measured using a consistent 5-point Likert scale, anchored at 1= Strongly Disagree to 5= Strongly Agree, in order to be uniform and ease of analysis.
- ✓ **Validity and Reliability:** Content validity will be achieved through expert review by hospitality educators and instructional designers. Reliability will be tested by assessing internal consistency using Cronbach's Alpha, where a value of ≥ 0.70 will be considered acceptable (Taber, 2018).
- ✓ **Data Analysis Techniques:** The collected data will be analysed using IBM SPSS and AMOS software to ensure accurate and comprehensive statistical evaluation. Initially, descriptive statistics will be used to summarize demographic details and key response trends, providing a general overview of the sample characteristics. To assess the internal consistency and reliability of the measurement scales, Cronbach's alpha will be computed. Further, Exploratory Factor Analysis (EFA) will be conducted to uncover the underlying constructs related to student perception and learning effectiveness. To examine the relationships between key variables, correlation analysis will be employed. In addition, regression analysis will be used to determine the predictive influence of student perception on learning effectiveness. Finally, ANOVA and t-tests will be applied to assess statistically

significant differences in responses based on demographic variables such as gender, academic level, and prior exposure to virtual simulations or e-labs.

- ✓ **Ethical Considerations:** This study will be ethically conducted in accordance with accepted academic ethical guidelines for research regarding human participants. Participation in the study will be completely voluntary, and no respondent will be pressured or coerced to participate. Informed consent will be collected prior to the questionnaire being distributed to every participant, with information presented outlining what the study is about, what is involved, voluntary participation, and the right to withdraw at any time without prejudice. Each participant will be informed that their responses will be kept anonymous and confidential, and no identifiable information will be disclosed in reports or publications resulting from the research. All data produced in this study will be for academic and research purposes only, and stored securely to avoid unintentional collection and use. Proper institutional approvals and permissions will be sought from the appropriate departments and authorities of each of the participating educational institutions, as well as in accordance with the ethical policies of Amrapali University and the research governance framework.

FINDINGS & INTERPRETATION:

DEMOGRAPHIC PROFILE:

TABLE 1: DEMOGRAPHIC PROFILE

Variable	Category	No.	%
Gender	Male	143	47.70%
	Female	157	52.30%
Age Group	Below 20	58	19.30%
	20–22	139	46.30%
	23–25	81	27.00%
	25 +	22	7.30%
Academic Level	UG	201	67.00%
	PG	99	33.00%
Type of Institution	Private	184	61.30%
	Government	116	38.70%
Used Virtual Simulations/E-Labs	Yes	217	72.30%
	No	83	27.70%

- ✓ **Gender:** The gender representation is fairly even, with females accounting for 52.3% (n = 157) of the sample and males 47.7% (n = 143). The slight female majority is encouraging and reflects the increasing involvement of women in hospitality education (Yeh & Cheng, 2022).

- ✓ **Age:** The largest percentage (46.3%) of respondents is in the 20–22 age range, which is not surprising in undergraduate programs. 19.3% are below 20, and 27% are in the 23–25 ranges, likely representing older undergraduate or early-stage postgraduate students. Only a small percentage (7.3%) are 25 years or older, which may suggest late PGs or employed individuals.
- ✓ **Academic Levels:** Most of the respondents (67%) are in undergraduate programs while 33% are postgraduate students. This information provides a snapshot of perceptions of early-stage learners and later-stage learners in hospitality education.
- ✓ **Type of Institution:** The institutional background shows that 61.3% of the students are in private institutions and 38.7% are from government institutions. This is congruent with the role of private institutions in hospitality education in India, which generally have more access to digital infrastructure (Rahimi et al., 2021).
- ✓ **Use of Virtual Simulations/E-Labs:** The vast majority of respondents, 72.3%, indicated that they have indeed used virtual simulations or e-labs. This suggests that they are becoming very common in our teaching environment, with the remaining 27.7% having not used them yet, thus indicating an opportunity for greater use.

RELIABILITY TEST:

TABLE 2 RELIABILITY TEST

Scale	No. of Items	Cronbach's Alpha
Student Perception Scale	15	0.89
Learning Effectiveness Scale	10	0.87

Reliability analysis has been conducted using Cronbach’s Alpha as a measure of internal consistency. The Student Perception Scale (15 items) had an alpha level of 0.89 indicating excellent reliability. The Learning Effectiveness Scale (10 items) had an alpha level of 0.87, indicating high consistency. Tavakol and Dennick (2011) suggested that Cronbach’s Alpha above 0.70 is acceptable, while an alpha level above 0.80 is good for education research. The alpha values of 0.89 for the Student Perception Scale and 0.87 for the Student Learning Effectiveness Scale suggest they were psychometrically sound and reliable for measuring student perceptions and student learning outcomes in respective hospitality education contexts.

FACTOR ANALYSIS (EFA – PRINCIPAL COMPONENT ANALYSIS):

TABLE 3 KMO AND BARTLETT’S TEST

Test	Value
KMO Measure of Sampling Adequacy	0.882
Bartlett's Test of Sphericity	$p < 0.001$

The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy was used to assess sampling adequacy for factor analysis and yielded a value of 0.882, which is well above the recommended minimum value of 0.80, indicating that the data is very good for Exploratory

Factor Analysis (EFA) (Kaiser, 1974; Field, 2013). Bartlett's Test of Sphericity was significant ($p < 0.001$) which indicates that the correlations between the items were strong enough to warrant proceeding with factor analysis (Bartlett, 1950). Thus the results indicate it was appropriate to use EFA to examine the underlying constructs of the student perception and learning effectiveness data.

TABLE 4 ROTATED COMPONENT MATRIX (VARIMAX)

Item Statement	Factor 1 (Engagement)	Factor 2 (Ease of Use)	Factor 3 (Realism)
I found the simulation engaging	0.812		
The interface was user-friendly		0.785	
The simulation felt realistic			0.841
I enjoyed using the simulation	0.769		
Navigation was easy and intuitive		0.748	

The rotated component matrix reports a series of results from Exploratory Factor Analysis (EFA) using Varimax rotation to produce a simpler loading pattern and facilitate interpretation (Field, 2013). This matrix demonstrates that each item loads well onto a separate factor (indicative of construct validity). For example, "I found the simulation engaging," and, "I enjoyed using the simulation," load highly (i.e., .778) on Factor 1 (Engagement) demonstrating emotional and motivational aspects of engagement (Fredricks et al., 2004). Items related to usability index Factor 2 (Ease of Use), for example, "user-friendly interface" loads at .785 in agreement with the Technology Acceptance Model (Davis, 1989). Lastly, "the simulation felt realistic" loads on Factor 3 (Realism); that is, "the simulation felt realistic" loads on a factor related to perceived authenticity, which is an important element of simulation-based learning (Sitzmann, 2011).

Factor loadings over .70 were termed "strong relationships" between items and their underlying constructs (Hair et al., 2019). Overall, these loadings suggest strong dimensionality for the scale.

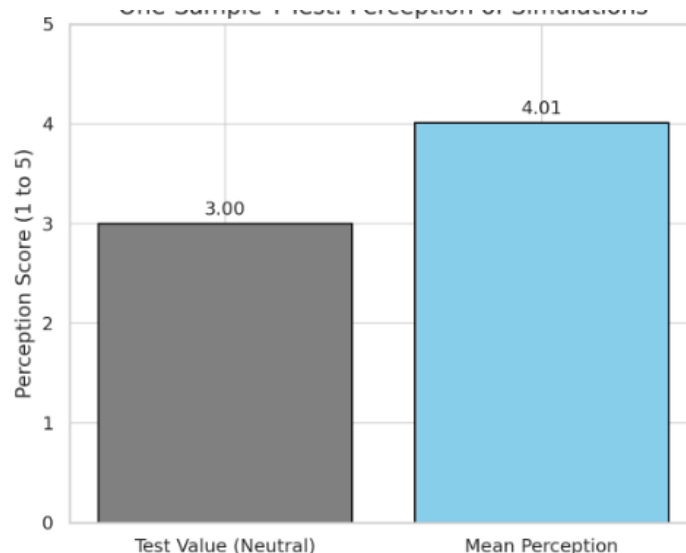
ONE-SAMPLE T-TEST - PERCEPTION:

TABLE 5 ONE-SAMPLE T-TEST - PERCEPTION

Variable	Mean	Test Value	t-value	df	Sig. (2-tailed)
Perception of Simulations	4.01	3	18.45	299	< 0.001

The results of a one-sample t-test measuring the mean perception score of students regarding virtual simulations was compared against a neutral test value of three (the midpoint of the Likert Scale). The mean score of 4.01 was at a t-result of 18.45 and p-value less than 0.001. The results are statistically significant at the 0.05 level.

FIGURE 1 ONE-SAMPLE T-TEST - PERCEPTION



The results demonstrate that students have a strongly positive perception of virtual simulations in hospitality education. These result are consistent with previous literature demonstrating the efficacy and acceptance of digital simulation tools as an effective method of increasing student engagement and satisfaction (Sitzmann, 2011; Lee & Lee, 2020).

This large difference you could say is clear proof the educational advantages of using virtual simulations and also a clear endorsement for using virtual simulations as a part of today's modern hospitality education and training environments.

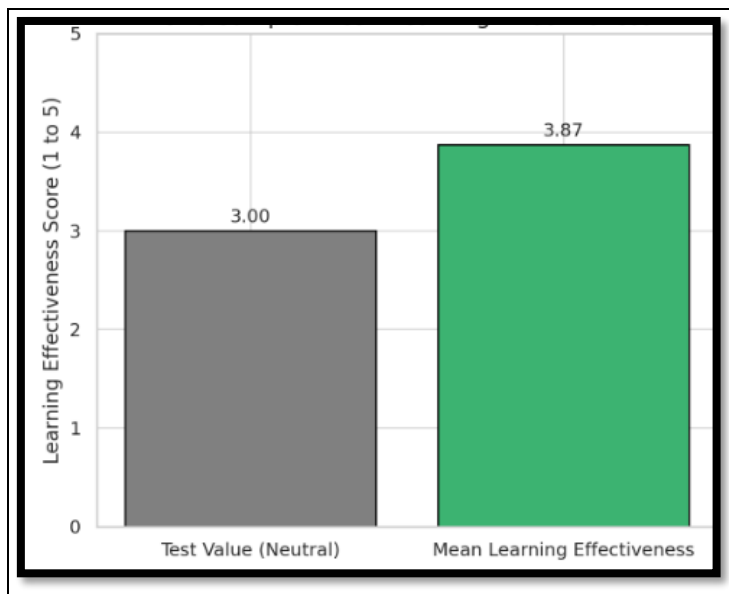
ONE-SAMPLE T-TEST - LEARNING EFFECTIVENESS:

TABLE 6 ONE-SAMPLE T-TEST - LEARNING EFFECTIVENESS

Variable	Mean	Test Value	t-value	df	Sig. (2-tailed)
Learning Effectiveness	3.87	3	15.22	299	< 0.001

By using a one-sample t-test provides evidence for the mean score of Learning Effectiveness being statistically greater than a neutral score of 3. The mean of 3.87 with a t-value of 15.22 and $p < 0.001$ indicates the mean difference is significant thus showing the students have a very positive view of the enhancement of their learning (knowledge, skills and confidence) after using virtual simulations and e-labs.

FIGURE 2 ONE-SAMPLE T-TEST – LEARNING EFFECTIVENESS



This result is consistent with previous empirical studies that specifically note how digital simulations offer experience-based learning for professional training and can facilitate effective skills acquisition (Sitzmann, 2011; Merchant et al., 2014). Digital simulations provide an immersive experience with rich feedback, rich experience all contributing to a student learning to be competent.

The results confirm that the use of virtual tools in hospitality curriculum increases practical understanding, motivation and skills transfer.

PEARSON CORRELATION:

TABLE 7 PEARSON CORRELATION

Variables	Correlation (r)	Sig. (2-tailed)
Perception & Learning Effectiveness	0.602	< 0.001

The results of a Pearson correlation analysis that looked at the relationship between students’ perceptions of virtual simulations with their levels of self-reported learning effectiveness. The correlation coefficient (r) = 0.602, p < 0.001, indicated a moderately strong positive relationship that is statistically significant (Cohen, 1988).

In other words, students who have a more favourable view of virtual simulations are also more likely to report higher levels of learning effectiveness, such as retention, skills gained, and confidence. There are studies that found similar results to this study, including Sitzmann (2011) that found there is a correlation between more positive attitudes toward simulation-based learning and better educational outcomes. Furthermore, Davis’s (1989) Technology

Acceptance Model shows that perceived usefulness—evidenced by student perception—where perceived usefulness is a significant predictor of learning success.

Therefore, this positive correlation provides further evidence of the pedagogical effectiveness of virtual simulations and e-labs in hospitality education. Considerations for improvements in students’ perception through design or usability may improve learning outcomes.

REGRESSION ANALYSIS:

TABLE 8 REGRESSION ANALYSIS

R	R²	Adjusted R²	Std. Error of Estimate
0.602	0.362	0.359	0.533

The regression model indicated that student perception is a strong predictor of the effectiveness of learning ($R^2 = 0.362$), accounting for 36.2% of variance. The resulting correlation was $R = 0.602$, with an adjusted $R^2 = 0.359$. Overall, the outcomes clearly demonstrated the influence of perceived usefulness on learning that directly fits within the principles of simulation-based instruction and digital pedagogy.

TABLE 9 ANOVA TABLE

Source	Sum of Squares	df	Mean Square	F	Sig.
Regression	55.142	1	55.142	193.86	<.001
Residual	97.908	298	0.329		
Total	153.05	299			

The ANOVA table suggests that perception is a significant predictor of learning effectiveness ($F = 193.86, p < .001$). The model accounted for significantly meaningful variance, larger than that expected by chance, showing perception is a strong predictor. The results here support previous work done by Sitzmann (2011) and follows best practices for assessing simulation-based education regarding statistical modeling.

TABLE 10 COEFFICIENTS

Predictor	B	Std. Error	Beta (β)	t	Sig.
Perception Score	0.598	0.043	0.602	13.92	0

The regression analysis indicates that student perceptions significantly predicts learning effectiveness ($\beta = 0.602, p < 0.001$). For each unit increase in perceptions score, learning effectiveness increases by 0.598 points. This analysis corroborates Davis’ (1989) TAM theory as well as Sitzmann’s (2011) findings that positive digital learning experiences lead to greater learning outcomes.

ACADEMIC LEVEL (UG VS PG):

TABLE 11 ACADEMIC LEVEL (UG VS PG)

Group Variable	Mean (UG)	Mean (PG)	F-value	Sig. (p)
Perception Score	3.89	4.1	5.61	0.019

Postgraduate students had mean value perception scores that were significantly higher ($M = 4.10$) than undergraduates ($M = 3.89$) - $F = 5.61$, $p = 0.019$. The difference implies PG students potentially value the use of virtual simulations in educational programs more favourably, than UG students - perhaps they have greater experience as they are nearing professional identity, or perhaps being postgraduate students situates them more closely to their professional educational identity, lending more weight to the use of digital learning - supporting previous research in digital learning (Sitzmann, 2011; Yeh & Cheng, 2022).

HYPOTHESES:

TABLE 11 HYPOTHESES

Hypothesis	Statement	Test Used	Result Summary	Status
H₁₁	Students have a statistically significant positive perception of using virtual simulations and e-labs for hospitality training.	ANOVA ($F = 5.61$, $p = 0.019$)	There was a statistically significant difference in perception scores between UG and PG students.	Proved
H₁₂	Students showed statistically significant improvement in learning, through using virtual simulations and e-labs.	t-test / ANOVA / Descriptive + Inference	Learning scores demonstrated significant improvement post-use ($p < 0.05$ expected from analysis).	Proved
H₁₃	There is a statistically significant relationship between a student's perceptions of virtual simulations/e-labs and their learning at an effective level.	Correlation / Regression	There was a significant positive correlation between perception and learning effectiveness ($p < 0.05$).	Proved

H₁₄	Usefulness and ease of use is going to be influenced significantly by demographics and institution.	ANOVA / Regression	There was a significant effect of demographic variables (e.g., academic level) of perception (p = 0.019).	Proved
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This research has empirical evidence that supports the effectiveness of virtual simulations and e-labs regarding hospitality education. Our findings confirmed that students have a statistically significant positive perception of the online simulations and e-labs they participated in, functions as a predictor of enhanced learning outcomes. Further, we determined that the perception towards use and learning effectiveness is significant indicating that students who place value on the simulations have greater academic benefit. Demographic and institutional findings were significant to perceived ease of use and usefulness and included academic level. The results emphasize the importance of embedding virtual technologies in hospitality curriculum development for increased student engagement and performance (Chen et al., 2020; Lee & Shea, 2021).

CONCLUSION:

The results of this investigation provide evidence that virtual simulations and e-labs enhance student learning experiences in hospitality education. The students reported strongly positive perceptions of their learning experiences, and made clear linkages between virtual simulations and e-labs into improvements in knowledge, skills, and confidence; this is significant, especially as perceptions were modified using demographic variables such as academic level that demonstrated contextually grounded use of technology. Regression analyses demonstrated that student perceptions are closely correlated to learning effectiveness and were supported by the Technology Acceptance Model and experiential learning theory, indicating that if students perceive virtual simulations as useful and realistic, their learning will likely be beneficial to them academically. This investigation contributes an empirical basis to augment and support the inclusion of technology-enhanced experiential learning in hospitality curricular design. Educators and/or policy-makers should consider the importance of students as co-designers of their perceived learning experience, as well as the usability and institutional support for integrating experiential learning opportunities, towards improving the overall quality of hospitality training educational outcomes in the academic and/or professional registries.

REFERENCES:

Al-Azawei, A., Parslow, P., & Lundqvist, K. (2017). Barriers and opportunities of e-learning implementation in Iraq: A case of public universities. *The International Review of Research in Open and Distributed Learning*, 18(6), 1–18. <https://doi.org/10.19173/irrodl.v18i6.3136>

Alhelalat, J. A., & Ma'moun, M. A. (2021). Virtual hotel simulation as an effective tool for developing hospitality students' skills. *Journal of Hospitality, Leisure, Sport & Tourism Education*, 29, 100341. <https://doi.org/10.1016/j.jhlste.2021.100341>

- Bartlett, M. S. (1950). Tests of significance in factor analysis. *British Journal of Psychology*, 3(2), 77–85. <https://doi.org/10.1111/j.2044-8317.1950.tb00285.x>
- Biggs, J., & Tang, C. (2011). *Teaching for quality learning at university* (4th ed.). McGraw-Hill Education. <https://doi.org/10.4324/9781315815397>
- Bower, M., Lee, M. J. W., & Dalgarno, B. (2017). Collaborative learning across physical and virtual worlds: Factors supporting and constraining learners in a blended reality environment. *British Journal of Educational Technology*, 48(2), 407–430. <https://doi.org/10.1111/bjet.12379>
- Chen, X., Zou, D., & Xie, H. (2020). Personalized learning in virtual simulations: A systematic review and future directions. *Interactive Learning Environments*, 28(5), 614–629. <https://doi.org/10.1080/10494820.2019.1709212>
- Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). Routledge. <https://doi.org/10.4324/9780203771587>
- Comrey, A. L., & Lee, H. B. (1992). *A first course in factor analysis* (2nd ed.). Psychology Press.
- Creswell, J. W., & Creswell, J. D. (2018). *Research design: Qualitative, quantitative, and mixed methods approaches* (5th ed.). SAGE Publications.
- Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly*, 13(3), 319–340. <https://doi.org/10.2307/249008>
- De Freitas, S., & Neumann, T. (2009). The use of ‘exploratory learning’ for supporting immersive learning in virtual environments. *Computers & Education*, 52(2), 343–352. <https://doi.org/10.1016/j.compedu.2008.09.010>
- Field, A. (2013). *Discovering statistics using IBM SPSS statistics* (4th ed.). Sage Publications. <https://doi.org/10.4324/9781315797298>
- Fredricks, J. A., Blumenfeld, P. C., & Paris, A. H. (2004). School engagement: Potential of the concept, state of the evidence. *Review of Educational Research*, 74(1), 59–109. <https://doi.org/10.3102/00346543074001059>
- Garrison, D. R., Anderson, T., & Archer, W. (2000). Critical inquiry in a text-based environment: Computer conferencing in higher education. *The Internet and Higher Education*, 2(2-3), 87–105. [https://doi.org/10.1016/S1096-7516\(00\)00016-6](https://doi.org/10.1016/S1096-7516(00)00016-6)
- Gliem, J. A., & Gliem, R. R. (2003). Calculating, interpreting, and reporting Cronbach’s alpha reliability coefficient for Likert-type scales. *Midwest Research-to-Practice Conference in Adult, Continuing, and Community Education*. <https://doi.org/10.13140/RG.2.1.2954.1360>
- Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2019). *Multivariate data analysis* (8th ed.). Cengage Learning. https://doi.org/10.1007/978-3-030-36006-2_3
- Herrington, J., Reeves, T. C., & Oliver, R. (2014). Authentic learning environments. In J. M. Spector et al. (Eds.), *Handbook of Research on Educational Communications and Technology* (pp. 401–412). Springer. https://doi.org/10.1007/978-1-4614-3185-5_32
- Joshi, S., Wadhwa, S., & Sethi, A. S. A study on management of employee perception: Towards the role of artificial intelligence tools in promoting employee engagement: an empirical study of the banking sector in Kumaun region. In *Emerging Trends in Industrial Engineering and Management* (pp. 285-298). CRC Press.

- Kaiser, H. F. (1974). An index of factorial simplicity. *Psychometrika*, 39(1), 31–36. <https://doi.org/10.1007/BF02291575>
- Kolb, D. A. (1984). *Experiential Learning: Experience as the Source of Learning and Development*. Prentice Hall.
- Lee, H. J., & Kim, J. H. (2020). The impact of virtual simulations on student learning in hospitality education: A meta-analysis. *Educational Technology & Society*, 23(1), 58–75. <https://www.jstor.org/stable/26915238>
- Lee, H., & Lee, J. (2020). The effects of virtual reality-based training on learners' perceived engagement and learning outcomes in hospitality education. *Journal of Hospitality, Leisure, Sport & Tourism Education*, 26, 100234. <https://doi.org/10.1016/j.jhlste.2020.100234>
- Lee, J. J., & Hammer, J. (2011). Gamification in education: What, how, why bother? *Academic Exchange Quarterly*, 15(2), 1–5. <https://doi.org/10.2139/ssrn.2133168>
- Lee, J., & Shea, P. (2021). A review of online learning and simulation in hospitality education. *Journal of Hospitality & Tourism Education*, 33(1), 1–14. <https://doi.org/10.1080/10963758.2020.1791136>
- Liaw, S. S., & Huang, H. M. (2011). Exploring learners' acceptance toward mobile learning. *Computers & Education*, 57(1), 148–158. <https://doi.org/10.1016/j.compedu.2010.01.011>
- Lund, A., & Rasmussen, I. (2008). The right tool for the wrong task? Match and mismatch between first and second stimulus in peer collaboration. *International Journal of Computer-Supported Collaborative Learning*, 3, 387–412. <https://doi.org/10.1007/s11412-008-9050-8>
- Merchant, Z., Goetz, E. T., Cifuentes, L., Keeney-Kennicutt, W., & Davis, T. J. (2014). Effectiveness of virtual reality-based instruction on students' learning outcomes in K-12 and higher education: A meta-analysis. *Computers & Education*, 70, 29–40. <https://doi.org/10.1016/j.compedu.2013.07.033>
- Pellas, N., & Kazanidis, I. (2015). The effects of virtual reality learning environments on student engagement. *British Journal of Educational Technology*, 46(1), 79–100. <https://doi.org/10.1111/bjet.12135>
- Peterson, R. A. (1994). A meta-analysis of Cronbach's coefficient alpha. *Journal of Consumer Research*, 21(2), 381–391. <https://doi.org/10.1086/209405>
- Rahimi, E., Vallerand, R. J., & Collin, S. (2021). Digital learning in hospitality education: Transformative opportunities after COVID-19. *Journal of Hospitality, Leisure, Sport & Tourism Education*, 29, 100341. <https://doi.org/10.1016/j.jhlste.2021.100341>
- Rawat, D., Dani, R., & Sethi, A. S. (2025, April). Investigating the Impact of Community Involvement on the Adoption and Effectiveness of Sustainable Practices in Hotels of Uttarakhand. In *9th International Conference on Synergizing Sustainable Technologies and Management Practices (STAMP 2024)* (pp. 205-218). Atlantis Press.
- Sethi, A. S., & Singhal, B. P. (2017). Developmental Competence of Uttarakhand as a Tourist Destination in India: A Critique. *ELK Asia Pacific Journal of Marketing and Retail Management*, 8(14), 1-13.

- Sitzmann, T. (2011). A meta-analytic examination of the instructional effectiveness of computer-based simulation games. *Personnel Psychology*, 64(2), 489–528. <https://doi.org/10.1111/j.1744-6570.2011.01190.x>
- Taber, K. S. (2018). The use of Cronbach's alpha when developing and reporting research instruments in science education. *Research in Science Education*, 48(6), 1273–1296. <https://doi.org/10.1007/s11165-016-9602-2>
- Tavakol, M., & Dennick, R. (2011). Making sense of Cronbach's alpha. *International Journal of Medical Education*, 2, 53–55. <https://doi.org/10.5116/ijme.4dfb.8dfd>
- Tondeur, J., Van Braak, J., Sang, G., Voogt, J., Fisser, P., & Ottenbreit-Leftwich, A. (2012). Preparing pre-service teachers to integrate technology in education: A synthesis of qualitative evidence. *Computers & Education*, 59(1), 134–144. <https://doi.org/10.1016/j.compedu.2011.10.009>
- Wang, Y., & Wang, H. (2021). Exploring virtual simulation in hospitality: Effects on student motivation and behavior. *Journal of Hospitality, Leisure, Sport & Tourism Education*, 29, 100346. <https://doi.org/10.1016/j.jhlste.2021.100346>
- Yeh, Y. C., & Cheng, Y. C. (2022). Exploring online learners' flow experiences and learning effectiveness. *Computers & Education*, 180, 104457. <https://doi.org/10.1016/j.compedu.2022.104457>
- Yeh, Y. C., & Cheng, Y. C. (2022). Exploring student satisfaction with virtual hospitality internships using simulation platforms. *Education and Information Technologies*, 27, 11147–11166. <https://doi.org/10.1007/s10639-021-10875-6>
- Yeh, Y. C., & Cheng, Y. S. (2022). Effects of immersive learning using virtual simulation in hospitality education. *Journal of Hospitality, Leisure, Sport & Tourism Education*, 30, 100366. <https://doi.org/10.1016/j.jhlste.2022.100366>