

Gamified Learning Platforms for Rural Education: A Comprehensive Review of Learning Theories, Game Design Elements, Empirical Evidence, and Deployment Challenges

Gadage Abhishek Ganesh, Prof. Bangar Abhishek Popat, Prof. S. B. Bhosale, Prof. Karad V. A.

Dept. of Computer Engineering
Jaihind College of Engineering, Pune, India

Abstract — Rural schools in developing regions face unequal teacher distribution, large classes, weak foundations in primary education and very limited access to computers and the Internet, which together depress learning in subjects such as mathematics. Gamification, the use of game design elements in non-game contexts, is widely proposed as a low-cost way to raise learner motivation and engagement. This paper presents a focused narrative review that synthesises five peer-reviewed studies: an ethnographic field study of a gamified tablet-based mathematics application with 130 grade-three students in rural Sri Lanka, a systematic mapping study of 34 empirical papers, a critical review of 51 empirical studies, a meta-analysis of gamification and learning outcomes, and a PRISMA-based review of 46 publications. The review examines three connected themes: theories and design elements of gamified learning, the strength of the empirical evidence, and the conditions that matter for rural deployment. The meta-analysis reports small but significant effects on cognitive ($g = 0.49$), motivational ($g = 0.36$) and behavioural ($g = 0.25$) outcomes, with the cognitive effect the only one that stays significant in high-rigour studies and larger in school settings. However, critical appraisal found conclusive evidence in only 15 of 41 studies of behavioural, affective or cognitive outcomes, and most studies are short, small and set in university computer-science courses. The one rural study reviewed reports higher engagement, a shift towards student-centred and collaborative lessons, and usability problems with complex drag-and-drop tasks, but it is brief and exposed to novelty effects. The review contributes a comparative table, a conceptual architecture for a gamified platform for rural schools, and a prioritised agenda of research gaps.

Keywords— Gamification, Rural Education, Mobile Learning, Self-Determination Theory, Game Design Elements, Digital Divide.

I. INTRODUCTION

Quality of schooling in rural areas is limited by a few stubborn constraints: too few qualified teachers, large classes in which individual attention is impossible, and little access to digital infrastructure. A field study in Sri Lanka reports a graduate-teacher-to-student ratio of 1:53 in the capital region with rural areas worse, nearly 45% of grade-11 students failing mathematics, and only 22.4% of households owning a desktop or laptop (4.6% in rural estates) and 10.3% having Internet access [1]. Any technology proposed for such settings has to work with scarce devices, scarce connectivity and teachers who have little time to learn it.

Gamification is defined as the use of game design elements in non-game contexts [2]–[5]. Unlike a serious game, which is a complete game built for learning, a gamified system adds elements such as points, badges, levels and progress bars to an existing learning process [4], [5]. Because it is cheaper than

building full games, it is attractive where budgets are tight. At the same time, reviewers warn that its popularity has run ahead of the evidence [3].

This paper reviews five studies that together span a rural field study [1], a systematic mapping study [2], a critical review [3], a meta-analysis [4] and a PRISMA-based literature review [5]. Three questions guide the review. RQ1: Which theories and game design elements underpin gamified learning? RQ2: How strong is the evidence that gamification improves learning, motivation and behaviour? RQ3: What does the evidence imply for gamified learning platforms in rural schools? The paper ends with a comparative table, a conceptual architecture and a list of research gaps.

II. REVIEW METHODOLOGY

This is a narrative review of a purposively chosen set of five peer-reviewed papers supplied for the study, not a systematic

database search, so no claim of exhaustive coverage is made. The papers are one ACM conference paper [1], two articles from Educational Technology & Society [2] and the International Journal of Educational Technology in Higher Education [3], one article from Educational Psychology Review [4] and one from the International Review of Education [5]. For each paper the aim, design, sample, main findings and stated limitations were extracted and compared. All figures quoted are those reported by the original authors. Studies that these papers cite are described only as the citing paper describes them and were not independently re-read. Because only one of the five concerns a rural school, conclusions about rural settings are inferences and are labelled as such.

III. THEORETICAL FOUNDATIONS

1. Gamification versus Game-Based Learning

Game-based learning means designing a full (serious) game. Gamified learning means altering an existing learning process so that it is experienced as game-like, so gamification is a design process rather than a product [4]. The reviewed papers agree that gamification cannot replace sound instruction: effective instructional content is a prerequisite [4], and gamification is more likely to work when basic instructional design principles are applied [5].

2. Motivation and Learning Theories

Self-determination theory (SDT) is the most cited basis. It holds that learners need autonomy, competence and relatedness, and that satisfying these needs supports intrinsic motivation and high-quality learning [4], [5]. Choice, achievable challenges and peer interaction are the game-design counterparts of these needs [5]. The theory of gamified learning proposes that gamification works indirectly: game elements change learner behaviours and attitudes, which in turn affect learning outcomes, either by mediating the effect of game elements or by moderating the effect of instruction [3], [4]. Reinforcement theory explains why simple rewards such as points can strengthen desired behaviour [5]. Organismic integration theory warns that if learners perceive a reward as control, motivation may vanish when the reward disappears [5]. Two further points qualify the picture. A study cited in [3] found that merely framing a task as a game raised engagement, and adding game mechanics on top of that framing added no measurable interest. Another cited work found that the challenge of mastering obstacles mattered more to players than competition against peers [3]. Both suggest that the meaning of the activity matters more than the number of mechanics added.

3. Frameworks

Frameworks mentioned in [5] include the Mechanics–Dynamics–Aesthetics (MDA) framework, the Werbach and Hunter framework, the ADDIE instructional-design model and Nicholson’s meaningful gamification. The review in [5] observes that frameworks concentrate on game components and often neglect story and technology, and the review in [2] notes that there is no commonly agreed classification of game elements. The same element, a badge, is variously called a design pattern, a mechanic, a dynamic or a motivational affordance in different sources [2].

IV. GAME ELEMENTS AND DESIGN PRINCIPLES

1. Common Elements

The mapping study of 34 empirical papers identified points, badges, levels, progress bars, leaderboards, virtual currency and avatars as the game mechanics in use, with points, badges and leaderboards the most popular [2]. Other elements listed in [5] include quests or missions, meaningful stories, performance graphs, virtual goods and profile development. The most frequently applied design principles were visible status, social engagement, freedom of choice, freedom to fail and rapid feedback, while clear goals and personalisation were rarely discussed [2].

2. Elements Used in the Rural Study

The Sri Lankan application [1] was deliberately simple. It had four stages, each unlocked by completing its levels, an introductory video that students could skip, and a five-point star score in place of a numerical mark, with a single star and an encouraging message for weak performance and more stars with animated graphics for better performance. Cartoon characters, animals, toffees and coins were used as child-relevant metaphors and the content followed the grade-three syllabus in Sinhala [1]. Students were observed calling out the number of stars they had won, which suggests that visible, low-threat feedback engaged these young learners [1].

3. Cautions

Several cautions recur. Points and badges change behaviour only when learners value them [5]. Rewards can lead to a chase for points rather than meaningful learning [5]. Renaming assignments as “quests” without changing the learning goals risks what one instructor called whitewashing [2]. A poor combination of elements can hurt: one study found badges, leaderboards, virtual coins and pseudonyms had a detrimental effect on motivation, satisfaction and empowerment [3].

Novelty is also a motivator that fades; two studies of exergames cited in [5] reported falling interest over time.

V. EVIDENCE OF EFFECTIVENESS

1. Meta-Analytic Evidence

The meta-analysis [4] used random-effects models and found significant small positive effects of gamification on cognitive outcomes ($g = 0.49$, 95% CI 0.30–0.69, $k = 19$, $N = 1686$), motivational outcomes ($g = 0.36$, $k = 16$, $N = 2246$) and behavioural outcomes ($g = 0.25$, $k = 9$, $N = 951$). Fail-safe numbers suggested the effects were not driven by publication bias, but when only high-rigour studies were analysed, just the cognitive effect stayed significant [4]. Cognitive effects were larger in school settings than in higher education or informal settings, although the school studies more often used passive-instruction control groups, which may inflate the difference [4]. Quasi-experimental studies showed larger motivational and behavioural effects than randomised ones, a reminder that weaker designs overstate gains [4].

2. Moderators

Including game fiction (a story or narrative) was associated with larger behavioural effects, but behavioural outcomes were measured during the intervention, so the result may reflect extra effort on gamified tasks rather than learning [4]. Combining competition with collaboration outperformed competition alone for motivational and behavioural outcomes in high-rigour studies [4]. The authors explain that competition can be discouraging for learners of widely different skill levels, which is a relevant concern for mixed-ability rural classes. For motivation, interventions lasting more than a month but under half a year showed a medium effect, while very short interventions of a day or less did not [4].

3. Quality of the Primary Studies

The critical review [3] classified 51 empirical studies published from mid-2014 to the end of 2015. Of 41 that measured behavioural, affective or cognitive outcomes, only 15 gave conclusive evidence: 12 reported positive and 3 negative effects, while 25 were judged inconclusive because of small samples, short duration, no comparison group or confounded factors [3]. The reviewers conclude that the practice of gamifying learning has outpaced understanding of its mechanisms, that evidence for long-term benefit is insufficient, and that research should ask narrower questions of the form: do game elements G work for learners of type L in activity A? [3]. The earlier mapping study [2] reached a similar view: most of its 34 papers reported promising results, but most lacked proper evaluation, which made meta-analysis difficult. The later

literature review [5] likewise concludes that further studies are needed and that gamification is most likely to succeed when combined with instructional design that fits learners' needs, ideally personalised to learner profiles.

4. Coverage of Educational Levels

The evidence is skewed towards universities. Only two of the 34 papers in [2] concerned K-12 education, and in [3] only 7 of 51 involved K-12 pupils (44 were at university level), with computer science and IT the dominant subjects in both. The authors of [2], [3] suggest that instructors in these areas find it easier to build and run gamified features. The consequence for rural primary education is that very little direct evidence exists.

VI. GAMIFICATION IN A RURAL PRIMARY SCHOOL

The only rural study among the five is an ethnographic investigation in Sri Lanka [1]. Researchers distributed 40 tablets with a self-developed gamified mathematics module to 130 grade-three (8-year-old) students in two primary schools, most of them from underprivileged backgrounds including nearby orphanages. None of the students or teachers had used a tablet before. After a one-hour familiarisation game on coin identification, each student spent about five hours with the module over two weeks. Observations, video recordings and pre- and post-study interviews with students and teachers were used [1].

1. Findings

Teaching in these classes was described as predominantly chalk and talk, and teachers said large classes made individual attention difficult. With tablets, teachers moved to students who were struggling, and the lesson became more student-centred [1]. Students asked for help more readily because they wanted to keep playing. More able students helped weaker ones, and one teacher who could not previously get her class to work in groups for ten minutes later saw them working together. The researchers also observed an "alpha student" who explored the game first and then taught peers [1]. Students stayed engaged even when the teacher left the room.

2. Design Issues

No major usability problems arose in Level A, which needed only drag-and-drop of coins and confirmation, but Level B, which required handing over notes, confirming, giving change and moving away, produced confusion. Many children found it hard to hold an item during a drag, and screen time-outs and rotation confused them and had to be disabled [1]. The teacher-only reporting module was hidden on the first screen, but one

student found it and showed the class. The authors planned hidden badges and trophies to promote collaboration [1].

3. Limits and Transferability

The study has no control group, lasted about two weeks and involved about five hours of use per student, so the authors themselves note that novelty may explain the positive results and plan a semester-long study with a comparison group [1]. Even so, its design lessons fit the broader literature. The lack of proper technological support is a major obstacle to applying game elements in education [2]. Needs assessment should precede design, since failing to know who the players are and

what motivates them is a common impediment [5]. Whether the effects reported in a school-level meta-analysis [4] would transfer to low-resource rural classes remains untested.

VII. COMPARATIVE ANALYSIS

Table I summarises the five reviewed studies. Findings are not directly comparable because designs, populations and outcome measures differ.

Table 1: Comparison of the Reviewed Studies

Author, year	Objective	Design / sample	Major reported findings	Limitations
Halloluwa et al., 2016 [1]	How students and teachers use a gamified maths app in rural classes	Ethnography, 2 weeks; 130 grade-3 students, 2 schools, 40 tablets; interviews, video	Higher engagement; more student-centred and collaborative lessons; drag-and-drop in complex level was hard	No control group; about 5 h per student; novelty effect; one subject, one country
Dicheva et al., 2015 [2]	Map contexts and game elements used in educational gamification	Systematic mapping; 34 empirical papers to June 2014; 7 databases	Points, badges, leaderboards most used; most results positive; only 2 K-12 papers; CS/IT dominant	Mostly weak evaluation; no meta-analysis possible; narrow inclusion rules
Dichev & Dicheva, 2017 [3]	Appraise the validity of reported gamification outcomes	Critical review; 51 empirical studies, mid-2014 to 2015	Only 15 of 41 ABC studies conclusive (12 positive, 3 negative); 25 inconclusive	Judgement of conclusiveness is partly subjective; coverage ends 2015
Sailer & Homner, 2020 [4]	Quantify effects on cognitive, motivational, behavioural outcomes	Random-effects meta-analysis; k = 19, 16 and 9 studies	$g = 0.49, 0.36, 0.25$; competition plus collaboration most promising; cognitive effect larger in schools	Small samples; only cognitive effect robust in high-rigour subsplit; few delayed post-tests
Triantafyllou et al., 2025 [5]	Synthesise theories, elements and challenges in education and training	Descriptive review, PRISMA; 46 of 18,496 records (2011–2024)	Gamification works best with sound instructional design and personalisation; points, badges, leaderboards common	Descriptive; no effect sizes; authors call for more studies

VIII. PROPOSED CONCEPTUAL ARCHITECTURE

rural school. It is a conceptual proposal derived from the literature and has not been tested experimentally.

Figure 1 gathers the design implications of the reviewed studies into a layered architecture for a gamified learning platform in a

1 Rural learning context	Shared tablets, large classes Limited / no Internet Teacher with little ICT time
2 Curriculum and content	Local-language syllabus content Child-relevant metaphors Graded complexity
3 Gamification layer	Stars, levels, progress bars Choice and freedom to fail Cooperative and competitive tasks
4 Interaction design	Tap / simple drag, onboarding No time-outs or auto-rotation Usability testing loop
5 Teacher support	Teacher-visible report dashboard Group and pair orchestration Teacher training
6 Offline-first data	Local storage of progress Sync when connected Privacy of child data
7 Evaluation	Control group, longer duration Delayed post-test, motivation scales Element-level analysis (feeds back into layer 3)

Fig. 1. Proposed conceptual architecture for a gamified learning platform for rural schools (conceptual, not experimentally validated)

Layer 1 captures the context: shared devices, large classes and little connectivity [1]. Layer 2 holds curriculum-aligned content in the local language with child-relevant metaphors and graded task complexity [1]; effective instruction is a precondition for gamification [4].

Layer 3 applies a small set of elements supported by the evidence: immediate feedback and visible progress such as stars and levels [1], [2], choice and freedom to fail [2], and tasks that combine collaboration with competition rather than competition alone [4]. Layer 4 handles interaction design, using simple touch actions, skippable onboarding and no time-outs or auto-rotation, with complexity raised gradually [1].

Layer 5 gives teachers a visible report view and supports pair and group work, since in the observed classes teachers became part of the collaborative group [1]. Layer 6, offline-first storage with synchronisation when a connection is available, is the authors' inference from the low Internet access reported in [1]; none of the reviewed studies tested it. Layer 7 closes the loop with evaluation: control groups, longer duration, delayed post-tests, validated motivation measures and element-level analysis [3], [4], with results fed back into the gamification layer.

IX. RESEARCH GAPS AND FUTURE DIRECTIONS

Gaps supported by the reviewed evidence. (i) Very little K-12 and rural evidence: two of 34 papers [2] and 7 of 51 [3] concern school pupils, and one of the five reviewed papers is rural [1]. (ii) Short and small studies: many inconclusive studies lasted days or weeks with small samples [3], and the rural study ran for two weeks [1]. (iii) Few controlled comparisons of single elements; only six studies in [2] examined one technique. (iv) Weak theoretical grounding: most studies lack a theory explaining why elements should work [3]. (v) Outcomes: behavioural outcomes are often measured during the intervention and delayed post-tests are rare [4]. (vi) Little attention to learner differences such as prior skill and motivation [4], [5]. (vii) Reliance on university CS/IT contexts limits generalisation [2], [3].

Directions requiring investigation. Priorities include semester-long, controlled field trials in rural schools with delayed post-tests; comparison of individual elements (stars, levels, hidden badges, cooperative tasks) for specific learner types and activities, following the question form proposed in [3]; tests of whether low-threat visual feedback sustains engagement after the novelty fades; participatory design with teachers and children to resolve interaction issues [1]; offline-capable platforms with teacher analytics; and personalised gamification matched to learner profiles [5].

X. CONCLUSION

Across the five reviewed studies, gamification shows modest but real promise for learning, motivation and behaviour, with the clearest meta-analytic support for cognitive outcomes and for school settings [4].

The evidence is nevertheless thin: many studies are short, small or confounded [3], most come from universities [2], and the only rural example reports encouraging classroom changes within a brief, uncontrolled study [1]. The literature agrees that game elements work best when built on sound instruction and matched to learners [5]. For rural schools this points to simple, low-threat, culturally relevant elements, careful interaction design, teacher involvement, and cooperative as well as competitive activities. Rigorous, longer field trials are needed before gamified platforms can be recommended as a proven remedy for rural education gaps.

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