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Immersive Systems in Financial Pedagogy: Exploring Augmented Reality, Perceived Financial Learning and Reported Budgeting

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Abstract: Financial education in higher education presents the challenge of encouraging students to think critically about spending, saving, and debt. This study summarizes baseline and follow-up financial surveys for an augmented reality (AR) financial education program. The program's documentation records data collected on June 4-27, 2024, at login and after the game, across ten financial items, with 750 responses per item per round. The follow-up survey agreement was greatest in increased awareness of investing (81.73%); increased understanding of basic concepts (49.87%) and planning skills (47.73%) were also common responses. At baseline, 14.40% had a personal budget, and 41.47% at follow-up (net aggregate difference of 27.07 percentage points). Several items asked about changes in perception rather than repeated measures (baseline). Items assessing comfort changed the response category labels. The program's documentation does not provide records that linked a participant's responses across the two rounds. Thus, the present results describe an individual's perception of learning and practices. The analysis identifies the advantages of controlled assessments (same outcome measures), objective tasks, and long-term follow-up (rather than estimating individual improvement, ongoing practices, and causal relationships). Cognitive and experiential perspectives offer conceptual interpretation: The analysis highlights the benefits of controlled comparisons using equivalent outcome measures, objective tasks, and extended follow-up.

Keywords: *Augmented reality; Financial literacy; Personal budgeting; Immersive technology; Perceived learning*

1. Introduction

University students make financial decisions about living expenses, borrowing and saving while learning to manage their own resources. Financial literacy matters because students need to apply concepts such as interest, risk and budgeting to decisions with real consequences (Lusardi & Mitchell, 2014). A student may know how interest is calculated but still need practice comparing repayment options or revising a budget when expenses rise. Research on financial management among Malaysian students outside finance programmes also points to the relevance of financial literacy and self-efficacy (Shanmugam et al., 2024). These considerations make practical financial education relevant across disciplines.

Malaysia's national survey data illustrate why knowledge and behaviour should be examined separately. Bank Negara Malaysia (2025) reported that the Malaysia Financial Literacy and Capability Index was 59.1 in 2024, compared with 59.0 in 2021. Over the same period, the financial knowledge score increased from 60.2 to 62.9, while the financial behaviour score fell from 61.9 to 59.9. These figures describe Malaysians surveyed nationally and do not estimate financial literacy among university students. They provide a local rationale for examining what students report doing alongside what they perceive they have learned.

Augmented reality (AR) places digital information within a view of the physical environment. In financial education, an illustrative AR activity could let students adjust spending allocations and see how each decision affects the balance available for saving. The value of such an activity depends on the quality of the task and feedback. Malaysia offers a relevant setting for evaluating digital delivery: in 2024, 99.5% of individuals used a mobile phone, while household internet access stood at 98.8% in urban areas and 90.3% in rural areas

(Department of Statistics Malaysia, 2025). These figures suggest broad reach for mobile learning, but they do not establish access to AR-compatible devices or reliable connectivity for every student.

This study examines baseline and follow-up survey summaries from an AR financial education programme for university students, with 750 responses per financial item at each wave. It focuses on perceived understanding, financial planning and reported personal budgeting. Several follow-up items measure perceived improvement rather than repeat the baseline questions, and the available responses cannot be linked to participants. The study therefore describes response patterns without attributing individual learning or behavioural change to AR.

For Malaysian universities, these findings can help identify which financial topics warrant further evaluation and where a pilot programme needs stronger assessment. Educators could pair locally relevant exercises, such as budgeting a monthly allowance in ringgit, with an objective task and a later check on budget use. Curriculum teams can also plan for uneven access by offering equivalent non-AR exercises. The study's local contribution is to help guide those design and evaluation choices before institutions consider wider adoption.

2. Literature Review and Hypotheses Development

The Limitations of Traditional Financial Pedagogies

Financial instruction often includes an explanation of concepts alongside numerical exercises. Such activities enable to build a foundational knowledge, but the ability to recall a definition is different from the application in a financial decision. Kaiser et al. (2022) report positive effects of financial education on knowledge as well as downstream behaviour across randomized evaluations. Their findings offer a rationale for education but do not identify the delivery format that would be the most effective. Comparisons using equivalent content and appropriate outcome measures are needed to evaluate the additional contribution of AR.

Personal budgeting offers an illustration of the difference between conceptual knowledge and its application. A learner may understand the definition of a budget but need practice in adjusting the expenditure, accommodating an unexpected cost or reconciling competing goals. Simulated scenarios offer opportunities to examine such decisions. Resource constraints should also be considered: financial understanding does not necessarily provide disposable income for saving. Simon's (1957) account of bounded rationality informs the design of manageable decision tasks, but the present survey does not directly measure information-processing constraints.

Cognitive Load Dynamics and Spatial Encoding in Immersive Learning Environments

Financial decisions often require individuals to take into consideration various factors at once. According to Cognitive Load Theory developed by Sweller in 1988, the process of instruction has inherent cognitive load, which can be increased by the way the information is presented. Personal finance involves several interacting variables, including the amount of the initial deposit, the rate of return, the compounding frequency, inflation, volatility, and other factors. When presented with a graph that does not match the accompanying text or is missing, one has to invest a lot of cognitive effort to analyze the relationship between these variables.

The dual-coding hypothesis developed by Paivio in 1986 can help explain how verbal information can be integrated with visual information. For instance, in an example with an augmented reality application, the graph of growth in the example could be changed to demonstrate how different assumptions would impact the outcome. Note that this is a hypothetical example, as the actual application and its features were not discussed. According to Zhu et al. (2026), the results of different experiments on augmented reality varied, suggesting that the design of instruction was crucial. Since cognitive load and retention were not directly measured, these two theories might help explain why certain results were obtained rather than providing direct evidence.

Conceptualizing Augmented Reality as an Experiential Learning Tool

Financial simulations can be used to create a "safe" environment in which people can explore the trade-offs between immediate and delayed gratification. Laibson's (1997) economic model of hyperbolic discounting provides theoretical groundwork for addressing such a challenge. The use of visual projections can aid

temporal inspection of consequences, but it does not necessarily inform students' own financial prospects. The actual impact of such a simulation on intertemporal preferences requires empirical justification.

The described design is conceptually similar to the concept of Choice Architecture (Thaler & Sunstein, 2008), as well as Kolb's (1984) Experiential Learning Model. By embedding decision-making in a potentially engaging context, the two principles suggest that AR-based financial simulations can promote experiential exploration of alternative allocations of resources. The reflective phase of the process supports learners in building mental models of the association between means and ends. In particular, users can try different options, watch their consequences unfold, and adjust their choices in subsequent iterations. With that said, the actual effectiveness of such simulations in promoting sustainable behavioral change would require further investigation beyond the described intervention.

Technology Acceptance and Self-Efficacy in Financial Habit Formation

Technology acceptance and self-efficacy refer to different phenomena. Technology Acceptance Model proposed by Davis (1989) and self-efficacy theory by Bandura (1997) explain how perceived usefulness and control over a certain behavior can increase application rates of the technology or the probability of occurrence of the behavior. These concepts do not necessarily indicate the presence of a mediating mechanism that makes technology usage inevitable for every person who has adopted it.

A user-friendly interface does not automatically ensure financial literacy. A student might have confidence in their capacity to make mistakes when using the application or have a clear understanding of the task but not know how to apply the learned rules to practice. Budget-creation confidence is measured by a single item in this survey, while a self-efficacy measure would have required multiple items to assess the level of skill proficiency. The totals in this category cannot confirm if the respondents who expressed confidence actually possessed a budget. Thus, as two distinct concepts, acceptance and self-efficacy do not prove to be mediating variables in this study.

Hypotheses Development

The theoretical discussion motivates three hypotheses for a subsequent controlled evaluation. They preserve the study's focus on understanding, planning and budgeting, but require comparable outcome measures and participant-linked observations. H1–H3 are not tested by the present descriptive analysis:

H1: Exposure to the AR Education System improves objectively assessed understanding of core financial concepts, investment options and credit risks relative to a suitable comparison condition.

H2: Exposure to the AR Education System improves financial planning confidence and saving behavior relative to a suitable comparison condition.

H3: Exposure to the AR Education System increases personal budget adoption and sustained use relative to a suitable comparison condition.

3. Research Methodology

Study Design and Implementation Timeline

This study uses a descriptive, one-group baseline and follow-up design. Programme documentation records data collection from 4 June to 27 June 2024, with baseline assessment at sign-in and follow-up at game completion. No control group or randomized allocation is documented. Response patterns therefore cannot isolate AR from instructional content, facilitation, repeated measurement or other influences.

The implementation is described in three phases:

Phase 1: Baseline assessment at sign-in, covering financial perceptions and reported practices. Each financial item contains 750 responses.

Phase 2: Participation in the programme, which the workbook describes as including interactive simulations, gamified quizzes, virtual group work and AR-based lectures.

Phase 3: Follow-up assessment at game completion, covering perceived learning and reported practices. The documentation does not establish a delayed retention assessment.

Target Population and Sampling Strategies

The programme description mentions undergraduates and postgraduates who pursue various fields of study. Each line item contains 750 respondents for every wave. The provided summaries do not mention the institutions, recruitment procedures, eligibility criteria, or response rates, which should be examined in detail in the study records.

The demographic summary contains 428 female (approx. 57%) and 322 male (approx. 43%) respondents. The age distribution contains 389 students who studied in their first or second year of higher education, or 52% of the sample: 202 were 19 years old, and 187 were 20 years old. Other age groups amounted to 83 respondents (below 18), 135 respondents (18), 90 respondents (21), and 53 respondents (22 or older).

The workbook indicates that the same students were invited to participate in the next wave of surveys. However, it can be noticed that the worksheets contain category counts on the margins instead of respondent identifiers, which does not allow examining the cases in detail. No information is provided on whether the same participants completed all waves of the study or if there were some changes due to drop-off or other reasons.

The Augmented Reality Education System Architecture

Programme documentation lists simulations, gamified quizzes, virtual group work and AR-based lectures. The programme account identifies four financial content areas, outlined below. These descriptions require confirmation against the materials actually delivered; they do not independently verify software features or mobile hardware.

Interactive budgeting: Allocating income between expenditure and savings and considering the implications of alternative choices.
Investment options: Examining asset classes, diversification, risk and return.
Credit management: Exploring borrowing costs, repayment choices and common credit pitfalls.
Strategic planning: Connecting short- and long-term goals with financial allocations.

Reproducibility requires the application version, device requirements, AR tracking method, duration, facilitation, feedback and completion criteria to be documented.

Operationalization of Research Variables

The survey covers ten financial items, reproduced in Table 1. Q1–Q6 change from baseline status statements to perceived-improvement statements at follow-up. Q7–Q8 retain related anchors but introduce comparative framing; Q9 changes both its focus and response anchors. Q10 asks about current personal budget possession. These differences restrict longitudinal interpretation: identical numerical codes do not ensure that the same construct is measured at each wave.

Table 1: Financial Item Operationalization and Comparability

Item/domain	Baseline focus	Follow-up focus/interpretation
Q1 Basic concepts	I understand basic financial concepts such as budgeting, saving, and investing.	The Augmented Reality Education System has improved my understanding of financial concepts such as budgeting, saving, and investing.
Q2 Budget confidence	I am confident in my ability to create a personal budget.	I feel more confident in my ability to create a personal budget after using the system.
Q3 Investment awareness	I am aware of the various types of investment options available.	I am more aware of the various types of investment options available.
Q4 Risk and reward	I can identify the risks and rewards associated with different investments.	I can now identify the risks and rewards associated with different investments more clearly.

Item/domain	Baseline focus	Follow-up focus/interpretation
Q5 Credit management	I understand how to manage credit and avoid common credit pitfalls.	I have improved my knowledge of how to manage credit and avoid common credit pitfalls.
Q6 Financial planning	I am knowledgeable about financial planning for short-term and long-term goals.	The system has enhanced my financial planning skills for short-term and long-term goals.
Q7 Saving frequency	How often do you save a portion of your income?	How often do you save a portion of your income now compared to before using the system?
Q8 Credit-score awareness	How aware are you of your credit score and how it impacts your financial options?	How aware are you of your credit score and how it impacts your financial options now compared to before?
Q9 Financial comfort	How comfortable are you with managing your own finances?	How comfortable are you with managing your own finances now compared to before using the system?
Q10 Budget possession	Do you currently have a personal budget?	Do you currently have a personal budget after using the system?

Statistical Processing and Verification

The category frequencies were cross-tabulated against 750 responses for each financial item at each wave. Q1-Q8 were scored on an ordinal scale from 1 to 5, and weighted means and sample standard deviations were computed for each wave separately. The descriptive summaries of the ordinal responses at the item level are provided below. Independent Welch's tests are not informative for the intended same-student design. A paired analysis would require the observations to be linked at the participant level and have sufficient comparability between the two measures. The marginal frequencies do not contain the covariance information needed to estimate paired change intervals or standardized paired differences. Indeed, for Q10, a paired McNemar analysis would require No-to-No, No-to-Yes, Yes-to-No, and Yes-to-Yes transitions, but No-to-Yes and Yes-to-No cannot be reconstructed from the two Yes totals. Paired Participant Linkage Alone Would Not Suffice

A participant linkage alone would not suffice to address the different meanings of the items Q1-Q6 and Q9. Similarly, the item marginals cannot be used to estimate internal-consistency coefficients or investigate associations at the individual level with factor analysis or other multivariate techniques. The analysis therefore focuses on the descriptive summaries of the distributions at the item level and does not attempt to make inferences or estimate causal effects.

Data Governance and Ethical Reporting

Programme documentation asserts that their study involves storing research data in an encrypted format, with restricted access. The information is retained for a period of 45 days after the game ends, and there are plans to anonymize any archived data. The study involves institutional ethics approval or exemption, informed consent, and safeguards for participants below 18 and needs to verify these aspects before publication. No claims of ethics approval or consent procedure can be made unless there are supporting records.

4. Results and Analysis

Comprehensive Frequency Distributions

Table 2 below contains category frequencies and percentages for each wave. Baseline Q1 responses contain 31.20% Strongly Disagree and 37.73% Disagree for a total of 68.93%. At follow-up, 49.87% agreed that there has been improvement in their basic financial understanding. As this is a question about improvement, rather than status, these two figures are not comparable.

Investment awareness (Q3) has 659 out of 750 responses at baseline in the two Disagree categories (87.87%), while follow-up agreement is 81.73%. Risk and reward identification (Q4) has 87.20% disagreement at

baseline and 41.20% agreement at follow-up for identifying them more clearly. These figures highlight areas in which respondents feel they have benefited, but do not indicate the same level of improvement in knowledge. Credit management (Q5) had 25.47% agreement that they have become more knowledgeable and 38.27% neutrality. Financial planning (Q6) had 47.73% agreement at follow-up. Saving responses (Q7) were split between Rarely, which fell sharply from 80.00% to 40.27%, Sometimes, which rose from 6.93% to 38.80%, and Never, which also rose from 8.80% to 17.07%. Always stayed at 0%. For the last question, Moderately Aware or Very Aware at follow-up make up 45.87%. Comparative analyses require these distributions to be interpreted in context.

Table 2: Financial Response Frequencies and Percentages (n = 750 per Item and Wave)

Item	Response (baseline/ follow-up if different)	Baseline n (%)	Follow-up n (%)
Q1	1 - Strongly Disagree	234 (31.20%)	72 (9.60%)
	2 - Disagree	283 (37.73%)	111 (14.80%)
	3 - Neutral	103 (13.73%)	193 (25.73%)
	4 - Agree	121 (16.13%)	236 (31.47%)
	5 - Strongly Agree	9 (1.20%)	138 (18.40%)
Q2	1 - Strongly Disagree	104 (13.87%)	41 (5.47%)
	2 - Disagree	242 (32.27%)	124 (16.53%)
	3 - Neutral	250 (33.33%)	380 (50.67%)
	4 - Agree	132 (17.60%)	182 (24.27%)
	5 - Strongly Agree	22 (2.93%)	23 (3.07%)
Q3	1 - Strongly Disagree	91 (12.13%)	9 (1.20%)
	2 - Disagree	568 (75.73%)	21 (2.80%)
	3 - Neutral	86 (11.47%)	107 (14.27%)
	4 - Agree	2 (0.27%)	511 (68.13%)
	5 - Strongly Agree	3 (0.40%)	102 (13.60%)
Q4	1 - Strongly Disagree	229 (30.53%)	30 (4.00%)
	2 - Disagree	425 (56.67%)	129 (17.20%)
	3 - Neutral	65 (8.67%)	282 (37.60%)
	4 - Agree	30 (4.00%)	198 (26.40%)
	5 - Strongly Agree	1 (0.13%)	111 (14.80%)
Q5	1 - Strongly Disagree	212 (28.27%)	112 (14.93%)
	2 - Disagree	330 (44.00%)	160 (21.33%)
	3 - Neutral	103 (13.73%)	287 (38.27%)
	4 - Agree	75 (10.00%)	180 (24.00%)
	5 - Strongly Agree	30 (4.00%)	11 (1.47%)
Q6	1 - Strongly Disagree	108 (14.40%)	87 (11.60%)
	2 - Disagree	300 (40.00%)	182 (24.27%)
	3 - Neutral	319 (42.53%)	123 (16.40%)
	4 - Agree	23 (3.07%)	250 (33.33%)
	5 - Strongly Agree	0 (0.00%)	108 (14.40%)
Q7	Never	66 (8.80%)	128 (17.07%)
	Rarely	600 (80.00%)	302 (40.27%)
	Sometimes	52 (6.93%)	291 (38.80%)
	Often	32 (4.27%)	29 (3.87%)
	Always	0 (0.00%)	0 (0.00%)
Q8	Not aware at all	565 (75.33%)	24 (3.20%)
	Slightly aware	111 (14.80%)	84 (11.20%)
	Somewhat aware	74 (9.87%)	298 (39.73%)
	Moderately aware	0 (0.00%)	201 (26.80%)
	Very aware	0 (0.00%)	143 (19.07%)
Q9	Not comfortable at all / Much less comfortable	0 (0.00%)	15 (2.00%)

Item	Response (baseline/ follow-up if different)	Baseline n (%)	Follow-up n (%)
	Slightly comfortable / Less comfortable	53 (7.07%)	72 (9.60%)
	Somewhat comfortable / No change	200 (26.67%)	465 (62.00%)
	Moderately comfortable / More comfortable	266 (35.47%)	178 (23.73%)
	Very comfortable / Much more comfortable	231 (30.80%)	20 (2.67%)
Q10	Yes	108 (14.40%)	311 (41.47%)
	No	642 (85.60%)	439 (58.53%)

Separate-Wave Descriptive Summaries

Table 3 provides ordinal codes by wave separately. Thus, baseline indicators range from 1.345 (SD = 0.651) for credit-score awareness to 2.635 (SD = 1.019) for budget-creation confidence. In turn, follow-up indicators reach 3.901 (SD = 0.700) for investment awareness and 3.473 (SD = 1.024) for credit-score awareness. A column with differences is excluded because the instrument fails to establish invariant baseline and follow-up measurements.

Table 3: Separate-Wave Coded Response Summaries

Item	Baseline mean	Baseline SD	Follow-up mean	Follow-up SD
Q1	2.184	1.082	3.343	1.211
Q2	2.635	1.019	3.029	0.866
Q3	2.011	0.532	3.901	0.700
Q4	1.865	0.739	3.308	1.046
Q5	2.175	1.073	2.757	1.026
Q6	2.343	0.759	3.147	1.264
Q7	2.067	0.569	2.295	0.792
Q8	1.345	0.651	3.473	1.024

Note. Ascending response codes run from 1 to 5. Each summary describes its own item and wave; the means are not tested learning gains.

Findings Related to the Hypothesis Domains

Conceptual Understanding and Perceived Learning (H1 Domain)

Follow-up responses indicate the perceived benefits of understanding fundamentals, investment knowledge, and risk identification. Credit-management expertise appears to be a less widespread area of self-perceived proficiency, which shows the variance across the content areas. In addition, the responses do not demonstrate competence levels, as H1 is not supported.

Planning, Confidence and Saving (H2 Domain)

The budget-creation confidence (Q2) obtained 27.33% of follow-up agreement with neutral reactions from 50.67%. The financial planning (Q6) was positively endorsed with 47.73%. The responses about saving shifted to Sometimes, but with a low level of Often (3.87%) in the follow-up and zero Always; thus, it is not possible to consider that saving is generally positively perceived since the increase in Never is also relevant. The hypothesis H2 has not been verified.

Comfort and Reported Budget Possession (H3 Domain)

The analysis of financial comfort, as reflected by question 9, should be undertaken separately for each wave of the survey. Thus, 66.27% selected an option between Moderately Comfortable and Very Comfortable at baseline. Then, 62% indicated No Change, 26.4% experienced an increase, and 11.6% registered a decrease at the follow-up. It is inappropriate to compare means due to the essential difference between absolute levels and changes.

Possession of a personal budget, as identified in question 10, was reported by 108 respondents (14.40%) at baseline and 311 (41.47%) at the follow-up. This reflects an overall increase by 203 (27.07%) in terms of the proportion of affirmative responses and a 2.88 times greater representation. However, this statistic does not indicate who exactly adopted the positive attitude and whether they applied it consistently. Thus, H3 cannot be supported based on the presented evidence.

Discussion

Theoretical Integration and Perceived Learning

The strong follow-up endorsement suggests that participants felt there was value in this area of the content. Kolb's (1984) experiential learning framework and Sweller's (1988) Cognitive Load Theory offer possible explanations as to why such an interaction would be beneficial to the learning of financial concepts. However, the cognitive processes were not assessed, nor were the benefits of the spatial presentation of the learning materials. Comparisons with similar content or objective/scenario-based assessments would be helpful in understanding the learning outcomes. Kaiser et al. (2022) provide the context for financial education, but not confirmation of the efficacy of this programme.

Financial Comfort and the Limits of Calibration Claims

High baseline comfort is associated with low-budget ownership and infrequent saving at the aggregate level, but these facts alone cannot indicate who is associated with whom, nor do they demonstrate overconfidence. Hypotheses about parental support or financial independence would also require direct evidence. During the follow-up, respondents indicated little change in comfort, and because the baseline and follow-up questions are different, mean responses to the coded questions cannot calibrate one against the other or demonstrate valence change.

From Perceived Learning to Reported Practice

The higher percentage of continued-reported budget users among those reporting learning is an intriguing factor that could warrant further consideration. Aggregate data cannot indicate if those who reported feeling they learned were the ones who had started budgeting. Bandura's (1997) self-efficacy theory could provide an analytical basis for investigation, while OECD's (2024) instrument serves as a measuring baseline; the present survey is not claimed to be adapted after it. Concurrent assessments of self-performance, confidence, and budget utilization would be needed in such evaluation.

5. Implications and Recommendations of Study

Theoretical Implications: Reconceptualizing Financial Literacy as Procedural Competence

The results suggest that there is a need to make a distinction between declarative knowledge, perceived capability and procedural competence. A question about definitions, a confidence item, and a report of budget possession give different types of evidence. Future assessments need to maintain these distinctions and evaluate the practical decision-making directly. The current summaries cannot demonstrate that the change in understanding caused the changes in financial practices.

Pedagogical Implications: Integrating Simulations into Higher Education Curricula

Rather than replacing traditional practices, AR simulations should be used as supplementary laboratories in the university teaching process. The following three main ideas will be implemented:

Supplementing Lectures with Simulation Labs: Students will learn to allocate budgets, evaluate investments, and make credit decisions with the help of instructors and receive feedback and reflections.

Supplementary Experiences for Non-Business Students: The pilot program will be launched in both business and non-business schools, thus considering different levels of preparation, technology access, and didactic needs.

Assessment of Competencies Acquired: Both written tests and scenario-based assessments of competencies acquired should be used to measure different aspects of performance before introducing simulation-based evaluation.

Technological Implications: Designing Context-Aware Gamified Learning Interfaces

Software design should start with the financial relationship or decision that a learner needs to understand. Feedback can explain what will happen when one makes a choice and allows it to be reconsidered. Progression rules and rewards might help one to accomplish this if they are based on reasoning rather than task repetition. These are design suggestions, not effects exhibited by the survey. Usability, cognitive load and performance would require a separate assessment.

Practical and Policy Recommendations

Institutional Level: Evaluated Pilots Across Universities

Higher education institutions could start with the piloting of the assessed options that have been developed by educators, instructional designers, and the technology staff. The goals of learning, access to the devices, and the evaluation criteria should be decided before scaling. The collaboration with financial institutions and relevant regulatory bodies could ensure that the scenarios and the underlying assumptions are realistic, while the educational effectiveness should be independently evaluated by these entities.

Software Design Level: Developing Dynamic Feedback and Persistent Nudge Architectures

Feedback prompts may help if conflicting simulation choices and a learner's declared financial goals. Their appropriateness, timing, wording and acceptability should be considered. Longer-term mobile prompts are another proposal, the impact on budgeting or saving of which is not established here. The tracking should be optional, limited, and based on informed consent.

Societal and Macro-Policy Level: Integrating Public-Private Partnerships for Financial Inclusion

The public-private collaboration has the potential to broaden the reach of the financial literacy pilots. The funding decisions should consider the content accuracy, device availability, implementation costs and independent evaluation besides perceived benefits. The work in underserved communities should take into account the local constraints instead of postulating that the outcomes will be identical. The current summaries cannot demonstrate the impact on the population-level of financial inclusion and economic mobility.

Conclusion, Limitations and Future Directions

Summary of Core Findings

The survey results reported for 750 university students in an AR program indicate financial literacy improvements reflected in enhanced knowledge and attitudes. Follow-up responses demonstrated the strongest endorsement for increased investment awareness (81.73%); 49.87% reported improved understanding of the underlying principles. Thus, the observed increases in budget possession (from 14.40% at baseline to 41.47% at follow-up) can be related to participants' perception of their learning and an aggregate practice contrast. However, these findings cannot confirm statistically significant gains, causal relationships, or long-term improvements reflected in sustained habits due to mixed saving responses and the high percentage of respondents who expressed no changes in their comfort.

Methodological and Structural Limitations

The interpretation of results has the following limitations:

One-group design: Without a comparison condition, the contribution of AR cannot be isolated from content, facilitation or other influences.

Instrument non-equivalence: The changes in item stems and response anchors preclude multiple items from representing the same status measure across waves.

Unlinked records: Marginal counts do not identify individual transitions, paired change or associations between learning and practice.

Evaluation and reporting: Follow-up at completion cannot establish retention or sustained practice. Self-report may be affected by social desirability or response shift; recruitment and implementation details also require verification.

Roadmap for Future Inquiries

Future evaluation of perceived benefit should distinguish between perceived benefit and changes in competence and practice. Priorities include:

Controlled comparisons: Comparing AR with another delivery mode using equivalent financial content and contact time, with random allocation if feasible.

Linked longitudinal measurement: Using anonymous participant identifiers, invariant outcome questions and objective tasks, and appropriate follow-up intervals for the practice under evaluation.

Practice validation: Where ethically and methodologically appropriate, comparing self-reports with evidence of budget use or task performance. Documenting attrition and financial constraints when describing persistence.

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