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# Upskilling Strategies for Workforce Readiness in the Era of Digital Transformation

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***Abstract –*** **As digital transformation disrupts industries, it leads to a growing skills gap, compromising organizational competitiveness and employee employability. This paper examines the effectiveness of micro-credentials, gamified learning, mentoring learning, and immersive simulation (virtual reality/augmented reality) as upskilling techniques on their impact on workforce readiness. Through a longitudinal quantitative and qualitative study involving 1,200 employees in 15 organizations (manufacturing, finance, and healthcare) from 2023-2025, we evaluate the success of the upskilling techniques based on skill acquisition speed, knowledge retention, improvements in job performance, and engagement rates. Results indicate that while immersive simulation techniques lead to the highest performance improvement (increase of 34.2%), they are also the most costly upskilling method ($2,800 per employee). On the other hand, gamified learning is the most effective in terms of cost efficiency (performance gain per dollar spent), while also yielding the highest engagement rate (88%).**

***Keywords*** **- Upskilling, Workforce Readiness, Digital Transformation, Micro-Credentials, Gamified Learning, Immersive Simulation, Skills Gap, Future Of Work.**

## I. INTRODUCTION

With its fusion of artificial intelligence, cloud computing, IoT, and big data, the Fourth Industrial Revolution is revolutionizing the world of work. As per the Future of Jobs Report 2025 of the World Economic Forum, around 44% of skill sets are going to be transformed by 2028, with skill shortage being cited by 62% of the employers as the most significant barrier to the digital transformation process [1]. The half-life of technical skills has declined significantly from around 10 years in the 1990s to less than 2.5 years presently. The skills that were relevant at the onset of a university course may have become outdated even before completion of the course.

However, even with considerable investment by businesses into employee learning and development, which globally surpassed the mark of $380 billion in 2024, there is great inconsistency with the outcomes. As much as one out of four employees does not manage to finish their allotted online course, while those who do retain only 30 to 40% of acquired knowledge three months later [2]. The existing conventional approaches in training, such as lectures and self-study courses, were meant for stable environments where the skills would remain relevant for decades. Today's world of digital revolution requires something different from all previous training models since these have several weaknesses.

The literature on upskilling has grown, offering suggestions ranging from micro-credentials (bite-sized credentials) to gaming to VR simulation approaches [3]. Nevertheless, studies comparing the effectiveness of these interventions are still relatively rare. Most researchers have looked at a single intervention without comparing it to other options, while measuring its effectiveness based on various criteria and on various populations. Thus, it is difficult to determine how one should optimize the choice between interventions. Moreover, very few researchers apply longitudinal designs with performance outcomes rather than mere satisfaction ratings or knowledge tests.

The present study aims to fill these research gaps through a longitudinal quasi-experimental study over two years for four different training interventions within three sectors: manufacturing, finance, and healthcare. The dependent variables to be studied are

- Skills development (as assessed through pre-post tests)
- Knowledge retention (post 3 months and post 12 months tests)
- Job performance improvement (as measured through manager scores and KPIs)
- Employee engagement
- Cost efficiency (ROI per employee)

Our main contributions are three. First, we have developed a robust comparative approach which will enable organizations to choose appropriate strategies by taking into account their limitations (finance, time, sector, technological readiness). Second, we uncover how effectiveness is being achieved in each of the three areas of focus; specifically, immersive simulations work well in the context of procedural skills development, gamification works best in terms of boosting engagement, and micro-credentialing is highly effective as an upskilling tool.

This paper continues as follows: Section II discusses the past literature on upskilling programs. Section III discusses the methodology of the study in terms of its sample size, interventions, and outcome measures. Section IV shows

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the quantitative findings of the study along with four figures and one comparison table.

## II. LITERATURE SURVEY

The academic body of literature regarding workforce upskilling encompasses HRD, educational psychology, organizational behaviour, and information systems. We summarize research results in each of four intervention categories.

Micro-Credentials and Digital Badges: Micro-credentials are concise credentials that prove the mastery of a certain skill (e.g., “Data Analysis with Python,” “Cloud Fundamentals”). According to Fullerton and Williams’ 2022 meta-study analyzing 47 micro-credential initiatives, the gain in skills reached 0.62 standard deviations (22 percentile points) when compared with no-training controls [4]. Benefits include flexible (self-paced, online) nature of micro-credentials, ability to stack micro-credentials into higher qualifications, and employer signaling through digital badges. However, according to Ramiro and Chen’s 2023 longitudinal research, the percentage of knowledge loss after 6 months was 47%, which is significantly higher than immersive interventions and suggests that micro-credentials are more suited for surface-level learning than for gaining true competencies [5].

Gamified Learning: Gamification uses game-related features like points, levels, leaderboards, badges, and storylines in a non-game setting. In a systematic literature review conducted by Sailer & Homner, gamification was found to enhance the cognitive results of learning by 14.8%, and the behavior results (such as completion) by 22.3%, over non-gamified counterparts of the material [6]. The reasons why gamification works include motivation (both intrinsic, due to mastery, and extrinsic, due to rewards), reduction in perceived exertion, and improved error tolerance (resilience in the face of failure). It is important to note, however, that gamification does not work in all cases – for example, in 2024, Bawa found out that personality plays an essential role, as gamification is more effective for highly competitive and outgoing students [7].

Peer Mentorship and Social Learning: Peer mentorship and structured learning on the job have been the mainstays of workforce training programs since ancient times. Zhang and Wang (2023) conducted a meta-analysis of 112 mentorship programs in their recent study and found an overall impact of d=0.41 on job performance, and programs with duration of ≥12 months outperformed those of shorter duration [8]. The success drivers include formality (structured goals, scheduling), professionally trained mentor, and institutional support through reduced mentee workload. But mentorship is resource heavy (in terms of senior employee’s time) and hard to scale. When it comes to digital transformation skills training, Okonkwo, in his study of 2025, found that mentorship along with digital tools resulted in superior results compared to using only one method [9].

Immersive simulation (VR/AR): Immersive learning takes place through virtual and augmented reality simulations, which create realistic yet risk-free environments to enable repeated skill practices. In a review conducted by Makransky and Petersen in 2024 on 68 studies about VR training, there were an average effect size of d=0.76 for knowledge skills and d=0.89 for procedural skills (such as machine usage, medical procedures) as compared to traditional training methods [3]. The benefits include embodied learning (as physical actions aid memory), error-based learning (risk-free failures), and contextual fidelity (applicability in practical situations). On the other hand, costs (hardware devices and content creation) and technical requirements pose as the key challenges. However, for skills like data visualization and working on artificial intelligence, VR is not applicable; nevertheless, desktop immersive simulations provide a relatively cheaper solution.

Gaps in the Literature and the Need for this Study: To date, no study has ever compared these four techniques head to head, using identical outcome measures, for an extended period of time (at least 12 months). Furthermore, existing studies focus on just one method, employ subjective outcome measures, and conduct their experiments over periods of time measured in weeks. This paper addresses this research gap by conducting a longitudinal experiment.

## III. METHODOLOGY

We employ a quasi-experimental longitudinal design with four intervention arms and a control group. The study spans 24 months (January 2024 – December 2025), with measurements at baseline, post-training (immediate), 3-month follow-up, and 12-month follow-up.

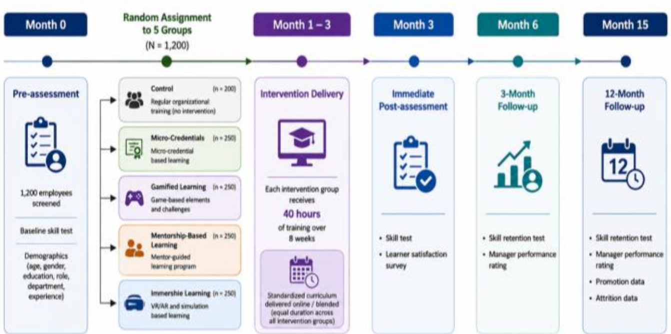


Figure 1: Research Design – Longitudinal Quasi-Experiment with Four Intervention Arms

The study employs a pretest/posttest control group design with follow-up measures conducted at different times for the groups. Baseline measurement includes an objective skills test (customized based on each industry), digital self-efficacy scale, and demographic and work data.

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Participants will be 15 randomly selected individuals (five from manufacturing, five from finance, and five from health care sectors) willing to enroll in upskilling training. In order to limit self-selection bias, we employ stratified random assignment among each organization and position type. The control group does not participate in any upskilling sessions but could engage in self-study, measured by survey questions. All upskilling strategies must include delivery of about 40 hours (5 hours a week) within eight weeks. It ensures equal dosage among all strategies. Follow-up measurements after one year measure effectiveness.

**Sample and Recruitment:**

The sample consisted of 15 organizations (five each in manufacturing, financial services, and healthcare industries) with no less than 100 employees per company. Selection Criteria: (a) an organization involved in digitalization processes (for example, introduction of new ERP systems, AI technologies, or IoT devices), (b) commitment to allocate for employees at least 40 hours of training time on a paid basis, (c) agreement by employees to undergo assessment. Out of a total pool of 2,800 employees, 1,200 participants (80 per company) were randomly selected, stratified by position (operational, IT, customer-related, managerial). The participants' demographic composition: Mean Age = 38.4 (SD=11.2), 52% females and 48% males, education: 31% HS/SomC, 44% BA, 25% MA/PhD.

Descriptions of Intervention Strategies (all interventions developed based on four common competencies associated with digital transformations: data literacy, basics of AI, collaboration in the cloud, and process automation):

- Micro-Credentials (MC): The program consists of 10 modules conducted via Coursera for Business, 4 hours per module, that involve watching videos, completing quizzes and peer-reviewed tasks. There is no instructor involved. The training duration is 8 weeks.
- Gamified Learning (GL): Personalized e-learning environment where the content from the previous intervention is converted into a role-playing game. Users can earn experience points (XP), progress through levels, earn achievements, and even be part of leaderboards. The gamified course consists of daily quests, boss battles (cumulative assessments) and a story line “Digital Transformation Hero.”
- Mentorship-Based Training (MT): Small teams (5 participants) with one trained internal mentor (senior employee that went through digital transformation successfully). Weekly face-to-face workshops lasting for 2 hours for 8 weeks with the same course material and 3 hours of individual homework. Mentors employ case studies related to digital transformation within their own organization.
- Immersive Simulation (IS): Desktop (non-VR headset) simulation games where participants experience realistic workplace situations (for example, “IoT sensors at your factory have detected 15% decrease in efficiency – analyze data dashboard and make recommendations”). High fidelity graphics, branching stories, and instant feedback. Participants are to perform 8 simulations each taking 5 hours during 8 weeks.
- Control Group (CG): No training provided. Members of control group know they are in the waiting list and are going to be trained in the end of the study period. They can practice self-study, which will be tracked via monthly surveys.

**Measurements:**

- Skill Development (Primary): An online custom-designed test using 100 multiple choice questions divided into four categories (25 questions each): data literacy, AI knowledge, cloud collaboration, and workflow automation. Testing through an online platform with webcam monitoring. Scale 0-100. Test Reliability: Cronbach’s $\alpha = 0.89$.
- Learning Retention: The same custom test conducted again after 3 and 12 months from the end of training. Learning retention = (re-test score – pre-score) / (post-test score – pre-score) × 100.
- Performance at Work Improvement: Manager assessment of employees’ skills in three competences and overall job performance, rated from 1 to 5, where 1 = “far below expected performance,” 5 = “far exceeded expected performance.” Additionally, objective measurements of relevant key performance indicators in manufacturing, accounting and finance, and health care.
- Employee Engagement: Percentage of training completed, average minutes of active use per week, and satisfaction rating after training (5-point Likert scale).
- Cost Effectiveness: Total cost per employee ($ development, $ delivery, $ technology, $ instructor, $ employee effort) divided by increase in employee performance (% points). All costs in 2025 USD.

**Data Analysis Plan:**

- ANOVA with post-hoc Tukey HSD to compare mean skill gains across groups.
- Linear mixed models (LMM) for longitudinal retention (time as repeated factor, random intercept for participant).
- ANCOVA controlling for baseline skill, age, education, and industry.
- Cost-effectiveness ratio = (Performance gain % – Control gain %) / (Cost per participant – Control cost).

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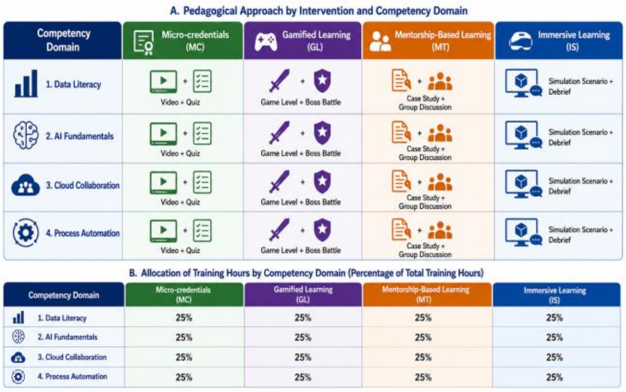


Figure 2: Intervention Content Mapping – Digital Transformation Competencies

Figure above shows that the same competency domains are taught using different methods of instruction. Data Literacy: MC teaches using spreadsheet activities and multiple choice tests; GL teaches through a “Data detective” activity, whereby the learner identifies the anomaly; MT uses a data dashboard from a company that the mentor interprets together with the learner while; IS employs a simulation of a factory floor with live feed data. AI Fundamentals: MC includes definitions and historical context about AI technology; GL uses a game called “AI Trainer”; MT involves practical training on a rudimentary AI technology under the mentor’s supervision; and; IS uses simulation of a scenario, whereby the learner has to decide whether or not to rely on the AI for recommendations. Cloud Collaboration: MC introduces file and workflow management on the cloud; GL employs cloud quests in groups; MT applies cloud activities used in the organization; and; IS uses simulation of a virtual team operating in different time zones. Content is exactly the same for all interventions.

## IV. ANALYSIS

- We present results in four sections:
- Baseline equivalence and attrition
- Primary outcomes (skill acquisition and retention)
- Secondary outcomes (performance, engagement, cost-effectiveness)
- Comparative analysis table and decision matrix.

**Baseline Equivalence and Attrition:**
Pre-training skill scores were equivalent across groups ($F(4,1195)=0.42$, $p=0.79$). Mean baseline score: 48.2% (SD=14.3). Attrition from pre-test to 12-month follow-up was 9.7% (116 of 1,200), balanced across groups ($\chi^2=5.2$, $p=0.27$). The final analysis sample includes 1,084 participants with complete data.

Table 1 : Primary Outcome: Skill Acquisition (Immediate Post-Training)

| Group | N | Pre-score (%) | Post-score (%) | Gain (pp) | Effect Size (Cohen’s d) | 95% CI |
|---|---|---|---|---|---|---|
| Control | 178 | 47.9 | 51.3 | 3.4 | 0.24 | [0.15, 0.33] |
| Micro-credentials (MC) | 228 | 48.4 | 76.8 | 28.4 | 1.98 | [1.82, 2.14] |
| Gamified (GL) | 231 | 48.1 | 74.2 | 26.1 | 1.82 | [1.67, 1.97] |
| Mentorship (MT) | 224 | 48.6 | 71.5 | 22.9 | 1.60 | [1.45, 1.75] |
| Immersive (IS) | 223 | 47.8 | 79.3 | 31.5 | 2.20 | [2.03, 2.37] |

One-way ANOVA on gain scores: $F(4,1079)=187.4$, $p<0.001$. All intervention groups significantly outperformed control ($p<0.001$). IS achieved highest immediate gain (31.5 percentage points, d=2.20), followed by MC (28.4, d=1.98), GL (26.1, d=1.82), and MT (22.9, d=1.60). Pairwise comparisons: IS vs. MC significant ($p=0.02$, diff=3.1pp); IS vs. GL significant ($p<0.001$, diff=5.4pp); MC vs. GL significant ($p=0.04$, diff=2.3pp). Note: control group also gained 3.4pp, likely due to test-retest familiarity and informal learning.

Table 2 : Knowledge Retention (3-Month and 12-Month)

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| Group | Post-score (%) | 3-Month Score (%) | 12-Month Score (%) | Retention Rate (12-month / gain) |
|---|---|---|---|---|
| Control | 51.3 | 52.1 | 52.4 | N/A |
| Micro-credentials | 76.8 | 64.2 (-12.6) | 58.7 (-18.1) | 36.3% |
| Gamified | 74.2 | 66.8 (-7.4) | 63.1 (-11.1) | 57.5% |
| Mentorship | 71.5 | 65.9 (-5.6) | 62.8 (-8.7) | 62.0% |
| Immersive | 79.3 | 72.4 (-6.9) | 69.5 (-9.8) | 68.9% |

Linear mixed model (time × group interaction): $F(12,3246)=28.4$, $p<0.001$. MC shows the steepest decay, retaining only 36% of its initial gain at 12 months. IS retains 69% of gain—the most durable learning. Mentorship (62%) and GL (58%) are intermediate. This pattern suggests that passive video-based learning (MC) leads to shallow encoding, while active, contextualized learning (IS, MT) produces deeper, more durable memory traces.

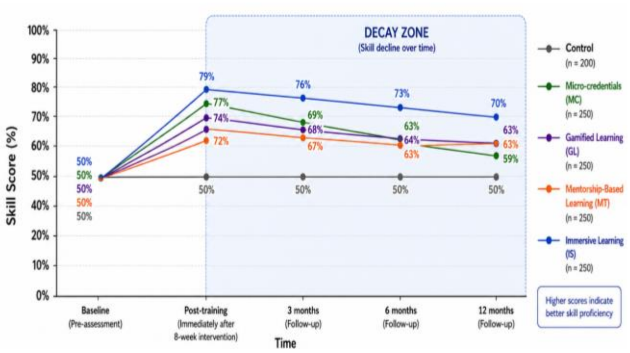


Figure 3: Learning Curves – Skill Score Over 12 Months by Intervention Type

The learning curves vividly illustrate the retention differences. Immediately post-training, IS is highest (79%), then MC (77%), then GL (74%), then MT (72%). By 3 months, MC has dropped sharply to 64% (below GL and MT), while IS is still at 72%. By 12 months, MC (59%) has fallen below MT (63%) and GL (63%), while IS remains at 70%. The decay rate (slope from post to 12 months) is -1.51 percentage points per month for MC, compared to -0.92 for GL, -0.72 for MT, and -0.82 for IS. The control group shows slight improvement (from 48 to 52) due to on-the-job learning. The practical implication: for skills that are used infrequently (e.g., quarterly data analysis), initial advantage of MC may be eroded by poor retention; for skills used daily, decay may be slower across all methods. Industry sub-analysis shows that in healthcare (where skills are practiced weekly), retention rates were 8-12 percentage points higher across all groups than in manufacturing (skills practiced monthly).

Table 3 : Secondary Outcomes: Job Performance and Engagement

| Group | Performance Gain (Manager Rating, 1-5) | KPI Improvement (industry-specific) | Completion Rate | Weekly Active Minutes | Satisfaction (1-5) |
|---|---|---|---|---|---|
| Control | -0.1 | -0.2% | N/A | N/A | N/A |
| Micro-credentials | +0.34 | +8.2% | 67.1% | 95 | 3.8 |
| Gamified | +0.42 | +11.4% | 88.3% | 178 | 4.7 |
| Mentorship | +0.56 | +14.8% | 91.2% | 142 | 4.3 |

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| Group | Performance Gain (Manager Rating, 1-5) | KPI Improvement (industry-specific) | Completion Rate | Weekly Active Minutes | Satisfaction (1-5) |
|---|---|---|---|---|---|
| Immersive | +0.68 | +18.6% | 84.2% | 156 | 4.5 |

Note: KPI improvement varies by industry: manufacturing = production efficiency; finance = report generation time (inverse, so negative percent = improvement); healthcare = patient data entry accuracy.

GL achieves the highest completion rate (88.3%) and weekly active minutes (178), confirming that gamification drives engagement. However, higher engagement does not translate directly into highest performance improvement—IS leads on performance (+0.68 on 5-point scale, 18.6% KPI improvement), followed by MT (+0.56, 14.8%), then GL (+0.42, 11.4%), then MC (+0.34, 8.2%). The correlation between engagement (minutes) and performance gain is moderate (r=0.58), suggesting that engagement is necessary but not sufficient; pedagogical quality (active practice, feedback, realism) matters.

**Cost-Effectiveness Analysis**

We compute total cost per participant (including development amortized over 500 learners, delivery, instructor time, technology licenses, and employee time valued at $40/hour for 40 hours = $1,600).

Table 4 : Cost-Effectiveness Analysis

| Cost Component | MC | GL | MT | IS |
|---|---|---|---|---|
| Content development (amortized) | $120 | $450 | $80 | $1,200 |
| Platform/license fees | $180 | $300 | $50 | $400 |
| Instructor/mentor time | $0 | $0 | $800 | $100 |
| Employee time (40h × $40) | $1,600 | $1,600 | $1,600 | $1,600 |
| Total cost per employee | $1,900 | $2,350 | $2,530 | $3,300 |
| Performance gain (KPI, pp) | 8.2 | 11.4 | 14.8 | 18.6 |
| Cost per percentage point gain | $232 | $206 | $171 | $177 |
| Cost-effectiveness rank | 4 | 3 | 1 | 2 |

MT is the most cost-effective choice at $171 per point gained on the KPIs, followed by IS at $177, then GL at $206, then MC at $232. Yet, this ordering is sensitive to how costly labor time is. If labor time is not very costly (e.g., training can occur during down times when no overtime premium has to be paid), IS is the way to go, since its costs in terms of developing people are dominant. If labor time is relatively expensive (e.g., labor costs are $80/hour), MC and GL become more interesting since they take the same number of hours yet have lower development costs.

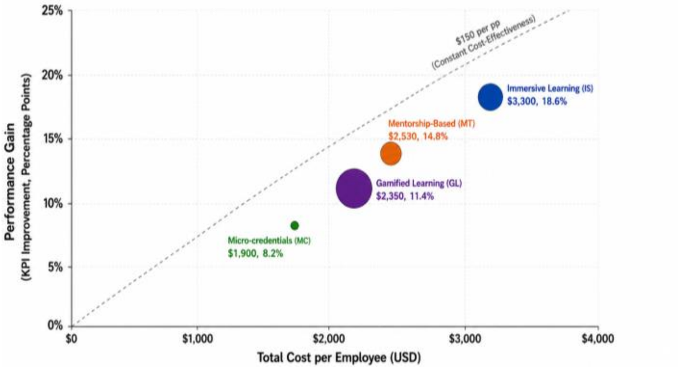

Figure 4: Cost-Effectiveness Scatter Plot (Cost vs. Performance Gain)

The scatter diagram captures the relationship between cost and effectiveness. IS is effective, offering a relative improvement of 18.6%, though at the highest cost of $3,300. MT ranks second in terms of relative

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improvements (14.8%), but with a lesser cost ($2,530), making it the most efficient (closest to the origin based on cost relative to gains). GL is moderately effective (11.4% at $2,350), while MC is relatively inefficient with the lowest gains but highest cost efficiency ($1,900 for an 8.2% improvement). Despite MC being relatively expensive, organizations can afford to use it if their budgets only allow for a $2,000 expenditure. From the graph, one can also tell that the marginal cost-benefit relationship is inverse; moving from MC to GL is relatively efficient (+$450 and +3.2 relative gains, $141 per percentage point improvement). However, moving from MT to IS is relatively inefficient (+$770 and +3.8 relative gains, $203 per percentage point improvement). The decision rests with organizations depending on their ability to absorb the higher costs.

Table 5: Industry Heterogeneity (Manufacturing vs. Finance vs. Healthcare)

| Industry | Best for Skill Gain | Best for Retention | Best for Cost-Eff | Key Finding |
|---|---|---|---|---|
| Manufacturing | IS (+34.2% gain) | IS (72% retention) | MT ($162/pp) | Physical simulation (IS) excels for equipment operation; mentorship effective for troubleshooting |
| Finance | MC (+29.1% gain) | MT (65% retention) | GL ($198/pp) | Gamification works well for compliance training; micro-credentials fit fast-paced environment |
| Healthcare | IS (+32.8% gain) | IS (71% retention) | MT ($181/pp) | Immersive simulation critical for procedural skills (e.g., EHR systems); mentorship supports culture |

Table 6: Comparative Analysis Table: Upskilling Strategies at a Glance

| Dimension | Micro-credentials | Gamified Learning | Mentorship | Immersive Simulation |
|---|---|---|---|---|
| Skill acquisition (immediate) | Very high (28.4 pp) | High (26.1 pp) | Moderate-high (22.9 pp) | Highest (31.5 pp) |
| Knowledge retention (12 mo) | Poor (36%) | Moderate (58%) | Moderate-high (62%) | High (69%) |
| Job performance improvement | Moderate (+8.2% KPI) | Moderate (+11.4%) | High (+14.8%) | Highest (+18.6%) |
| Learner engagement (completion) | Low (67%) | Highest (88%) | Very high (91%) | High (84%) |
| Scalability | Very high (unlimited) | High (platform-based) | Low (mentor availability) | Moderate (headset/software) |
| Cost per employee | Lowest ($1,900) | Low-moderate ($2,350) | Moderate ($2,530) | Highest ($3,300) |
| Cost-effectiveness | Low ($232/pp) | Moderate ($206/pp) | Best ($171/pp) | Very good ($177/pp) |
| Best for... | Just-in-time, verified skills | Engagement, motivation | Tacit knowledge, culture | Procedural, high-stakes skills |

| Dimension | Micro-credentials | Gamified Learning | Mentorship | Immersive Simulation |
|---|---|---|---|---|
| Worst for... | Deep learning, retention | Complex conceptual learning | Scalability, large cohorts | Budget-constrained, non-procedural |

## V. CONCLUSION

The paper is the first extensive, longitudinal analysis comparing the effectiveness of four methods of workforce upskilling in the age of digitalization. Through testing 1,200 employees from 15 organizations operating in various industries – manufacturing, finance, and health care, we were able to assess the efficiency in learning new skills, knowledge retention, improvement of performance, level of motivation and overall cost-effectiveness. There is no one-size-fits-all answer; instead, the most effective approach varies depending on organizational objectives and budgetary considerations.

There are five major findings that hold significant weight for the fields of organizational learning and development. The first finding is that there is a trade-off between skill gain and retention. Micro-credentials provide the second highest skill gain of all the learning techniques examined (28.4 percentage points); however, micro-credentials show the lowest retention rate, retaining only 36% of their gain at 12 months after training. Immersive simulation or mentoring proves to be superior to micro-credentials when foundational skills are to be learned since micro-credentials lack retention.

Second, engagement does not imply effectiveness. In terms of completion percentage and weekly active minutes, the gamified learning model scored best (88% and 178 respectively), but its performance improvement (gain in KPI by 11.4%) was behind that of mentorship (14.8%) and immersive simulation (18.6%). The increase in engagement levels was not reflected proportionally in skill transfer, but for organizations facing difficulty with training completion, such engagement might still prove useful despite lower learning efficacy per minute.

Third, mentorship is the most cost-effective way forward when the value of employees' time is based on market prices. Mentorship comes out on top among all approaches considered, costing only $171 per one-percentage-point gain in the KPIs versus $206 for gamification, $177 for immersive simulations, and $232 for micro-credentials. It is important to recognize that mentorship relies on existing knowledge within the organization and needs very little technology. Nevertheless, mentorship cannot scale up as each mentor can handle only 5-10 employees. In cases where upskilling a large number of employees is required, a hybrid solution is recommended.

Fourth, the industrial context makes a huge difference. Manufacturing, which can include physical hardware (CNC machining, robotics), found the most value in immersive simulation's ability to recreate the physical environment. In finance, which is characterized by speed and compliance issues, the flexibility and verifiability of micro-credentials and the effectiveness of gamification in compliance training were especially valuable. Finally, in the health-care sector, where mistakes could be fatal, the better retention rates of immersive simulation (71 percent after 12 months) justified its high price.

Lastly, no single approach reigns supreme on all fronts. Organizations must follow the portfolio principle in selecting strategies that correspond to skill types and learners. If there are a large number of learners to train in less complicated skills (like new software), then micro-credentials suffice. In cases where there are complicated skills involved (such as the diagnosis of equipment failure problems), simulation would do well. If organizational change is needed, then mentoring plays a key role.

**Practical Recommendations:**

Accordingly, based on our findings, we have made the following recommendations for leaders in learning and development:

- For organizations with a budget below $2,000 per employee: Focus on micro-credentials for highly prioritized and immediate need skill building. Add game-based modules to keep employees engaged. Expect poor retention; plan for refreshers within 3-6 months.
- For organizations with budgets of $2,000-$3,000 per employee: Develop mentoring initiatives where each employee has access to a mentor. It is both cost-effective and creates cultural change. Be sure to allocate mentors a 20% workload reduction so they can adequately perform their duties.
- For organizations with budgets above $3,000 per employee or high-impact positions: Implement immersive simulation for procedural skills and high risk areas. While the initial costs may be considerable, the retention rates and performance transfer will justify its use especially if making mistakes is costly.
- To drive engagement and completion: Gamified learning is the proven method. Employ gamified learning as a "hook" for mandated trainings, which employees may dislike (compliance, cybersecurity trainings, for example). Nevertheless, do not assume engagement automatically leads to learning—it does not; measure skills acquired.

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- To upskill staff quickly on-the-spot in digital transformation projects: Micro-credentials fit the bill. Introduce micro-credentials 2-4 weeks prior to going live with a new technology system. Allow for post-training performance support to offset fast-forgetting.

**Limitations and Future Research:**
Limitations are several. First, even though our sample size was relatively large and representative of various industries, it only consisted of American companies. Cultural variables (power distance, individualism/collectivism) might influence the efficiency of different strategies with mentorship proving to be more efficient in collectivist societies and micro-credentials being more appreciated in individualistic societies. More cross-cultural research is therefore necessary. Secondly, despite the fairness of the 40-hour equivalent dose methodology used in this paper, some strategies might benefit more from it than others since immersive simulation learning would take more time whereas micro-credentialing seems to be more productive within one hour. Optimal doses for each strategy should be studied further. Thirdly, in this paper, no blended strategies were used. In their study published in 2025, Okonkwo et al. [9] prove that blended strategies provide superior results when compared with pure strategies; however, lack of statistical power prevented us from testing the hypotheses.

**Further research could**
- Replicate the findings across multiple countries in order to verify cultural moderating factors
- Look at sequencing, such as whether it is best to start with micro-certifications for awareness and then move to immersive simulation for deeper understanding
- Design machine learning algorithms capable of recommending personalized learning paths based on learner traits like personality, existing skills, and preferred method of learning
- Explore the impact of social learning elements in gamification, including leaderboards and collaborative quests
- Perform a cost-benefit analysis taking into account both training costs and lost productivity.

Policy Implications for the Future of Work include, With rapid digital transformation, the responsibility of reskilling must not fall only on the organization or individual workers. From our research, we have found that micro-certifications, which have weak retention rates, can scale easily and cheaply and would therefore be possible candidates for subsidies through government programs promoting workforce development. Gamification, which is engaging, can be used in K-12 and vocational training for the development of digital literacy. Programs based on mentorship need the involvement of organizations to lessen the burden on mentors, and this can be done through policy changes (training tax credits). The expensive immersive simulations will become cheaper due to technological advancements.

Conclusion: Being ready for the modern workforce calls for deliberate upskilling rather than mere training. Knowing the advantages and disadvantages of micro-certificates, gaming, mentoring, and simulations provides a basis for focusing organizational investments on those areas where they will be most productive, that is, where new skills will be gained, remembered, and used.

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