

Measuring Technology Acceptance, Creativity Development, and Narrative Quality in Virtual Simulation-Based Storyboard Learning: A Pilot Validation Study

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ABSTRACT: While there is a certain degree of overlap, research conducted in creative and technical domains using simulation-based learning has typically used technology-acceptance tools and/or measures of creativity and narrative quality with few studies combining both constructs. This void makes the field unable to account for why learners embrace an immersion-based learning system and whether the immersive learning system is effective in enhancing the creative and narrative abilities that it aims to build. In order to close that gap, this article describes the creation and pilot psychometric validation of an integrated EDIPT–UTAUT2 instrument. This instrument consists of a 40-item, eight-construct questionnaire that combines two learning-outcome constructs that are adapted from current creativity and visual-narrative theory (creativity development, narrative quality) with six constructs from the Unified Theory of Acceptance and Use of Technology 2 (UTAUT2) (performance expectancy, effort expectancy, facilitating conditions, hedonic motivation, behavioral intention, and use behavior). A selected sample of 33 undergraduate students with technology-enhanced learning were given the instrument after it had been structurally modified and content verified. The internal-consistency reliability coefficient (Cronbach's alpha) scores for all eight constructs ranged from 0.75 to 0.90, with creativity development exhibiting the highest reliability ($\alpha = 0.90$) and use behavior the lowest ($\alpha = 0.75$), both of which were within or above the generally recognized threshold. Two of the original UTAUT2 model's constructs, social influence and habit, were purposefully left out of the final instrument on theoretical grounds since they didn't seem to be as pertinent to the planned, time-bound experimental treatments. The resultant instrument provides a psychometrically solid foundation for the broader structural model presented elsewhere in this research program and has strong internal consistency and concept clarity. The entire instrument-development process is fully recorded from conceptualization to theoretical basis, item generation, content validation, pilot test administration, and reliability analysis, in such a way that it provides detailed methods for the replication and easy adaptation by other researchers who are developing measurement instruments for immersive and creativity-oriented educational technologies.

KEYWORDS: Instrument development, Psychometric validation, UTAUT2, Creativity development, Narrative quality, Pilot study, Virtual simulation, Animation education

1. INTRODUCTION

Measurement is the silent foundation of empirical research in education technology. Before any structural model is estimated, any intervention is compared, and any learning outcome claim is made, the researcher must show that the data collection tool is consistently measuring what it is supposed to measure. In the field of technology-acceptance research, the set of constructs and items of the Unified Theory of Acceptance and Use of Technology 2 (UTAUT2) is well validated and established as a methodological obligation (Venkatesh et al., 2012). The integration of domain-specific learning outcomes like creativity or narrative competence as well as technology acceptance is not as well established for research that aims at this, as there is no validated instrument currently which covers both areas for immersive and simulation-based creative learning (Hair et al., 2019; Hayes & Coutts, 2020).

A study that measures technology acceptance only will demonstrate that learners would like to use the system, but it would not be able to demonstrate that the system teaches creative and narrative skills. On the other hand, if the study is limited to measures of creativity or narrative outcomes, but does not include measures of acceptance constructs (such as performance

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expectancy or hedonic motivation) then the study will not be able to explain why some learners are more involved with a system than others, or to predict whether a system will be adopted beyond the immediate study context. Researchers studying the immersive storyboard and animation learning environment are therefore presented with a pragmatic dilemma: either create new, ad hoc instruments lacking the psychometric rigor and depth of existing instruments, or accept an existing acceptance instrument and hope that creativity and narrative outcomes can be inferred from it. Neither option is really ideal (Bond et al., 2020; Cabrera-Duffaut et al., 2024).

In this article, a third approach is reported that involves the purposeful construction of an integrated instrument with two theoretically grounded learning-outcome constructs, developed specifically for the evaluation of an EDIPT (Empathize, Define, Ideate, Prototype, Test) based Virtual Simulation Storyboard system in Malaysian higher education. This article reports on the entire development and pilot validation process of this instrument as a methodological contribution rather than merely as an addition to a larger structural model as is customary in educational-technology publications. This is in keeping with accepted practices in measurement research in which reporting of the development of an instrument is made sufficiently transparent and detailed to enable others to review, reproduce, and use it (Stefana et al., 2025; Hair et al., 2022) (Panke, 2019).

This article aims to (i) present the theoretical justifications for the constructs used in the integrated instrument and for two constructs deliberately omitted from the original UTAUT2 model, (ii) document the item generation and content validation process from which the 40 items of this instrument are derived, (iii) report the design, administration, and results of a pilot reliability study using 33 undergraduate students, and (iv) discuss the implications of these results for researchers interested in measuring technology acceptance and creative learning outcomes together within immersive learning environments. Aiming at these, the article presents a documented, reusable instrument of measurement and a transparent description of its psychometric development as complementary to the other contributions on structural modelling, system design and literature synthesis found in the same research programme.

2. THEORETICAL BACKGROUND AND CONSTRUCT JUSTIFICATION

2.1 UTAUT2 as the Technology-Acceptance Foundation

In this study, the technology acceptance foundation is represented by UTAUT2, which was developed by the Unified Theory of Acceptance and Use of Technology 2, is an extension of the original UTAUT model from organizational to consumer and educational technology-use contexts, which also includes hedonic motivation, price value, and habit to the original constructs of UTAUT. Since then, UTAUT2 has been one of the most widely used models in the acceptance research of educational technology, praised for the high level of its explanation and its ability to be customized to the specific technological and institutional environment (Tamilmani et al., 2021) (Blut et al., 2022; Xue et al., 2024).

The four key UTAUT2 constructs were kept in their original form for this instrument. Performance expectancy is the extent to which a learner feels that the application of the virtual simulation system will improve their storyboarding design, and has been found to be one of the most consistent factors to predict behavioural intention in UTAUT and UTAUT2 studies (Venkatesh et al., 2012). Effort expectancy is derived from the same theoretical background as perceived ease of use in Technology Acceptance Model, and refers to the ease of use of the system (Davis, 1989). Facilitating conditions refers to learners' perception of the presence of adequate technical and organizational support, which is especially significant in an institutional environment, where the technical and organizational infrastructure and training support differ between classrooms and campuses. Hedonic motivation measured the fun or enjoyment associated with the use of the system, and its addition to UTAUT2 occurred when it became recognized that motivation to use technology in voluntary and semi-voluntary settings is not just for the purposes of extrinsic performance, but also for the sake of enjoyment (Venkatesh et al., 2012) (Marks & Thomas, 2022).

According to the UTAUT2 theoretical framework, behavioral intention and use behavior continued to be the model's outcome constructs because they are central to the model: behavioral intention is the learners' plan to continue using the system in the subsequent learning activity, while use behavior is the learners' use of the system during the intervention period. These six pillars uphold the UTAUT2 model's theoretical foundation and guaranty that the tool only captures elements of the model that are especially pertinent to a brief educational intervention, not necessarily to any specific setting.

2.2 Extending UTAUT2 with Learning-Outcome Constructs

UTAUT2 was created to address technology acceptance in general, so it is not sufficient to determine whether a learning technology develops a specific competency which it was designed to teach. One significant gap in an instrument designed to assess a storyboard-focused virtual simulation system is that a learner may accept a system without any discernible improvement in their creative or storytelling skills; the instrument must be able to identify this, not assume it does (Lu et al., 2022).

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2.2.1 Creativity Development

The creativity development construct was derived from the componential theory of creativity (Amabile, 1996), which views creativity as the products of three components: (a) domain-relevant skills, (b) creativity-relevant processes, and (c) task motivation, and which has been widely used and tested in subsequent creativity assessment studies in educational and organizational contexts. The conceptualization of creativity in this construct was expanded by Zhou and George (2001), who defined creativity as the production of novel and useful ideas within a specific context, which was applicable to the design of storyboards, as creativity requires ideas to be novel and useful more in terms of the narrative and production than novelty alone. Constructs measuring this construct cover students' self-reported competence in producing, elaborating and refining their creative storyboard ideas, ranging from originality, flexibility, problem-solving, and as outlined by prior studies, multi-dimensional approaches in the study of creativity in educational and organizational settings (Amabile, 1996; Zhou & George, 2001; Plucker, 2023) (Barbot, 2019; Irwanto et al., 2025; Lin & Wang, 2021).

2.2.2 Narrative Quality

The construct of narrative quality was created based on existing literature in the field of visual storytelling and narrative theory, including the theoretical framework of narrative as a cognitive and structural phenomenon by Ryan (2004) and the framework for analyzing the narrative coherence, continuity, and communicative effectiveness in visual media by Bordwell, Thompson, and Smith (2023). This construct level's elements, which include logical sequencing, clarity, emotional expression, and structural organization, concentrate on the efficacy and coherence of the storyboard output. This is due to the fact that the instrument's ability to distinguish between two conceptually related but empirically distinct outcomes, namely, a story board that is creative but lacks narrative coherence and a story board that is narratively coherent but not creative, is diminished by the addition of the narrative quality component with creativity development (Calvert & Hume, 2022; Shadiev et al., 2021).

2.3 Constructs Deliberately Excluded: Social Influence and Habit

This instrument excludes two further constructs from the original UTAUT2 that were not included to highlight the differences in the model between the two versions, namely social influence, which reflects how likely learners feel that important others think they should use a system, and habit, which reflects how routine system use has become. Both constructs were specifically omitted after pilot phase review because they have a very context dependent theoretical relevance. Social influence and habit are most predictive in the contexts of technology use in which the decision to use the technology is voluntary, the adoption process takes place over time, and social networks and repeated use influence adoption (Tamilmani et al., 2021). Both constructs have no clear theoretical mechanism by which they would operate in a structured, time limited, quasi-experimental classroom intervention where system exposure was a specified part of the intervention itself and was not freely chosen and accumulated over an extended period. Limited opportunity for developing a habit of using the system, and social influence is reduced when system exposure is an assigned classroom activity as opposed to a personal choice influenced by peer networks. This exclusion decision is based on a general methodological principle, model parsimony, which stresses the need to keep only those constructs that have been justified by the theory and are relevant to the context in which the research is conducted (Hair et al., 2022).

2.4 The Integrated Instrument Structure

The resulting instrument structure is summarized in figure 1, which shows that six UTAUT2 acceptance constructs were retained, two learning-outcome constructs were added and there were a total of 40 items, evenly distributed between eight constructs (between four and six items per construct), which is found suitable for the construct reliability and validity in subsequent structural equation modelling (Hair et al., 2022). This structure was designed deliberately to maintain the same number of items on the acceptance side of the model as that of the validated theoretical source whereas the learning-outcome side of the model contained six items per construct, a number that would assure reliable estimation of the model's reliability, as these constructs were newly adapted for this study instead of adopting them from a single existing validated instrument.

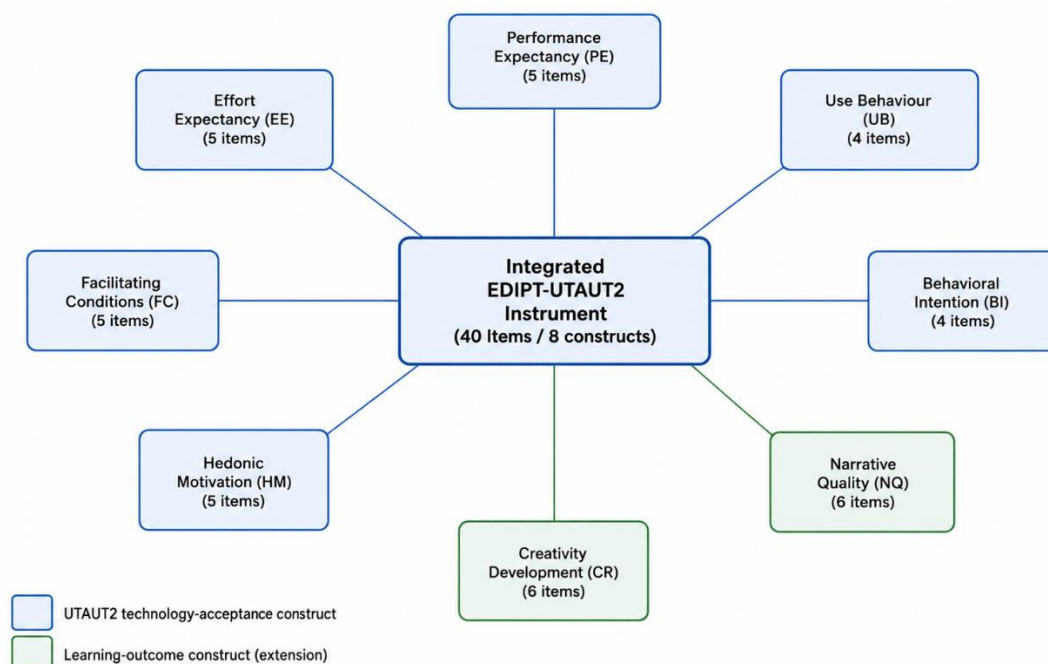


Figure 1: Structure of the integrated EDIPT–UTAUT2 measurement instrument.

2.5 Prior Applications of UTAUT2 in Immersive and Creative Learning Contexts

Although UTAUT2 has been widely used to explain technology adoption in higher education, its use for explaining the adoption of immersive, simulation-based creative learning is comparatively recent. In a systematic review of virtual reality applications in higher education, Radianti et al. (2020) reported that constructs related to acceptance (e.g., perceived usefulness, ease of use) were included in almost all the studies, but they were not statistically combined with learning-outcome measures. They also noted that the research studies were fragmented, a pattern this instrument was designed to remedy. Hwang et al. (2021) also found that there were strong positive effects of performance-expectancy and hedonic-motivation in a technology supported problem-posing context, but they did not extend the acceptance model to directly predict creative or narrative products. Facilitating conditions and technical support were observed as common barriers to learner engagement in blended-reality collaborative learning as identified by Bower et al. (2017), and were also found to be comparatively low, but still satisfactory, reliability for the present pilot study (Peixoto et al., 2021; Di Natale et al., 2020; Stracke et al., 2025).

All of these earlier studies lead to two areas of interest for the current instrument. First, the UTAUT2 core constructs: performance expectancy, effort expectancy, facilitating conditions, and hedonic motivation, have demonstrated satisfactory measurement performance in immersive and technologically enhanced learning contexts. This suggests that the adapted items used in this instrument would perform similarly, as supported by the preliminary results presented in this study. Second, none of the existing literature has integrated the constructs of acceptance, creativity, and narrative quality into a single validated instrument. This is the gap that the current instrument was intended to fill, and the integration of constructs is covered in more detail (Petersen et al., 2022; Makransky & Petersen, 2021).

3. METHODOLOGY

3.1 Instrument Development Process

This instrument was adapted and content validated in four steps. First, items for each of the eight constructs were selected from existing previously validated instruments: the six UTAUT2 constructs (Venkatesh et al. 2012), creativity development (Amabile 1996, Zhou and George 2001), and narrative quality (Ryan 2004, Bordwell et al. 2023). Second, the candidates' items were reworded to suit the context of the storyboard learning in the virtual simulation environment: generic references to 'the system' or 'the technology' were changed to direct reference to the virtual simulation storyboard environment; generic references to 'the task' or 'the performance' or 'the creativity' were changed to explicit reference to the scene, the character and the camera decision. Third, the items were checked for content validity, in order to ensure that the wording of the items maintained the theoretical meaning of the source construct, but were not too technical to be understood by undergraduate respondents who have no background in technical psychometric terminology. Fourth, the entire 40 item draft instrument was combined into a

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structured questionnaire with a five-point Likert-type response format as per the standard UTAUT2 and creativity-measurement practice for external review by experts and for subsequent pilot administration.

This adaptation approach (changing validated instrument to another not contextually but theory and psychometrically validated context) is included in the instrument-development methodology and is required to maintain the theoretical and psychometric foundation of the source instrument(s), and contextual specificity (Stefana et al., 2025; Hair et al., 2022). All items were kept as reflective indicators, in line with the theoretical assumption that each measure represents a reflection of the underlying latent constructs, and not a formative component that defines the construct, as is the norm in the source literature for operationalizing the constructs of UTAUT2 and creativity (Yusoff, 2019).

3.2 Content and Face Validity: Expert Panel Review

The face and content validity of the instrument were initially checked through a structured process with a panel of six experts who were purposively selected to ensure that the instrument on its face would measure what it is meant to measure for the specific context of its application, as recommended (Stefana et al., 2025). The panel included experts with experience in four pertinent areas: multimedia design, educational technology, language and instructional communication, and curriculum development. To avoid the instrument's evaluation from a single disciplinary angle, this composition was deliberately selected to evaluate it from complementary pedagogical, technical, and linguistic angles (Ringle & Sarstedt, 2022).

The questionnaire was used by each expert individually based on his/her expertise. The multimedia design specialist checked the appropriateness of the visual presentation and interface of items related to the simulation environment to ensure that they are aligned with the set of multimedia-learning principles. The educational technology specialist evaluated the instructional design quality for each item and its pedagogical appropriateness for a learning environment that utilizes technology. The language and instructional communication specialist looked at linguistic clarity, grammatical correctness, general readability, and comprehensibility for both the linguistic and the general college audience of undergraduate students who might not be familiar with the technical, psychometric language. The curriculum development specialist examined the fidelity of the alignment of each individual item and its intended learning outcomes, making sure that each item was conceptually linked to the construct it was targeting, while maintaining fidelity to the broad instructional context (Parong & Mayer, 2021).

The feedback gathered from the panel focused on four common themes: item clarity, contextual relevance of the item to the virtual simulation storyboard environment, target respondent appropriateness of language used, and conceptual congruence between the language of the item and the intended construct. This feedback resulted in minor changes to items' wording and structure, such as making compound sentence structures simpler or changing generic technology-acceptance language to language specific to the storyboards, but not making any changes to the theoretical meaning or the psychometric intent of any item. At this point, no items were taken. The expert panel process is described in this article as establishing the face and content validity of the instrument, rather than as an alternative to the internal consistency reliability evidence which is described in the following sections on the pilot study.

3.3 Item Distribution Across Constructs

Table 1 includes the brief descriptions of the constructs, the number of items included, and the brief description of the sources of the constructs in theory. Four UTAUT2 constructs (performance expectancy, effort expectancy, facilitating conditions, hedonic motivation) were each measured with five items, while the two learning-outcome constructs (creativity development, narrative quality) had six and the two outcome constructs of the acceptance model (behavioural intention, use behaviour) had four items.

Table 1: Summary of measurement constructs, item counts, operational descriptions, and theoretical sources (N = 40 items across 8 constructs).

Construct	Items	Operational Description	Theoretical Source
Performance Expectancy (PE)	5	Degree to which students believe the virtual simulation system enhances their learning performance and productivity in storyboard design.	Venkatesh et al. (2012)
Effort Expectancy (EE)	5	Degree of ease associated with using the virtual simulation system for storyboard learning.	Venkatesh et al. (2012)
Facilitating Conditions (FC)	5	Extent to which students perceive that technical and organizational support is available for using the system.	Venkatesh et al. (2012)
Hedonic Motivation (HM)	5	Level of enjoyment and pleasure derived from using the virtual simulation system.	Venkatesh et al. (2012)

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Construct	Items	Operational Description	Theoretical Source
Creativity Development (CR)	6	Students' ability to generate, refine, and develop creative storyboard ideas, including originality, flexibility, and problem-solving.	Amabile (1996); Zhou & George (2001)
Narrative Quality (NQ)	6	Effectiveness and coherence of storyboard outputs, including logical sequencing, clarity, emotional expression, and structure.	Ryan (2004); Bordwell et al. (2023)
Behavioural Intention (BI)	4	Extent to which students intend to use the virtual simulation system in future learning activities.	Venkatesh et al. (2012)
Use Behaviour (UB)	4	Actual usage behaviour of the virtual simulation system in storyboard learning.	Venkatesh et al. (2012)

3.4 Pilot Study Design and Sample

The survey instrument was first pre-tested through a pilot study, in line with the recommended procedure in Structural Equation Modelling (SEM) research to check the clarity, readability and contextual suitability of the draft instrument and to gain preliminary evidence of an internal consistency reliability (Hair et al., 2022). The pilot instrument was the same in content as was the instrument in the main study and was structured and presented as a questionnaire on Google Forms (Memon et al., 2020).

Purposive sampling was used to find pilot participants since the purpose of the pilot phase was to test and improve the instruments without generalizing to the population (Creswell & Creswell, 2023; Andrade, 2021). The participants were undergraduate students from Lincoln University College's programs as well as those from other universities or institutions with comparable academic and technological contexts who had been exposed to digital and technology-enhanced learning environments. The survey link for the pilot was sent out in May 2025 and data collection was open for about two weeks, which was deemed methodologically sufficient to get preliminary responses as well as to test the clarity of the instruments and to start making preliminary reliability analyses (Bujang et al., 2024). All responses were anonymous, and participation was entirely optional. Thirty-three valid responses were obtained and kept for analysis (a typical amount for pilot research, when the primary objective is to assess item clarity and internal consistency rather than do confirmatory factor analysis or inferential hypothesis testing) (Bujang et al., 2024; Hair et al., 2022).

3.5 Data Analysis Approach

The pilot data were analyzed in SPSS Statistics (Version 30) from IBM. The most prevalent analytical method used was Cronbach's alpha reliability analysis, a widely used statistical method for evaluating the internal consistency of multi-item, reflective scales. The alpha values were interpreted following the widely accepted psychometric benchmarks: < 0.70 unacceptable for research use, 0.70 – 0.79 acceptable, 0.80 – 0.89 good, ≥ 0.90 excellent, which means that the items in the tests are very homogeneous (Hair et al., 2022). The interpretation of individual construct reliability and overall judgement of the instrument readiness for full-scale deployment was guided by these benchmarks.

3.6 Ethical Considerations

It was submitted to the Institutional Ethics Committee for review and approval before the data collection process started, following the ethical governance in educational and behavioural research (Creswell & Creswell, 2023; British Educational Research Association, 2024). Informed consent was obtained from all participants before completing the questionnaire, and all participants were informed of the purpose of this study, their right to withdraw at any point without penalty, and protections for their data to ensure confidentiality. The dataset was anonymized before analysis, consisting of each respondent having a coded identifier; the data was kept in encrypted, controlled digital files and was only kept for the duration necessary for academic analysis and reporting.

4. RESULTS

4.1 Overview

Thirty-three valid pilot responses were analyzed. The size of the pilot sample was small, but it was not small enough to warrant the larger sample sizes needed for confirmatory factor analysis or estimation of structural models. It was small enough to be consistent with recommended minimum sample sizes for pilot reliability testing, where the aim is to provide an examination of the item-level clarity and internal consistency of the scale (Bujang et al., 2024; Hair et al., 2022). No items were identified as needing deletion on reliability grounds, and there was nothing of substantial nature that needed revision of the wording of items

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beyond minor clarifications which were gathered from informal respondent feedback used in conjunction with the structured questionnaire.

4.2 Internal-Consistency Reliability Results

The Cronbach's alpha values of the eight constructs are summarized in Table 2 and shown graphically in Figure 2. The alpha values were above the minimum acceptable limit of 0.70 on the whole instrument, with all eight constructs being above 0.75. The alpha level for all the constructs was in the range 0.75 to 0.90 with a mean alpha across the constructs of about 0.82, which represents good internal consistency.

Table 2. Reliability results of the pilot study (N = 33)

Construct	Cronbach's Alpha	Reliability Level
Performance Expectancy (PE)	0.81	Good
Effort Expectancy (EE)	0.79	Acceptable
Facilitating Conditions (FC)	0.77	Acceptable
Hedonic Motivation (HM)	0.88	Good
Creativity Development (CR)	0.90	Excellent
Narrative Quality (NQ)	0.86	Good
Behavioural Intention (BI)	0.84	Good
Use Behaviour (UB)	0.75	Acceptable

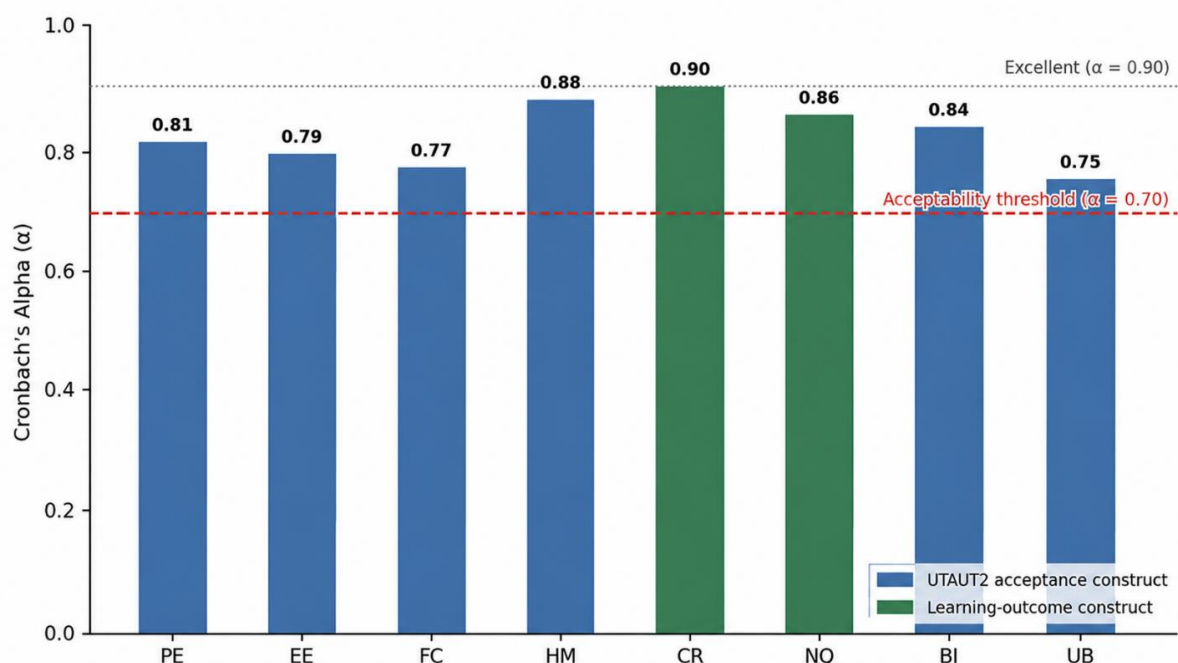


Figure 2: Pilot-study reliability profile of the integrated EDIPT–UTAUT2 instrument.

4.3 Construct-by-Construct Interpretation

The highest reliability value in the instrument was obtained in creativity development ($\alpha = 0.90$), which shows very high internal consistency of items measuring creative cognition, idea generation, originality, and narrative innovation. This is a significant finding because the construct was not from any one validated scale, but rather was newly adapted for this study, and indicates that the adaptation process maintained strong conceptual clarity of the Amabile (1996) and Zhou and George (2001) theoretical sources of this construct. Narrative Quality ($\alpha = 0.86$) was also found to have good reliability, and was therefore considered as a coherent and measurable construct that is different from creativity development.

The other constructs of UTAUT2 (Hedonic Motivation, $\alpha = 0.88$, and Behavioural Intention, $\alpha = 0.84$) showed good reliability, with the respondents interpreting the items regarding enjoyment and engagement, as well as the intention to use this behaviour in the future, in a similar way. Performance Expectancy ($\alpha = 0.81$) also had good internal consistency, which was in line

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with previous studies using UTAUT2 in educational technology that have found it to be a stable and high-performing construct (Venkatesh et al., 2012; Hair et al., 2022).

Effort expectancy ($\alpha = 0.79$) and Facilitating conditions ($\alpha = 0.77$) had acceptable (but relatively low) reliabilities. The internal consistency of both is above the 0.70 threshold, and both are thus statistically defensible for inclusion in the final instrument. However, their somewhat lower internal consistencies may suggest that they are more moment-to-moment and context-dependent constructs, which are likely to fluctuate more with respect to the technical issues of the moment such as network stability, familiarity with hardware, classroom setup on a given day, etc., than the more stable cognitive and motivational judgements that would be captured by such constructs as development of creativity or performance expectancy.

The lowest reliability was found for the instrument with use of Behaviour ($\alpha = 0.75$). This is broadly consistent with what has been previously reported in the UTAUT2 literature: use-behaviour items (usually asking respondents about their own actual use behaviour) tend to have more response variability as compared to belief-based items, and this disparity tends to be more pronounced in short duration interventions where the observable range of use behaviour is naturally limited by the fixed time frame of the intervention (Venkatesh et al., 2012; Tamilmani et al., 2021).

4.4 Instrument Refinement Following the Pilot

The following four areas for instrument improvement are suggested by the pilot's findings: The pilot research served as a model-refinement function in addition to reliability testing. The social influence and habit constructs were not administered in the pilot instrument because they were excluded from the main instrument due to their non-poor performance, not because of their poor performance, as stated in Section 2.3. The initial instrument was reviewed against the entire UTAUT2 construct set. Pilot analysis revealed that none of the eight constructs were dropped, as all constructs had an alpha coefficient over 0.70, and informal feedback from participants did not suggest the presence of a significant level of ambiguity or misunderstanding for any item. The pilot process thus confirmed, and did not necessitate significant changes to, the basic structure of the instrument.

4.5 Benchmarking Against Reliability Values Reported in Prior Studies

Table 3 compares the reliability results obtained in the present pilot study with the reliability values commonly reported in previous UTAUT2-based studies and creativity-measurement studies. This comparison is intended as an indicative check, not a formal statistical test, due to differences in sample, context, and wording of the items, between studies, but it offers a benefit of the doubt to ensure that the reliability profile of the adapted instrument is not outside the range that a researcher might expect based on the broader literature.

Table 3: Indicative benchmarking of pilot reliability values against ranges reported in prior literature.

Construct	Present Study α (N = 33)	Typical Range in Prior Literature	Representative Source(s)
Performance Expectancy	0.81	0.78 – 0.93	Venkatesh et al. (2012); Tamilmani et al. (2021)
Effort Expectancy	0.79	0.75 – 0.90	Venkatesh et al. (2012); Tamilmani et al. (2021)
Facilitating Conditions	0.77	0.70 – 0.88	Venkatesh et al. (2012); Bower et al. (2017)
Hedonic Motivation	0.88	0.80 – 0.94	Venkatesh et al. (2012); Hwang et al. (2021)
Creativity Development	0.90	0.75 – 0.92 (varies widely by adaptation)	Amabile (1996); Zhou & George (2001)
Narrative Quality	0.86	Not consistently reported as a single scale in prior literature	Ryan (2004); Bordwell et al. (2023)
Behavioural Intention	0.84	0.80 – 0.93	Venkatesh et al. (2012); Tamilmani et al. (2021)
Use Behaviour	0.75	0.70 – 0.85	Venkatesh et al. (2012); Dwivedi et al. (2019)

The eight constructs' ranges fall within the ranges often reported in the broader literature, with creative growth at the upper end. The reliability value obtained here should be interpreted as an early indicator because the narrative quality construct has been evaluated more frequently through expert or rubric-based scoring than through self-report Likert scales. The value obtained here is the lowest to the extent that this construct is truly comparable with the established scale literature on narrative quality (Huang et al., 2021).

5. DISCUSSION

5.1 Contribution to the Measurement of Creativity and Narrative Outcomes in Immersive Learning

The key methodological finding of this study is that the measure of creativity and the measure of narrative quality constructs can be adapted to fit the UTAUT2 framework and reach the same or higher reliability scores than the established constructs of the UTAUT2 instrument. This is significant since one of the underlying presumptions in the measurement of educational technology in the area is that using already validated scales, such as UTAUT2, is preferable to trying to employ freshly created domain-specific scales based on psychometric considerations. That notion is not supported by the current data. Four of the six recognized UTAUT2 constructs performed at least as well as the two learning-outcome constructs created for this work, and in one case considerably better. This suggests that it is feasible to create measurement items with a psychological quality comparable to those found in the well-known technology-acceptance scales by making the appropriate theoretical adjustments and using the same care as when creating the items for the acceptance scales (Amabile, 1996; Zhou & George, 2001; Ryan, 2004; Bordwell et al., 2023).

5.2 Comparison with Prior UTAUT2 Pilot Reliability Findings

This pattern matches the reliability pattern found in earlier pilot and validation studies in educational-technology contexts. The reliability of the three components: performance expectancy, hedonic motivation, and behavioral intention, is fairly good, while the reliability of the other two, facilitating conditions and use behavior is somewhat lower but still acceptable (Venkatesh et al., 2012; Tamilmani et al., 2021). The consistency confirms the validity of the adaption process described in Section 3.1 and provides indirect supporting evidence that the inclusion of the virtual simulation storyboard context did not affect the UTAUT2 questions (Pellas et al., 2021).

5.3 Implications for Full-Scale Validation

Convergent, discriminant, and nomological validity are provided by larger sample size confirmatory techniques such as confirmatory factor analysis or in the main study phase of this research program, PLS-SEM. A pilot reliability test is performed to ensure internal consistency. In terms of composite reliability, average variance extracted, and discriminant validity on the entire sample, the evaluation of the measurement model (main-study) for each concept was subsequently verified as sufficient. These findings were presented elsewhere in this research program and are not (completely) reproduced in this paper. Therefore, the findings of this pilot testing should be taken as a suitable and standard step in the phases of the validation process, rather than as a substitute for reliable psychological testing (Hair et al., 2022).

5.4 A Staged Validation Framework

In terms of face and content validity as well as internal-consistency reliability at the pilot stage, Table 4 describes the stepwise validation methodology used throughout this research program and highlights the contribution made in this publication. The purpose of the staged presentation is to help researchers who are unfamiliar with the larger research program, accurately calibrate the claims made in this article. Specifically, it claims a psychometrically sound pilot instrument that is ready to be used in the main study, rather than a fully validated freestanding scale that can be used without further validation in other research contexts.

Table 4: Staged validation framework for the integrated EDIPT–UTAUT2 instrument, showing the scope of the present article within the broader validation sequence

Validation Stage	Validity Evidence Type	Method	Status
1. Item development	Content validity	Adaptation from established validated scales (Section 3.1)	Complete
2. Expert review	Face validity	Six-expert purposive panel review (Section 3.2)	Complete
3. Pilot administration	Internal-consistency reliability	Cronbach's alpha, N = 33 (Sections 3.4–4.3, this article)	Complete — reported here
4. Main-study administration	Convergent & discriminant validity	PLS-SEM measurement model: composite reliability, AVE, HTMT (reported elsewhere in this programme)	Complete — reported separately
5. Independent replication	Cross-sample / cross-institutional validity	Confirmatory factor analysis on an independent sample (Section 8)	Recommended future work

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6. Temporal stability	Test–retest reliability	Repeated administration at two time points (Section 8)	Recommended future work
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6. IMPLICATIONS FOR THEORY, METHODOLOGY, AND PRACTICE

6.1 Theoretical Implications

Although the UTAUT2 is a static model that is not intended to be extended, this study shows a general approach for adapting the UTAUT2 to a domain that contains constructs with strong non-acceptance-related outcomes of interest. Researchers can identify the specific outcome constructs that their context was interested in, ground those constructs in a body of domain theory, and then adapt items in the same way as the items adapted on the acceptance side of the model. It offers a substance-based template for a context-specific extension at the item level that can be creatively applied to researchers creating narratives, and it aligns with the most recent calls from the technology-acceptance literature to extend UTAUT2 in a context-specific manner rather than to apply it blindly (Tamilmani et al., 2021) (Hamilton et al., 2021; Luo et al., 2021).

6.2 Methodological Implications

Deliberate exclusion of social influence and habit for theoretical rather than purely statistical reasons exemplify for measurement methodology in general the need to make instrument parsimony decisions proactively, rather than as a result of poor performance after data collection. This distinction is significant because it influences the epistemic status of the final instrument: a construct eliminated because there was no theoretical mechanism to explain the research context is a principled design decision, whereas a construct eliminated simply because it did not work in the empirical context may result in post-hoc rationalization. The clear reporting of this distinction improves the methodological transparency of the resulting instrument, as shown in Section 2.3.

6.3 Practical Implications for Instructional Designers and Researchers

The consequences for instructional designers and researchers are summarized here. The instrument described here provides a starting point, as it could be adapted to other domains in which creativity and the quality of the outcome are the foci of the domain, such as game design, product design, architectural visualization, or other domains that are similarly visually and narratively structured, by replacing domain-specific constructs for creativity and outcome quality with domain-specific constructs for creativity development or narrative quality and re The item-adaptation approach outlined in Section 3.1 should be precise enough to allow for this sort of reuse while adhering to rules for reporting research on instrument development (Stefana et al., 2025) (Burke et al., 2025; Nesenbergs et al., 2021).

6.4 Implications for Reporting Practice in Educational-Technology Research

On a broader level, reporting of this article as a methodological contribution to instrument creation, rather than a brief measurements part of an outcomes-focused study, is a strategy that other areas in this field may benefit from adopting more frequently. Readers and researchers are frequently encouraged to believe an instrument's psychometric qualities solely on the validity of a single phrase providing an alpha range, while having no knowledge of how constructs were selected, developed, evaluated, or piloted. The level of methodological detail presented in Sections 2 and 3 of this article, including construct justification, adaptation procedure, expert review, and pilot design, is one example of how the depth of reporting required to evaluate a new measurement instrument and confidently reuse or adapt it should be included rather than assumed and treated as a background detail of the outcome reporting (Villena-Taranilla et al., 2022).

7. LIMITATIONS

There are a few restrictions on how the results should be interpreted. First, although the pilot study's sample size of 33 students is adequate for reliability testing, it is insufficient to meet the requirements for confirmatory factor analysis, exploratory factor analysis, and convergent and discriminant validity estimation. As a result, the current findings should be viewed as preliminary reliability evidence rather than the complete validity evidence of the main study phase. Second, reliability estimates may differ somewhat in a probability-sampled or bigger sample due to the purposive sampling technique used in pilot recruitment, which prevents the pilot sample from fully representing the wider target population.

Thirdly, all of the items were self-reported, which is typical in UTAUT2 and creativity-assessment studies but may lead to social-desirability bias, particularly for the constructs of narrative quality and creativity development, since the respondents may wish to give their creative performance a high rating. Fourth, test-retest reliability and cross-institutional consistency were not assessed during the pilot stage and are available for additional research throughout the validation phase. The pilot study was

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conducted once and in a single institutional environment. Aside from that, researchers wishing to compare the results of this study to other studies that use different subsets of the constructs should be aware that the absence of social influence and habit, although theoretically appropriate for this study's specific intervention design, makes this instrument not directly comparable to other studies that include the entire six constructs of the UTAUT2 core plus price value.

8. RECOMMENDATIONS FOR FUTURE INSTRUMENT REFINEMENT

There are multiple possibilities for additional instrument improvement based on the dependability statistics on the pilot instrument presented here. Confirmatory factor analysis, composite reliability, average variance extraction, and discriminant validity (e.g., heterotrait-monotrait ratio) should all be evaluated using the full-sample data from the primary study phase of this research program in order to provide the fuller validity evidence that a pilot study with 33 respondents alone cannot. In addition to the internal consistency evidence shown here, the instrument may be retested on the same respondents in the future to assess its stability. Given the relatively low reliability of use behavior and facilitating conditions, focused qualitative follow-up, like conducting cognitive interviews with a limited number of respondents, could help ascertain whether specific items within these constructs are contributing to their lower internal consistency, which could be used to further refine the items. Also, the instrument would need to be used in organizations and nations other than Malaysia, where it was created, in order to better comprehend its psychometric qualities.

Lastly, researchers who rework this instrument for other disciplines, which are creative or technical, but not storyboard and animation education, are encouraged to go through the adaptation process and content validation procedure originally developed for the storyboard and animation-education environment as described in section 3.1, not simply use the specific wording of the items without modifications.

9. CONCLUSION

It was presented how an integrated EDIPT-UTAUT2 instrument was created and psychometrically validated in a pilot study to measure the quality of narration, the development of creativity, and the acceptance of technologies in a virtual simulation-based storyboard learning process in a measurement model that makes sense theoretically. The pilots' reliabilities varied from satisfactory ($\alpha = 0.75$) to outstanding ($\alpha = 0.90$) across all eight constructs. The two newly modified learning-outcome constructs were on par with, and in one instance better than, the instrument's acceptance constructs based on UTAUT2.

An example of a systematic approach to instrument parsimony appropriate for organized, time-limited educational inputs is a deliberate, theoretically grounded system of social influence and habit exclusion. Although these results do not demonstrate full construct validity, they do support the instrument's reliability (internal-consistency reliability) and offer a transparent, documented framework that other researchers can use to build upon the foundation of the well-established technology-acceptance instruments and advance them with domain-specific creative learning-outcome constructs to other areas of interest.

This pilot study also demonstrates how a well-enacted instrument does not have to be a weak link in an otherwise well-validated instrument. This applies to the combination of behavioral and outcome measurement in immersive-learning research in general, as well as this pilot study in particular, where a domain-specific learning-outcome construct is carefully developed from theory rather than copied from another existing scale. Even if the main-study structural results are equivocal, the small but useful discovery that Creativity Development has the single greatest dependability value in the complete instrument of eight constructs is noteworthy on its own. It proposes that researchers who face the "pragmatic dilemma" described in the introduction, between an ad hoc instrument and an acceptance-only one, have a viable third option if they follow the same disciplined adaptation and content-validation process outlined in Sections 3.1 and 3.2, rather than bypassing it. The validity of this promise is, of course, dependent on confirmatory factor analysis and discriminant validity, which should be tested in the main-study report rather than in this pilot alone.

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