Investigating Pupils' Motivation with a Reward-Driven Feature in a Game-Based Learning Environment

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Abstract: This study examines how 31 Swiss primary pupils engaged with the *Compendium*—an optional, loot box–inspired feature embedded in the GamesHub platform for reading comprehension. We combined an adapted EGameFlow survey and trace data (total usage time) to identify distinct engagement profiles. Results show high Knowledge ratings and varied usage patterns: some pupils spent little time yet rated the *Compendium* highly, while others used it extensively with more moderate scores. These findings highlight that non-essential, reward-based tools can foster intrinsic motivation and early appropriation (instrumental genesis), suggesting design guidelines for inclusive, learner-driven game mechanics.

Keywords: Game-Based learning environment, Game mechanic design, Instrumental genesis, Motivation, Loot box

1. Introduction

While the educational potential of video games has been widely explored – particularly in relation to learner motivation, engagement, and performance (Gee 2003; Connolly, Boyle, MacArthur, Hainey and Boyle 2012; Irina 2023; Luo 2024; López-Fernández, Gordillo, Pérez and Tovar 2024) – less attention has been paid to how pupils interact with appropriate embedded non-essential tools within these environments. In that respect, most studies focus on core game mechanics that directly affect performance or progression (Wouters, van Nimwegen, van Oostendorp and van der Spek 2013), overlooking secondary features such as glossaries, encyclopedias, or collectible systems that may still influence knowledge construction and learner autonomy (Clarck, Tanner-Smith and Killingsworth 2016).

To better understand how pupils engage with such peripheral elements, this study draws on the concept of instrumental genesis (Vérillon and Rabardel 1995) which describes how users transform *artefacts*[1] into *instruments*[2]. Surprisingly, and despite its relevance for examining how learners make sense of optional digital tools they use, this framework has rarely been applied to learning environments or even to serious games or gamified learning platforms.

In parallel, recent developments in game design have shifted attention away from traditional gamification elements - like points, badges, and leaderboards that are some of the most common game mechanics used in gamified learning environments (Dehghanzadeh, Fardanesh, Hatami, Talaee and Noroozi 2023) - towards new combinations of mechanics centered around narrative, avatars, and characters. If gamification aims to have a positive and effective impact on learners' motivation and performance, the design of these mechanics should be responsive to the cognitive and behavioral profiles of the target learners (Dehghanzadeh, Fardanesh, Hatami, Talaee and Noroozi 2023).

One mechanism could be the *loot box*, used extensively in modern video games. Loot boxes are a reward mechanism that is used to motivate players to accomplish challenging activities, in the form of packages that give out random digital rewards when opened. In a gamification context, loot boxes may foster motivation in education and performance, particularly when rewards are intrinsic, by promoting collection curiosity and discovery (Lichtenber and Brendel 2020).

[1]We call *artefact* any tool or resource provided by a learning environment, external to the learner's own cognitive schemes, and endowed with specific functionalities (Vérillon and Rabardel 1995).

[2]We call *instrument* the dual entity resulting from instrumental genesis: the artefact as transformed by the learner's schemes of use and the cognitive structures that emerge from this interaction (Vérillon and Rabardel 1995).

This paper investigates the *compendium*, a feature embedded in the GamesHub platform, developed as part of the DocTALE-Fr[3] project. Designed for primary school children aged 8 to 10, one of the main learning objectives included in GamesHUB is the reading-comprehension of short texts, with French as the schooling language. GamesHUB includes the loot box as a gamification feature: the *compendium* is an inventory system that accumulates extrinsic rewards obtained by learners by succeeding in mini games. Although it is tied to performance for unlocking content, it does not influence progression, making it an ideal case to explore the educational value of non-performative, reward-based tools. This secondary feature has also been integrated as it may promote knowledge structuring the learner autonomy (Clarck, Tanner-Smith and Killingsworth 2016); this latter point being a purpose of the platform developed as an inclusive and universal tool (within the meaning of universal design for learning, UDL, CAST, 2024).

We aim to understand how learners engage with the *Compendium*, and whether such a feature – though not instrumental in gameplay – can turn into an instrument of personal learning through processes of appropriation. This raises the following research question:

How do pupils engage with and appropriate a feature that belongs to the gameplay but remains non-essential for task completion? And what does it reveal about their motivation and learner agency?

2. Theoretical Background

This study builds on three interrelated theoretical strands: (a) random rewards mechanics in gamification, (b) learner motivation and agency, and (c) *instrumental genesis*. Together, they form a coherent lens to explore how pupils engage with the *compendium* — a feature in the GamesHub platform designed to reward performance through collectible but non-performative content.

2.1 Gamification and Reward Mechanics

As previously stated, current design trends show a shift toward more immersive and narrative-based elements, such as avatars, characters, or randomised rewards inspired by mechanics like loot boxes that are packages revealing random digital contents, typically used to sustain motivation by generating excitement and surprise. While controversial in commercial gaming (Drummond and Sauer 2018), recent studies suggest that loot box-inspired systems can support engagement and performance in educational contexts — provided they are ethically designed and not linked to monetary transactions (Lichtenberg and Brendel 2020). Indeed, there are valid criticisms, though, of the linkage between loot boxes and gambling (Yokomitsu, Irie, Shinkawa and Tanaka 2021). Implementing mechanisms initially designed to encourage spending money in the form of microtransactions brings serious issues when applied in schools. Nevertheless, if the loot box is well used, a study showed that the top motivations among adolescents for buying loot boxes were: (a) gaining in-game rewards, (b) completing a collection, (c) the excitement of opening the box itself, and (d) cosmetic reasons (Zendle, Meyer and Over 2019).

In our platform, we added a feature called the *compendium* that integrates some of the loot boxes principles: after each mini-game, pupils receive a performance score (0 to 3 stars) which unlocks a random element of a themed collection. These entries span topics like mythology, geography, and biology (all linked to the current school study programme), and include a title, an image, and a short description. Although this feature is indirectly tied to performance, it is not essential to gameplay progression and thus aims at functioning as a pedagogical reward system rather than a competitive incentive. In this way, it may impact motivation and learner agency.

2.2 Motivation and Learner Agency

Our study is informed by Self-Determination Theory (Deci and Ryan 2000) which identifies autonomy, competence, and relatedness as key motivational needs. In game-based learning, pupils tend to be more engaged when they can act autonomously and explore content at their own pace (Gee 2003). This last point is in line with another pillar of the overall project: to develop an inclusive teaching and learning tool with the universal design for learning (UDL) (CAST 2024) as a perspective.

Because the *compendium* provides no in-game advantage, its use depends on the learner's intrinsic motivation and interest in the content. Students can browse the entries they unlock whenever they want, if they want to, they can expect to complete specific collections and share their discoveries with peers. This opens the

[3]Project *Documenter et Tester l'Apprentissage Adaptatif à L'École en Français*, **FNS** n°100019_215373

possibility that learners will develop personal engagement strategies that go beyond extrinsic incentives. This may lead to a personal appropriation of the feature, transforming it and its basic purpose, which is the central perspective of the instrumental genesis.

2.3 Instrumental Genesis

Instrumental genesis (Vérillon and Rabardel 1995) refers to the dual process by which a user transforms an artefact - something initially external and neutral - into an instrument that becomes part of his/her activity. This dual process includes: (a) Instrumentation, in which the tool, in turn, structures and influences the user's cognitive activity; (b) Instrumentalization, in which the user adapts the artefact to his/her needs. Though widely used in the study of digital tools in education (Artigue 2002; Trouche 2004; Drijvers 2019; Gueudet and Trouche 2022; Pittalis and Drijvers 2023), instrumental genesis has rarely been applied to game-based environments. Yet, these environments often include optional features that are not directly tied to task success or progression, and whose appropriation depends on learner agency. In this study, we investigate whether pupils appropriate the *compendium*- an artefact that provides no direct advantage in gameplay- as an instrument. The question is not whether the feature works, but how it is used, transformed and integrated into the learners' activity, becoming a tool.

Rather than prescribing how a feature should support learning, we observe how learners—regardless of their cognitive profiles or needs—engage with it in practice. From our point of view, instrumental genesis offers a useful lens for understanding inclusive learner-driven appropriation and provides design insight with UDL principles (Meyer, Rose and Gordon 2014; Al-Azaei, Serenelli and Lundqvist 2016). In sum, by combining these three perspectives -gamification, learner motivation, and instrumental genesis- this study examines how pupils engage with the *compendium*, and whether it can evolve from a simple collection feature into a real tool for using or even building knowledge to succeed in games.

3. Research Context and Methodology

To drive this study, we use the data collected during the second round of experimentation of the platform in primary classrooms.

The GamesHub platform is a digital didactic tool aiming to assist teaching and to promote learning reading-comprehension of short texts in French as the schooling language, at primary school, and for all pupils whatever their needs. In that scope, the platform uses Adaptive Learning to personalize learning pathways. A pathway is an articulation of games and game levels (Karoui, Alvarez, Geoffre, Guin, Lefèvre, Lachand-Pascal and Ramalho 2022) and that is where the *compendium* appears.The study was conducted in two French-speaking elementary school classrooms, in Switzerland. Participants (n = 31) were pupils (from 3rd and 4th grade of primary school) who used the GamesHub platform across 20 sessions over a period of 10 weeks, with or without adaptive learning activated, according to the single case design protocol the team used. The digital hardware was provided by schools, and attendance at such sessions was uncommon.

3.1 The Compendium in GamesHUB

The *compendium* is an encyclopedia with an embedded random reward system where students increasingly earn tokens to complete it. It consists of a list of entries organized in twelve theme sets, for example, "Gods and Goddesses of Greek Mythology" or "The Solar System". Each entry has a title, a picture, and a short description, and each set is an issue of a general knowledge topic — geography, history, or biology — mapped onto the Plan d'Études Romand (Swiss French curriculum framework)[4].

[4]Plan d'Études Romand (PER) (Swiss French Study Program): https://portail.ciip.ch/per

Figure 1: The *compendium* in GamesHUB shows the collection "The first 10 Swiss Cantons"

After completing a mini game, the pupil earns 0 to 3 stars. 5 stars are required to open an element of an entry (image, description, or title) randomly selected from the pool. Higher scores mean faster completion of entries.

The *compendium* is a feature designed to increase learners' motivation through random reward mechanisms in an in-game benefit-free manner. The *compendium* works as a pedagogical encyclopedia taking advantage of several motivational game mechanics: (a) randomness, (b) performance-based advancement, (c) accumulation of content, and (d) comparing collections with peers. Practice conforms to the most recent recommendations on the use of lootbox-like mechanisms within education regarding ethicality and efficiency (Lichtenberg and Brendel 2020). We could directly observe that the *compendium* contributed as expected to students' motivation, but this point isn't discussed here as we aim to go further and document if and how it has been moved from a feature to an instrument facilitating learning. We then used an adapted version of the eGame Flow survey.

3.2 Instrument: The eGameFlow Survey

The games will only be useful to increase reading-comprehension skills if they are correctly played, which means that the learner's interaction with the tool, via the player's interface, must be sustained. Flow experience is essential to keep players' engagement, and this engagement is itself a guarantee of motivation. Flow and engagement may therefore contribute to the process of instrumental genesis: experiencing flow while interacting with an optional resource like the *compendium* could facilitate its appropriation, transforming it from a peripheral artefact into a meaningful instrument.

The eGameFlow survey is a standardized instrument for measuring learners' satisfaction in game-based learning contexts (Fu, Su and Yu 2009). It was originally created out of the GameFlow model, primarily designed to quantify the flow experience in computer games (Sweetser and Wyeth 2005). In 2022, a child-appropriate version was developed (Alvarez, Llorens and Rodríguez 2022) and used in the context of the DocTALE-Fr project to assess pupils' flow experience using the platform, prior to integrating the *compendium* feature. For this phase, we created and used a revised version of the questionnaire[5]. The new version now contains five dimensions: Concentration, Challenge, Autonomy, Immersion, and Knowledge improvement. The 2022 version lacks the Knowledge improvement dimension that has been added following the inclusion of the *compendium*. This specific dimension refers to the information shared in the content of the collections based on the Swiss French Curriculum Framework. Instead of assessing pupils' perceived gains in knowledge —since the validity of self-assessment at this age is questionable— the new questions inquire about whether pupils

[5] https://zenodo.org/records/15308805

use the *compendium* and if they enjoy acquiring new entries. Like in the 2022 version, numerical values were replaced with smiley faces and some statements rearranged for improved readability and child-friendliness. Having researchers accompanying classes was familiar to pupils since they typically went through focus groups, particularly with how they used another additional feature, the visual lexicon tool (Plessis-Ouzariah and Geoffre 2025). For this research, the second researcher also joined the classrooms when the flow survey was proposed. Pupils filled out the questionnaire simultaneously as the researcher read each question aloud. Clarifications were always present if they were unable to get some questions, with pupils encouraged to ask in case they had difficulties. We consider social desirability bias risk (Krumpal 2013) to be low, as the pupils were instructed to respond based on their overall feelings and were accustomed to researchers' presence during learning sessions.

4. Results

The adapted EgameFlow used in this study consists of five dimensions: (1) C.Concentration (3 items): games must encourage concentration and minimize cognitive overload; (2) H.Challenge (5 items): feedback must help players assess progress; (3) A.Autonomy (3 items): players must feel in control of decisions; (4) I.Immersion (2 items): games must promote engagement; (5) K.Knowledge Improvement (3 items): game must be conductive to curriculum goal. The leftmost column of Table 1 identifies each eGameFlow dimension being measured. The second column (N) shows the number of participants who provided valid responses for each dimension. The third column (Mean) displays the arithmetic mean (average) of pupils' ratings for each dimension on the 5-point scale. The questionnaire used a 5-point scale where: 1 = strongly disagree/very poor experience, 2 = disagree/poor experience, 3 = neutral/adequate experience, 4 = agree/good experience, 5 = strongly agree/excellent experience.

Interpretation Benchmarks:

- Means above 4.0: Indicate strong positive experiences
- Means 3.5-4.0: Indicate moderately positive experiences
- Means 2.5-3.5: Indicate neutral to mixed experiences (not observed in this study)

The fourth column (SD) shows the standard deviation, which measures how much individual responses varied around the mean. The two last columns (Min, Max) show the lowest and highest rating given by any participant for each dimension.

Table 1: Descriptive statistics of the "flow" documented with the adapted eGameFlow

Variables	N	Mean	SD	Min	Max
C.Concentration	31	4.14	0.65	1	5
H.Challenge	31	4.26	0.77	3	5
A.Autonomy	31	4.32	0.53	2	5
I.Immersion	31	3.70	1.09	1	5
K.Knowledge Improvement	31	4.47	0.60	1	5

As can be seen in Table 1, the five dimensions of eGameFlow modified for children rated rather high. Average ratings were 4.14 (SD = 0.65) on concentration, 4.26 (SD = 0.77) on challenge, 4.32 (SD = 0.53) on autonomy, 3.70 (SD = 1.09) on immersion, and 4.47 (SD = 0.60) on knowledge. What is striking to observe here is that the knowledge category, linked to the items of the compendium, had the highest mean rating. The relatively low SD combined with high mean indicates reliable positive experience.

In the open-response section of the questionnaire, the pupils gave drawings that primarily depicted the compendium and rewards that accompanied it (n = 12), as well as their favorite games. In the answers related to the compendium, pupils expressed pleasure at gaining rewards and watching their collection grow, with a score of 4.87.

During the experiment, teachers had reported that the pupils enjoyed using GamesHub and were very engaged in the games. Pupils frequently discussed the compendium with one another and delighted in unlocking and learning about its content. One of the possible reasons that may have contributed to the high flow scores is the general enthusiasm for the games themselves. When asked to name their favorite aspects of GamesHub, the most prevalent mentioned features were the games (n = 17), then the compendium and

reward system (n = 12). Adaptive learning (n = 1) and the visual lexicon tool (n = 1) were further noted as favorites, though to a lesser degree.

Table 2: Pearson correlation matrix that shows the relationships between five eGameFlow dimensions

Variable		C.Concen.	H.Challe.	A.Autono.	I.Immers.	K.Knowle.
C.Concentration	r	-				
	p-value	-				
H.Challenge	r	- 0.271	-			
	p-value	0.140	-			
A.Autonomy	R	0.090	0.334	-		
	p-value	0.629	0.066	-		
I.Immersion	R	0.633	- 0.303	- 0.035	-	
	p-value	<0.001	0.098	0.853	-	
K.Knowledge Improvement	R	0.486	0.135	0.052	0.579	-
	p-value	<0.001	0.469	0.782	<0.001	-

Table 2 is organized as a correlation matrix, which is a standard statistical format for displaying relationships between multiple variables. The table has both rows and columns representing the same five eGameFlow dimensions. The leftmost column identifies which eGameFlow dimension is being correlated with all others. Each variable appears twice in this column: first as the variable name (e.g., "C.Concentration"), second as "p-value" (the statistical significance level for that row's correlations)

Table 2 shows strong and significant correlations between Knowledge improvement and Concentration ($p < .001$), Knowledge improvement and Immersion ($p < .001$), and Concentration and Immersion ($p < .001$). These results show that the *compendium* can keep learners engaged for extended periods—particularly since the experiment took weeks. The other eGameFlow dimensions were less strong or statistically insignificant, compared to Fu (2009) original results. These discrepancies may be a consequence of the shortened or altered version of the questionnaire used with younger children.

We also measured pupils' *compendium* browsing time and related it to their survey scores since instrumental genesis is a cumulative process that occurs over time. Measuring duration could therefore provide information on variations in learner engagement. The correlation between the two was weak ($r = 0.21$) and non-significant (p-value = 0.24), offering no clear evidence that the increased use of the *compendium* was related to increased enjoyment of GamesHub.

However, to better understand potential differences, we visualized each pupil's *compendium* usage alongside their self-reported score (Figure 2).

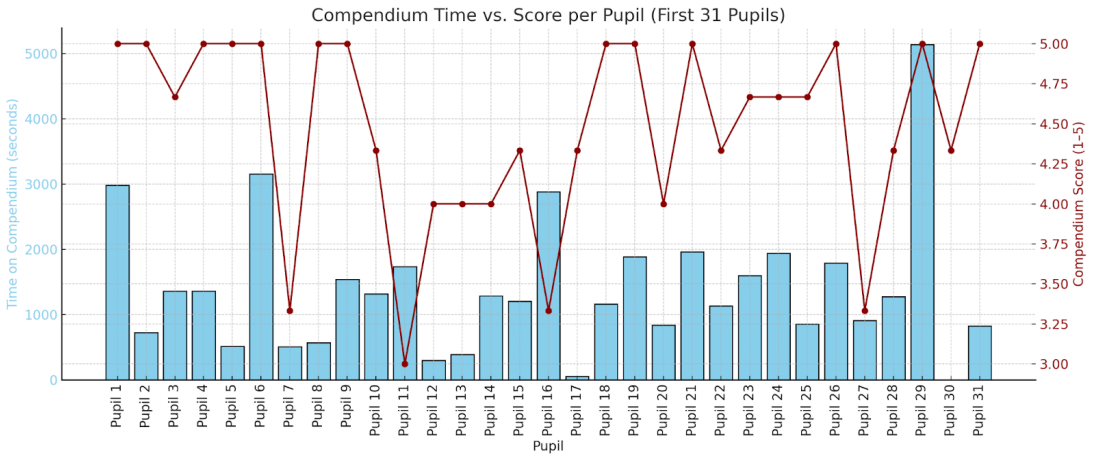

Figure 2: Pupils' time spent on the *compendium* and their appreciation scores (dimension K)

This dual-axis graph compares the total time each of the 31 pupils spent interacting with the *compendium* (blue bars, in seconds) and the appreciation score they assigned to it (red line, on a scale of 1 to 5). While

many pupils who used the *compendium* frequently also rated it positively, some showed high appreciation despite brief interaction. Conversely, a few pupils spent considerable time with the feature but gave more moderate scores. This representation helps to highlight diverse engagement behaviors across individuals and may give some clues to specify the different ways of use of the *compendium*.

5. Discussion

5.1 Overview of key Results

Overall, the results from the adapted EGameFlow survey suggest that pupils rated their experiences positively across all dimensions, with Knowledge emerging as the highest-rated dimension.

Qualitative responses indicated that pupils not only enjoyed collecting rewards but also actively represented the *compendium* in their drawings and peer discussions, which shows emotional investment and affective engagement. The significant correlations observed between knowledge, concentration, and Immersion further suggest that the *compendium* contributed to maintaining sustained attention and emotional involvement throughout the learning sessions.

5.2 Flow and the Early Stages of Instrumental Genesis

Beyond immediate engagement, these results may be interpreted through the instrumental genesis concept (Vérillon and Rabardel 1995). Experiencing flow—particularly high concentration and immersion—could facilitate the first stages of appropriation of a digital artefact. In this case, the *compendium*, initially designed as a secondary feature, appears to have started transforming into an instrument for some pupils. While full instrumental genesis would imply more deliberate cognitive strategies (such as thematic organization or knowledge restructuring), the observed affective investment - pleasure in collecting and discussing gains - is an essential prerequisite. It creates favorable conditions for instrumentalization, whereby pupils begin assigning personal meaning to the artefact. In this way, we may suggest flow experiences can indirectly support the genesis of learning tools such as GamesHub, even for non-performative functions such as the *compendium*, by making interaction more fluid, enjoyable and autonomous.

5.3 Types of Engagement and Learner Agency

The data also reveal some layers of engagement. Affective engagement was evident because pupils expressed enjoyment by showing pride in building complete collections. Even if the social aspect of engagement is less dominant, we have observed it when pupils discussed their progress with peers.

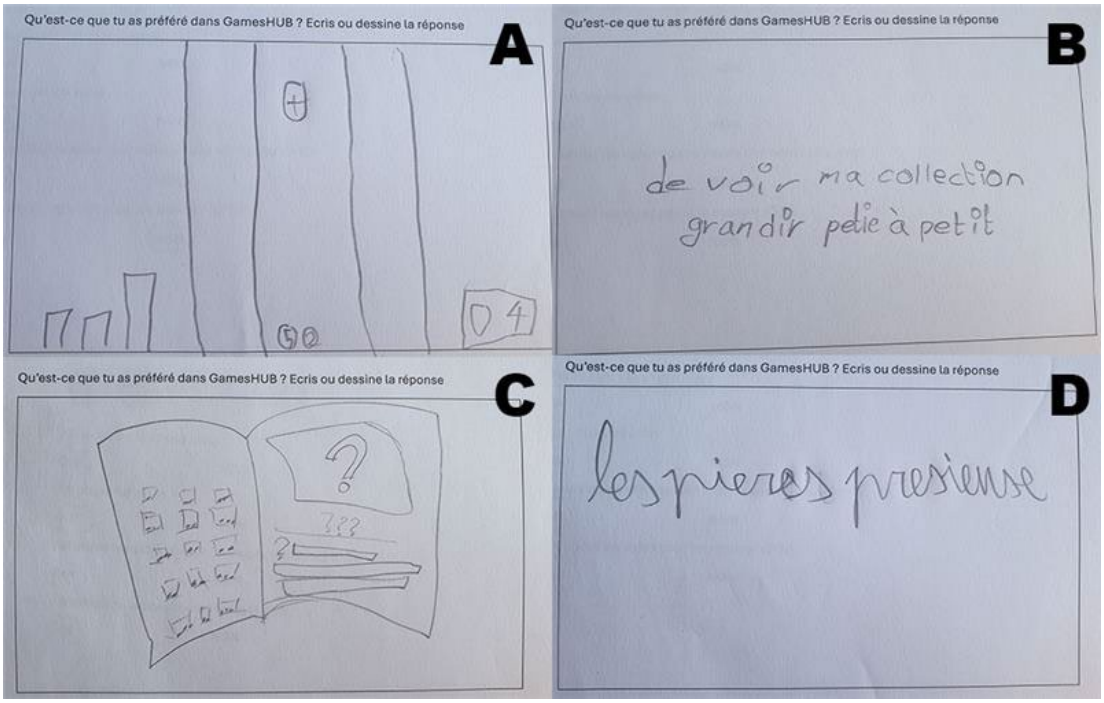

Figure 3: A-an illustration of a mini-game, B-a text saying "Watching my collection grow," C-an illustration of the compendium, D-a text saying "Precious stones," representing the items in the collection

What about the learner agency? By allowing pupils to unlock content without affecting their performance in the game, the *compendium* provided a space for autonomous exploration. Students could spend as much time as they wanted in the *compendium*. In fact, they could access it at any time during the game. We might then suggest that a reward-based system can encourage a sense of ownership and autonomous playing, allowing autonomous learning.

To further investigate this point, we compared pupils' actual use of the *compendium* (time spent) with the appreciation scores they assigned to it. Although the overall correlation between the two was weak and non-significant, a closer examination of individual profiles revealed contrasting behaviors. Some pupils reported high enjoyment despite limited usage, suggesting a strong but punctual interest, while others spent considerable time in the *compendium* with varying levels of appreciation. These discrepancies point toward differentiated forms of appropriation that are not visible in aggregate data. They could also support types of learner engagement and autonomy depending on the pupils' intentions and references.

Moreover, some pupils were even willing to look up the meaning of certain words in the *compendium* description texts using the visual lexicon, which supports this openness to learner autonomy in the activity. However, it should be noted that further analyses would be necessary to evaluate the role of the *compendium* in the construction of knowledge or in the strategic use of cognitive abilities for a more complete process of instrumental genesis.

6. Conclusion

This study investigated how pupils engage with and appropriate the *compendium*, examining whether a non-essential, reward-based game mechanics could transform from a peripheral artefact into an instrument of personal learning. The *compendium*'s design, which incorporated randomness, performance-based advancement, content accumulation, and peer comparison opportunities, successfully generated what pupils described as excitement about "watching my collection grow." However, the highest mean rating across all eGameFlow dimensions was for Knowledge Improvement ($M = 4.47$, $SD = 0.60$), suggesting that pupils valued the educational content itself rather than merely the reward mechanism.

These finding challenges simplistic interpretations of gamification that focus solely on extrinsic motivation, indicating instead that well-designed reward systems can create pathways to intrinsic engagement with learning content. The qualitative evidence further supports this interpretation. Pupils' drawings predominantly featured the compendium and its rewards, and their spontaneous discussions about unlocked content demonstrated genuine interest in the educational material. This suggests that the loot box-inspired mechanism served as an effective bridge between extrinsic motivation and intrinsic curiosity about curriculum-aligned content spanning mythology, geography, and biology.

The fact that some pupils voluntarily used the visual lexicon tool to understand compendium descriptions provides evidence of self-directed learning behaviors. This cross-feature usage demonstrates how autonomous engagement with one tool can catalyze broader learning strategies, supporting the development of learner agency that extends beyond the immediate context of the *compendium* itself. While the *compendium* was initially designed as a secondary feature to enhance motivation, our results suggest that, for many pupils, it began transforming into a genuine learning instrument through processes of appropriation and personal meaning-making.

The strong correlations between Knowledge Improvement and both Concentration ($r = 0.486$, $p < .001$) and Immersion ($r = 0.579$, $p < .001$) indicate that pupils' engagement with the compendium supported sustained attention and deep involvement with learning content. These correlations suggest that the feature facilitated what Vérillon and Rabardel describe as the dual process of instrumental genesis (1995): pupils adapted the compendium to their personal learning needs (instrumentalization) while simultaneously allowing the tool to structure their cognitive engagement with curriculum content (instrumentation).

While our findings provide valuable insights into pupils' engagement with reward-driven educational features, several limitations should be acknowledged. The study was conducted over a 10-week period with 31 participants from two classrooms, which limits the generalizability of findings to broader populations and longer-term usage patterns. Additionally, the adapted eGameFlow survey, while appropriate for the target age group, may not have captured all dimensions of flow experience with the same precision as the original instrument. Future research should investigate the long-term development of instrumental genesis with educational game features, examining how pupils' uses of tools like the *compendium* evolve over extended periods. Longitudinal studies could reveal whether the early appropriation behaviors observed in this study

develop into more sophisticated learning strategies and whether these strategies transfer to other educational contexts. Additionally, research examining the relationship between different types of reward content and learning outcomes could inform more targeted designs. Our study focused on general knowledge content aligned with curriculum standards, but investigation of how different content types (procedural knowledge, conceptual understanding, metacognitive strategies) interact with reward mechanisms could yield valuable design insights.

Future research should explore individual trajectories of appropriation. Case studies could help identify how specific learner profiles emerge over time, and how variables such as in-game performance, initial motivation or curiosity influence the appropriation and perceived value of optional features like the *compendium*. Longitudinal approaches would also clarify whether sustained us reinforce learners' interest in optional content or encourage more deliberate and strategic forms engagement over time.

Ethics declaration: All procedures performed in this study involving human participants were conducted in accordance with the ethical standards. Informed consent was obtained from the legal guardians of all individual participants included in the study. Participation was voluntary, and the data collected were anonymized to ensure confidentiality. The research was conducted in collaboration with the schools involved, with the full support of teachers and school administrators.

AI declaration: DeepL translator, an Artificial intelligence tool developed by DeepL SE a Cologne-based company, used to support translations from French to English. All results were reviewed and validated by the authors.

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