

Exploratory Study of the Relationship Between HEXAD Player Types and Cognitive Learning Objectives

Sarah Hase

Neu-Ulm University of Applied Sciences, Germany

hasesarah@web.de

Abstract: *Introduction and Aim* Despite the widespread practical application of gamification in education, existing empirical evidence of its effectiveness often lacks a theoretical foundation. In particular, there is a lack of systematic analysis of specific learning outcomes in relation to cognitive complexity, without taking modern taxonomies into account. The aim of this study is to identify initial trends regarding behavior in a gamified learning environment and to explore the extent to which there is a systematic relationship between the individual gamification player types of the HEXAD model and the attainment of different cognitive learning levels according to the taxonomy of Anderson and Krathwohl. *Methods* The study employs a mixed-methods approach (explanatory sequential design). In the first quantitative phase (n = 12), participants complete a gamified online test via LimeSurvey. The instructional design is based on the taxonomy developed by Anderson and Krathwohl, while the gamification draws on insights from Krath and von Korflesch. The data is analyzed using descriptive and exploratory statistics (IBM SPSS). Specific research questions are derived from these results to provide a deeper explanation of the quantitative findings for the second qualitative phase of guided interviews (n = 7; analyzed via Atlas.ti). Finally, the quantitative and qualitative data are triangulated in a joint display. *Results* The analysis reveals differences in learning outcomes depending on player type and cognitive complexity. Players and Achievers perform better on tangible learning objectives. However, the performance curve for Players declines as cognitive complexity increases. Philanthropists, on the other hand, demonstrate their strength in analytical, subjective, and evaluative tasks and show a continuous upward trend in meaningful, content-rich challenges. Socialisers exhibit consistent performance on tasks of moderate complexity, but a drop in performance when it comes to evaluation. Additionally, a crossover effect from Players to Philanthropists can be observed when it comes to evaluative goals. *Conclusion* The results suggest a task-specific relationship between individual characteristics of the HEXAD player types and learning success at various cognitive levels. It can therefore be concluded that future game-based learning applications should be explicitly tailored to the specific game design elements and cognitive requirements of the respective player types. To verify these exploratory findings, it is recommended that follow-up studies be conducted with a larger sample size over a longer observation period.

Keywords: Didactics, Gamification, Game-based-learning, Anderson & Krathwohl, HEXAD-model

1. Introduction

The integration of digital technologies into higher education has been accompanied by growing interest in gamification, the purposeful application of game design elements in non-game contexts to enhance motivation and engagement (Deterding et al, 2011). A substantial body of literature confirms positive effects of gamification on student engagement and learning motivation (Bai et al, 2020, Sailer and Homner, 2020). However, these studies predominantly focus on demonstrating generalized effectiveness or observing broad behavioral change, without incorporating a validated framework for differentiating between learner types or connecting outcomes to structured taxonomies of cognitive complexity.

While prior research has begun to examine connections between gamification and cognitive learning goals (Nagarajan and Sen, 2019, Wood and Drew, 2025), these studies largely rely on outdated taxonomy models and do not incorporate validated user typologies. The intersection of HEXAD player types (Marczewski, 2015) and the Anderson and Krathwohl taxonomy (Anderson and Krathwohl, 2001) thus represents an unexplored research space. This study addresses this gap through an exploratory investigation guided by three research questions:

F1: What relationships exist between HEXAD player types and the attainment of specific cognitive learning objectives?

F2: To what extent does the distribution of attained learning levels vary depending on player type?

F3: What tendencies are observable regarding the affinity of specific player types for higher or lower cognitive complexity levels?

To investigate these questions, the study employs a mixed-methods approach in the form of an Explanatory Sequential Design (Hesse-Biber and Johnson, 2015), combining a quantitative gamified online test with subsequent qualitative guided interviews.

The remainder of this paper is structured as follows: Section 2 presents the theoretical background on gamification, the HEXAD model, and the taxonomy of Anderson and Krathwohl. Section 3 outlines the methodology of both study phases and their integration. Section 4 reports the quantitative and qualitative findings as well as their synthesis. Section 5 discusses the results and their implications for game-based learning design, and Section 6 draws conclusions and directions for future research.

2. Theoretical Background

2.1 Gamification

Gamification refers to the targeted use of game design elements in non-game contexts to enhance motivation, engagement, and specific behaviors (Barata et al, 2015, Deterding et al, 2011). In educational settings, gamification is employed to make learning experiences feel more playful and to sustain learner attention through mechanics such as points, badges, leaderboards, progression, and challenges (Deterding et al, 2011, Tols and Sailer, 2021). Empirical studies confirm positive average effects on engagement and learning motivation, though effect sizes vary considerably across contexts, subject areas, and population (Bai et al, 2020, Sailer and Homner, 2020, Hamari et al, 2014).

A key limitation of existing research is the treatment of learners as a homogeneous group. Studies rarely account for individual motivational differences or their interaction with cognitive task demands, leaving open the question of for whom gamification works and under what conditions (Nagarajan and Sen, 2019, Wood and Drew, 2025).

2.2 HEXAD Model

The HEXAD Model (Marczewski, 2015) classifies users of gamified systems into six types based on their motivational preferences: Philanthropists (motivated by purpose and altruism), Socialisers (motivated by social connection), Free Spirits (motivated by autonomy and exploration), Achievers (motivated by mastery and competence), Players (primarily extrinsically motivated by rewards), and Disruptors (motivated by change and disruption of the system).

Users rarely belong exclusively to one type; rather, they exhibit individual profiles with varying degrees of each. The model was operationalized through a validated 24-item scale (Tondello et al, 2016) which has since been validated for both English- and German-speaking contexts (Krath and von Korflesch, 2021). Crucially for this study, existing research on HEXAD has focused predominantly on motivational and affective outcomes such as engagement and preference, leaving the relationship between player types and objective, taxonomically defined learning outcomes largely unexplored (Mora et al, 2019, Willig et al, 2021).

2.3 Taxonomy of Anderson and Krathwohl

The revised taxonomy of Anderson and Krathwohl (2001) is a two-dimensional framework classifying learning objectives according to a knowledge dimension (factual, conceptual, procedural, metacognitive) and a cognitive process dimension with six hierarchical levels: Remember, Understand, Apply, Analyze, Evaluate, and Create (as shown in Figure 1). This structure enables precise formulation of learning objectives in the form “verb + noun” (cognitive process + knowledge type), facilitating alignment between instructional goals, teaching methods, and assessment formats.

Compared to Bloom’s original taxonomy (1956), the 2001 revision separates knowledge from cognitive process as distinct dimensions, introduces “Create” at the apex of the hierarchy, and more clearly operationalizes each level for assessment purposes (Anderson and Krathwohl, 2001). This makes it particularly suited to the present study, which requires a structured and measurable account of cognitive learning outcomes.

		Cognitive Domain					
		1. Remember	2. Understand	3. Apply	4. Analyze	5. Evaluate	6. Create
Knowledge Domain	A. Factual Knowledge						
	B. Conceptual Knowledge						
	C. Procedural Knowledge						
	D. Metacognitive Knowledge						

Figure 1: Taxonomy table by Anderson and Krathwohl

3. Methodology

This study employs an Explanatory Sequential Design (Hesse-Biber and Johnson, 2015), in which quantitative data are collected and analyzed first, with qualitative data subsequently used to explain and contextualize the statistical findings.

3.1 Study 1 (Quantitative Phase)

A gamified online test was developed using LimeSurvey and administered over ten days in January 2026 to bachelor-degree students at a German university. The content domains process optimization and the Customer Journey were selected for this broad accessibility across disciplines and their suitability for assessment across multiple cognitive levels. Process optimization, as outlined by Stöger (2025), focuses on the customer-oriented alignment of all business processes, targeting simultaneous improvements in efficiency, quality, and productivity through iterative, measurable cycles. The Customer Journey, as an applied method of process optimization, analyzes all contact points between customer and organization to systematically identify strengths, weaknesses, and improvement potential (Stöger, 2025). Both topics were considered appropriate for a cross-disciplinary student sample, as they require no domain-specific prior knowledge while enabling assessment across multiple cognitive levels of the Anderson and Krathwohl taxonomy. The instructional design was structured around the four organizational questions and instructional objectives of Anderson and Krathwohl (2001), covering cognitive levels from Remember (factual) to Evaluate (conceptual), excluding Create due to time constraints. The metacognitive knowledge dimension was likewise excluded, in order to keep the focus on differentiating player types across cognitive process levels rather than knowledge domains. Eight instructional objectives were formulated and mapped onto individual cells of the learning objective matrix, spanning naming, explaining, applying, analyzing and evaluating tasks related to process optimization and the Customer Journey (e.g. “learners name key aims of process optimization”). Item content and its placement within the taxonomy matrix were validated by a professor of applied computer science specializing in didactics.

To validly assess motivational preferences, participants were temporarily redirected to the official HEXAD test by Marczewski and manually transferred their individual scores back into the main questionnaire. Game design elements were selected based on the empirically validated preferences of the three most widely represented HEXAD types (Krath and von Korflesch, 2021): badges and progress bars for Achievers, badge collection for Philanthropists, and anonymity and optional non-linear pathways for Disruptors. Learning content was delivered via short explanatory videos, followed by quiz items (multiple-choice and free text) mapped onto the learning objective matrix. Multiple-choice items were used for the Remember, Understand and Apply levels, while the Analyze and Evaluate levels were assessed via free-text responses requiring learners to construct their own answers, reducing the influence of guessing at the higher cognitive levels. A pre-test assessed prior knowledge before the gamified intervention, a post-test evaluated attainment after.

A total of $n = 12$ participants completed the test fully. Due to the small sample size, statistical analysis was restricted to descriptive and exploratory methods using IBM SPSS Statistics (Version 31) to identify patterns and dependencies between the player profiles and learning success. Inferential statistics were not applied, as the sample size precludes stable significance testing, and the ordinal distribution of HEXAD scores prevents clean categorical separation (Field, 2017). A threshold of 75% of maximum points was applied as a conventional cut-off to dichotomize attainment of each learning level. This value was set a priori rather than derived empirically from the present data and should be regarded as one of several plausible operationalizations. Sensitivity to alternative thresholds was not tested given the small sample.

3.2 Study 2 (Qualitative Phase)

Seven participants ($n = 7$) from the quantitative phase took part in semi-structured guided interviews conducted via Zoom approximately three weeks after the test. This delay allowed prior quantitative analysis to form the interview guide. Participants were selected based on voluntary participation, diversity of HEXAD profiles, and prior experience of gamification. Transcripts were processed according to the simplified transcription rules of Kuckartz (2010) and analyzed via qualitative content analysis (Mayring et al, 2022) using Atlas.ti (Version 25) with a combined deductive-inductive coding procedure. Intra-coder reliability was assessed to ensure consistency. No new codes emerged in the final transcripts, offering a preliminary indication of saturation, however given the small number of interviews ($n = 7$), this should be interpreted with caution.

3.3 Mixed-Methods Integration

Findings from both phases were synthesized in a joint display (as shown in Table 1; Mayring et al, 2022), mapping quantitative performance data onto qualitative explanatory codes across four cognitive complexity levels. This triangulation enabled causal explanation of the statistical patterns observed in Study 1.

Table 1: Joint-Display

Cognitive Complexity	Quantitative Data	Qualitative Explanatory Approaches	Synthesis
Low Complexity Remember and Understand	High attainment (M = 0.50–0.92, except Remember (factual) M = 0.33). Notable score gap between Player ($\Delta 2.58$) and Philanthropist ($\Delta 2.33$) types. Ceiling effects visible Understand (conceptual) M = 0.92).	Gamification perceived as a focus aid. Strategic guessing observed under content uncertainty. Matching tasks perceived as markedly simpler.	At low complexity, gamification appears to focus rather than distract learners, though extrinsic incentives vary in effectiveness by type. Coupling points to closed formats may favor guessing over deeper processing. The effectiveness of this strategy appears to vary by sub-level.
Medium Complexity Apply (procedural)	Attainment drops to M = 0.67. Players dominate the successful group (M = 18.88).	Badge collection cited as motivating. Clear rules described as motivating task completion. Gamification described as bundling attention.	Rule-based formats appear to serve Players' extrinsic focus well. Where the path to reward remains transparent, gamification appears to bundle attention and raise this type's readiness to perform.
High Complexity Analyze (conceptual)	Low attainment (M = 0.33). Philanthropists lead the successful group (M = 18.67) vs. Players (M = 17.67).	Content relevance cited as primary motivator. Difficulty measuring progress on free-text tasks noted. Gamification elements described as filtered out.	A cross-over pattern emerges: For open free-text tasks, Players appear to lack reward transparency, coinciding with a performance decline, while Philanthropists appear intrinsically motivated by content relevance. Under higher cognitive load, extrinsic elements appear to be perceptually filtered out.
Highest Complexity Evaluate	Sample splits evenly (M = 0.50). Marked decline in Socialiser performance. Highest scores for Achiever (M = 17.17).	Absence of collaborative options noted alongside demand for critical judgement. Missing system features cited across interviews.	The even split may plausibly relate to a missing didactic scaffold. The decline in Socialiser performance may relate to the absence of collaboration options at this stage. Achievers appear to respond positively to increasing difficulty.

4. Results

4.1 Quantitative Study

Participants had a mean age of 24.67 years (SD = 1.92) and were, on average, in their 6.57th semester (SD = 1.36). While 58.3% were enrolled in Game Production and Management, the remaining 41.7% represented a range of diverse disciplines including Data Science, Information Management and Communication, Psychology, and Sports Science, contributing to a cross-disciplinary sample composition. The sample was predominantly male (66.7%). However, since the present study aims to identify general patterns between player types and cognitive learning stages, and gender-specific differences are not the focus of the research questions, this distribution is considered irrelevant for further analysis. HEXAD profiles showed the highest mean scores for Philanthropists (M = 18.58), Free Spirits and Players (both M = 17.83), and Socialisers (M = 17.08), with Achievers (M = 15.75) and Disruptors (M = 12.92) lower. The comparatively low variance among Achievers and Free Spirits, as well as the closely clustered mean values of the remaining player types, confirms that HEXAD types function as continuous profiles rather than discrete categories.

Learning level attainment varied considerably across the seven assessed levels. Rated on a scale from 0 (not attained) to 1 (attained), the levels of Remember (conceptual) and Understand (conceptual) were most

frequently attained ($M = 0.92$), while Analyze (conceptual) and Remember (factual) were reached least often ($M = 0.33$). Apply (procedural) and Evaluate showed an exact 50/50 split, indicating systematic variation in performance related to individual differences (as shown in Table 2).

Table 2: Achievement of learning objectives

Achievement of learning objectives								
		Remember (factual)	Remember (conceptual)	Understand (conceptual)	Understand (procedural)	Apply (procedural)	Analyze (conceptual)	Evaluate
	N	12	12	12	12	12	12	12
Mean		.33	.92	.92	.50	.67	.33	.50
Median		.00	1.00	1.00	.50	1.00	.00	.50
Modus		0	1	1	0 ^a	1	0	0
Std.-Deviation		.492	.289	.289	.522	.492	.492	.522
Variance		.242	.083	.083	.273	.242	.242	.273

a. Several modes are available. The smallest value is displayed.

For each learning level, mean HEXAD scores were calculated only from the subset of participants who successfully attained that level ($\geq 75\%$ of maximum points). The composition of this subgroup therefore differs across levels, so the analysis captures differences between successful subgroups rather than change within the same individuals over time.

When HEXAD profiles were examined in relation to which participants successfully attained each level, a clear pattern emerged. At the Apply (procedural) level, successful participants showed a markedly higher Player score ($M = 18.88$), consistent with the rule-based, feedback-rich format of the corresponding tasks. At the Analyze (conceptual) level, the lowest overall attainment rate, Philanthropists dominated the successful group ($M = 18.67$), while Player and Free Spirit scores declined. Achiever scores increased continuously across ascending difficulty levels, suggesting a particular affinity for progressive challenge. Figure 2 plots the mean HEXAD sum score for each of the six player types at each of the seven learning objective levels.

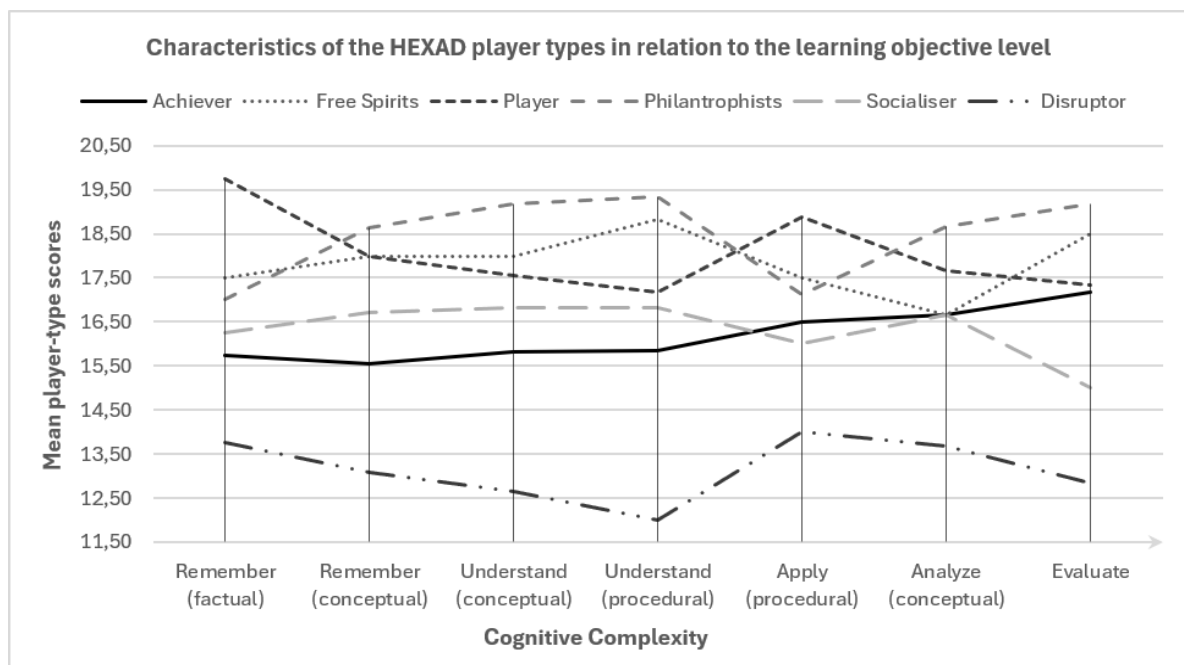


Figure 2: Characteristics of the HEXAD player types in relation to the learning objective level

At the Evaluate level, successful participants showed higher Disruptor, Player, and Socialiser scores than unsuccessful ones. However, the mean Socialiser score dropped sharply across the full sample when moving from Analyze to Evaluate, representing one of the most striking individual findings.

4.2 Qualitative Study

Three coding categories structured the qualitative analysis. Category A (gamification and cognitive load) found that gamification was predominantly perceived as a focus aid (code A2; total weight = 28.8), with no participant reporting cognitive overload from game elements. When cognitive demands exceeded the supportive capacity of gamification, elements were simply filtered out rather than experienced as disruptive (code A4; 16.05). Strategic guessing was observed in a small number of cases (A3; 2.4), providing qualitative confirmation of the suspected rate effect in multiple-choice items.

Category B (HEXAD motivational needs) demonstrated the validity of the HEXAD instrument through complete saturation of code B6 (HEXAD self-assessment alignment; 12.28), with all seven participants confirming their assigned profile as accurate. Extrinsic reward motivation (B1; 15.4) and intrinsic meaning-seeking (B2; 11.7) emerged as the two dominant motivational orientations, directly corresponding to the cross-over effect observed quantitatively. Social deficit (B3; 8.2) explained the Socialiser performance drop at the Evaluate level: the complete absence of collaborative elements at this stage violated the type's core need for social connectedness.

Category C (task design and barriers) revealed a systematic instructional design deficit. Code C2 (missing system features; 21.67) was the most frequently coded item and appeared in all seven interviews, indicating that all participants, regardless of player type, identified concrete structural gaps in the system's scaffolding. The perceived difficulty of free text tasks (C6; 10.33) contrasted with the ease of assignment tasks (C3; 6.83), explaining the performance shift across player types as cognitive demands moved from closed to open formats.

4.3 Synthesis

The joint display triangulation indicates four overarching tendencies:

At low cognitive complexity, gamification functions as a general focus aid. Strategic guessing inflates performance in multiple-choice formats, particularly for extrinsically motivated types.

At moderate complexity, rule-based task formats align with the reward transparency needs of Players, who dominate the successful group. Gamification effectively bundles attention when the path to reward remains clear.

At high complexity, a cross-over effect occurs: Players decline due to missing reward transparency in open free text formats, while Philanthropists advance due to the intrinsic relevance of the case study content. Gamification elements are perceptually filtered out rather than disruptive.

At maximum complexity, the sample splits exactly in half. The decline in Socialiser performance may plausibly be explained by the absence of collaborative mechanics, as suggested by the qualitative interview data. Achievers, conversely, respond positively to escalating difficulty. The primary cause of the half-sample failure is not gamification overload but missing instructional scaffolding.

Returning to the three research questions posed in the introduction: Regarding F1, the study provides preliminary evidence that a relationship between HEXAD player types and cognitive learning objectives exists but appears task-specific rather than universal, as no single type excels across all cognitive levels. Regarding F2, the distribution of attained learning levels appears to vary substantially depending on player type: Players were most represented among successful participants at the procedural application level, and Philanthropists prevail at analytical and evaluative levels, while Socialisers and Disruptors show context-dependent performance patterns. Regarding F3, tentative complexity affinities emerge: Players show declining performance with increasing cognitive complexity, Philanthropists show an upward trend toward higher complexity, and Achievers respond positively to escalating challenge, suggesting that cognitive complexity itself may function as a motivational design variable.

5. Discussion and Limitations

The results provide initial evidence for a task-specific relationship between HEXAD player types and cognitive learning success. Three key implications emerge for the design of game-based learning systems.

First, these exploratory findings tentatively suggest that gamification design may benefit from being aligned with cognitive complexity levels. Extrinsically motivating elements such as points and leaderboards appeared more effective at lower and mid-range complexity levels, where task formats were closed and reward paths

transparent. At higher complexity levels, intrinsic scaffolding, meaningful context, real world relevance, and sense-making opportunities become the more effective motivational lever. These patterns warrant confirmation in larger, more diverse samples before informing concrete design recommendations.

Second, the data tentatively suggest that Socialisers may be underserved by solo-mode gamification systems. Integrating collaborative mechanics (e.g. peer feedback loops, team quests, discussion elements) at evaluative and analytical task levels could be a worthwhile approach for future, larger-sample studies aimed at addressing the marked motivational decline observed for this profile here. Third, instructional scaffolding, glossaries, adaptive hints, and structured guidance at open task formats, are plausible contributors to more equitable effectiveness across player types. This absence may be one factor, among others, behind the performance split observed at high complexity in this small sample. Several limitations must be acknowledged. The sample size ($n = 12$) precludes inferential generalization, and the sample composition, predominantly Game Production and Management students with above-average gamification experience, introduces a profile specific bias. The short-term, online test format measures only working memory performance without ecological validity. Future research should embed such systems in real semester-long university modules, diversify the sample, and test whether the cross-over effect persists or diminishes with repeated exposure (novelty effect). Furthermore, the present sample showed a notable gender imbalance, with male participants representing two thirds of the group. Future studies should therefore investigate whether gender differences interact with HEXAD player type profiles in their effect on cognitive learning outcomes, as prior research suggests that HEXAD type distributions may vary by gender (Senocak et al, 2021).

6. Conclusions

This exploratory study provides preliminary indications that gamification may not function as a universal learning support but rather appears to interact with individual motivational profiles and cognitive task demands. The motivational profile of successful learners appears to shift dynamically depending on the cognitive level required: Players tend to perform best at rule-based application tasks, Philanthropists at analytical and evaluative depth tasks, and Achievers show a positive response to escalating challenge. Socialisers appear to need social interaction mechanisms to sustain performance at the highest complexity levels. Gamification elements did not appear disruptive at high cognitive load or universally motivating. Their effect seemed instead to depend on the match between task format, reward structure, and player type.

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Ethics Declaration: Ethical clearance was obtained in accordance with the data protection guidelines of the University of Applied Sciences Neu-Ulm. All participants provided informed consent for anonymous data processing. Interview participants additionally consented to recording and transcription. No personally identifiable data is included in this paper.

AI Declaration: The AI Tool Claude was used to assist in condensing and reformulating content from the author's prior bachelor thesis for submission in conference paper format. All intellectual contributions, research design, data collection, analysis, and conclusions are the author's own.

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