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From Warm-Up to Mastery: A Mixed-Methods Study of How *Kahoot* Practice Enhances IT Skills for Youth with Special Needs

FUNG Ka Yan, SIN Kuen Fung, The Education University of Hong Kong

***Abstract*—Interactive gamification tools, such as *Kahoot*, have transformed higher education by boosting motivation and engagement. However, *Kahoot* remains underexplored for youths with special educational needs (Y-SEN) in IT vocational training. While some studies showed benefits in mainstream contexts, empirical gaps persist regarding how Y-SEN acquire IT skills amid cognitive challenges and ability disparities. This mixed-methods study examines weekly *Kahoot*-embedded revisions in a 10-week introductory IT course Y-SEN and is guided by self-determination theory (SDT). Research questions address the impact of *Kahoot* on Y-SEN motivation and engagement, and its effects on IT knowledge and skills. The results reveal that Y-SEN show a statistically significant improvement in emotional, cognitive engagement, and motivation. Also, true/false questions excel for accessibility, but high-load questions expose persistent gaps. Thus, *Kahoot* can enhance IT learning of Y-SEN by calibrating through cognitive load, ultimately promoting the development of inclusive teaching approaches.**

***Index Terms*—Kahoot, Learning Motivation, Engagement, Gamification, SEN, IT Course, Self-determination Theory**

I. Introduction

Interactive learning and gamification have been widely recognised as promising approaches [1]. They can increase students' motivation, engagement and learning outcomes [2]. Game-based digital tools can transform traditional, teacher-centred teaching approaches into more student-centred experiences [3] [4]. They can support active participation, immediate feedback and collaboration [5]. *Kahoot* is one of the popular game-based online quiz platforms. Özdemir [6] mentioned that *Kahoot* had positive effects on academic achievement and on students' learning retention and motivation. The findings suggest that game-based platforms can enhance students' learning experience and strengthen their cognitive and affective learning.

From a theoretical perspective, gamification is often interpreted through self-determination theory (SDT) [7] [8]. According to SDT, learners' intrinsic motivation is supported when they experience autonomy, competence, and relatedness [9] [10]. Game elements can strengthen perceived competence and autonomy, such as choice, points, leaderboards and immediate feedback [11]–[13]. Also, learners can enhance relatedness with peers and teachers through shared play and competition [14] [15].

Kahoot has been applied in a wide range of disciplines, including engineering, language learning, animal science, and K–12 subjects such as mathematics and science [16]–[18]. More and more educators incorporate *Kahoot* into lectures as a formative assessment tool. Licorish et al. [19] highlighted that game-based student response systems can enrich classroom dynamics, reduce distracting behaviours and make revision more enjoyable. Importantly, learners perceive *Kahoot* as a legitimate part of the lesson rather than "just a game". However, the researchers noted several limitations, including technical issues [20], time pressure [18], and the possibility that some students focus more on winning than on understanding the content [19]. These mixed findings underline the need to examine how *Kahoot* operates in specific learner groups and curricular contexts.

Gamification and digital tools have been identified as promising technology enablers, particularly for students with special educational needs (SEN) [21]. Game-based environments can offer multimodal input, repeated practice, and safe spaces for trial-and-error [22]. However, existing work on *Kahoot* has focused more on mainstream teaching. There is limited empirical evidence on IT-related training courses for youths with SEN (Y-SEN).

This study addresses the gap by examining the use of *Kahoot* in an introductory IT-based training course for 19 Y-SEN (aged 18 – 30) at a local institution. *Kahoot* was used weekly as a short (within 10-min) and game-based revision at the start of Weeks 2 – 10. Guided by SDT and prior gamification research, the study addresses two research questions (RQs): RQ 1: To what extent does the use of *Kahoot* improve learning motivation and engagement of Y-SEN in an introductory IT-based training course. RQ 2: To what extent does weekly *Kahoot*-based revision impact IT knowledge and skills of Y-SEN. The contribution of this study is twofold. Empirically, this work provides one of the first mixed-methods analyses of *Kahoot* with Y-SEN in an IT context, combining weekly quiz data, repeated-question trajectories and interview evidence from Y-SEN and teaching assistants (TAs). Theoretically, this work interprets these findings through SDT, discussing how different question types and implementation choices support or hinder Y-SEN's sense of competence, autonomy, and relatedness.

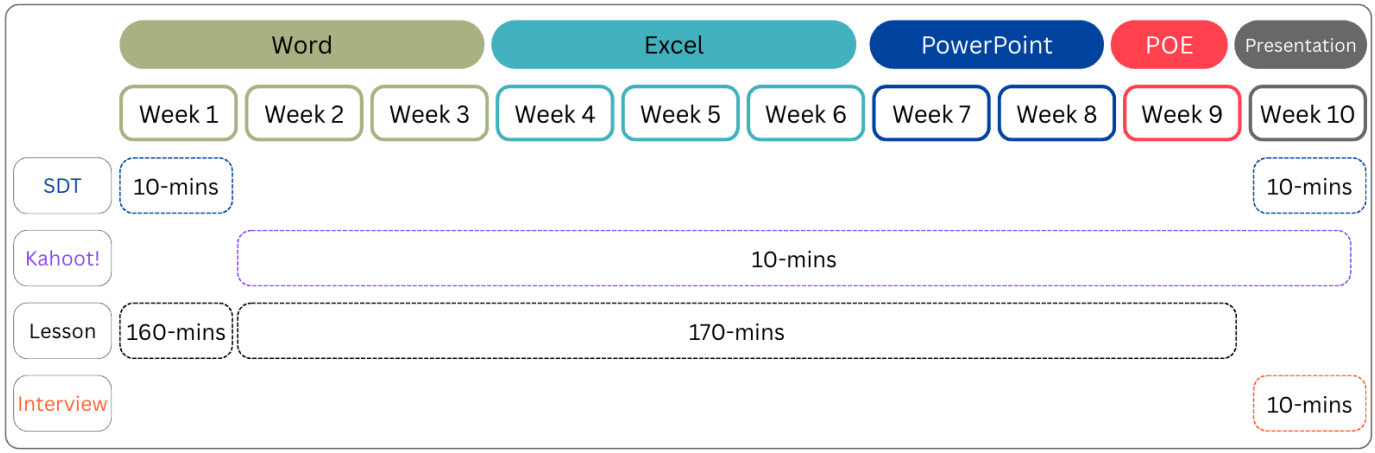

Fig. 1. The overview of an introductory IT-based training course at a local institution serving Y-SEN.

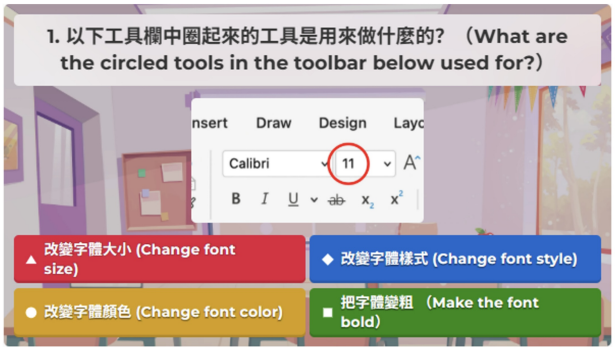

Fig. 2. The overview of a sample quiz of *Kahoot* .

II. Method

A. Study Design

The study took part in an introductory IT-based training course at a local institution serving Y-SEN.

a) Course: As shown in Fig. 1, the course was held for 3 hours (180 minutes) for 10 weeks. A professional delivered the course, with backgrounds in SEN and IT. Three TAs with special education/inclusive learning backgrounds supported the course. Weeks 1 – 9 were formal lessons to teach Microsoft tools and POE (Weeks 1 – 3: Word; Weeks 4 – 6: Excel; Weeks 7 – 8: PowerPoint; Week 9: POE). Week 10 was for the presentation.

Kahoot: Questions were designed based on five types and difficulty levels (Sample shown in Fig. 2). *Level* 1 is a True/False question with two options. *Level* 2 is a Picture-based question with three options. *Level* 3 is a Picture-based question with four options. *Level* 4 is a Functional-based question with four options. *Level* 5 is a Text-based question with four options.

As shown in Table I, *Week 1 Question 2* was repeated each week. The aim was to explore Y-SEN's memory retention over 10 weeks. The rest of the repeated questions were incorrect from the previous lesson. The aim was to examine whether Y-SEN could consolidate their understanding over time.

b) Questionnaire: Weeks 1 & 10, Y-SEN were required to complete an SDT questionnaire [23]. Each questionnaire consisted of 12 equally weighted questions, including behaviour (N=3; e.g., When interacting with *Kahoot*, I complete all learning activities), emotional (N=3; e.g., I find interacting with *Kahoot* fun), cognitive engagement (N=3; e.g., I think of different ways to get points in *Kahoot*), and intrinsic motivation (N=3; e.g., I am interested in interacting with *Kahoot*). Each question was based on a 5-point Likert scale, ranging from "Totally agree" (5 points) to "Totally disagree" (1 point).

c) Interview: TAs and Y-SEN completed the interview, respectively. The interviews for TAs were (1) What were your observations about Y-SEN's learning progress, behaviour, emotional management, and needs in the IT lessons? (2) How did *Kahoot* impact Y-SEN's interest, knowledge retention, and participation, (3) What improvements would you suggest for future lessons? The interviews for Y-SEN were (1) With the *Kahoot* game, how do you feel about classes, (2) Is *Kahoot* easy to focus? Why, (3) How do you feel after playing *Kahoot*? Why, (4) What other games could help you learn better?

d) Participant: We recruited 19 Y-SEN (aged from 18 – 30, two females and 17 males). All Y-SEN have at least one type of SEN (e.g., special learning disabilities (SpLD), autism spectrum disorder (ASD), intellectual disability (ID), intellectual developmental disorder (IDD), attention deficit/hyperactivity disorder (AD/HD), conduct disorder (CD), emotional and behavioural difficulties (EBD), and speech impairment (SI)). Based on teachers' prior assessments and classroom functioning, Y-SEN were grouped into a higher-functioning (Y-SEN with HF) and lower-functioning (Y-SEN with LF) group.

The criteria of participation were (1) having at least one type of SEN, and (2) having prior knowledge to interact with tablets. Before having the experiment, we obtained verbal consent from students. Participation is fully voluntary. No

compensation or remuneration is provided. The experimental protocol has received approval from the University Institutional Review Board (IRB).

III. Efficacy

A. Performance of Learning Engagement

A single-factor ANOVA revealed statistically significant improvements in emotional, cognitive engagement, and intrinsic motivation, as shown in Table II. Emotional engagement rose 14.55% (pre-test: $\bar{M}$ = 74.74, $\sigma = 16.42$; post-test: $\bar{M}$ = 85.61, $\sigma = 10.25$; $F = 6.00$, $p < .05$). Cognitive engagement increased by 13.08% (pre-test: $\bar{M}$ = 75.09, $\sigma = 16.61$; post-test: $\bar{M}$ = 84.91, $\sigma = 9.65$; $F = 4.97$, $p < .05$). Intrinsic motivation escalated by 16.75% (pre-test: $\bar{M}$ = 73.33, $\sigma = 20.61$; post-test: $\bar{M}$ = 85.61, $\sigma = 10.00$; $F = 5.46$, $p < .05$). However, behavioural engagement did not show statistically significant improvement (+8.14%; pre-test: $\bar{M}$ = 77.54, $\sigma = 18.62$; post-test: $\bar{M}$ = 83.86, $\sigma = 11.83$; $F = 1.56$, $p > .05$). These results indicated *Kahoot* could boost internal psychological needs, except for behavioural engagement. The outcomes suggest greater score uniformity, reflecting enhanced group cohesion.

B. Performance of Each Category

a) Level 1 – True/False Question (Two Options): Throughout the whole course, the correctness was 79.45% ($\sigma = 40.54$), with 81.18% ($\sigma = 39.32$) correct rate for Y-SEN with HF and 77.05% ($\sigma = 42.40$) for Y-SEN with LF. As shown in Table III, the performance of Y-SEN with HF rose from $\bar{M} = 72.73$ ($\sigma = 46.71$) in Week 2 to $\bar{M} = 80.00$ ($\sigma = 42.16$) in Week 10 (+10.00%, $F = 0.14$, $p = .71$). Y-SEN with LF maintained consistently moderate performance, from $\bar{M} = 85.71$ ($\sigma = 37.80$) in Week 2 to $\bar{M} = 87.50$ ($\sigma = 35.36$) in Week 10 (+2.08%, $F = 0.01$, $p = .93$). These results indicated stable accessibility of the true/false format in ability levels, with post-test uniformity suggesting mastery consolidation in both groups.

b) Level 2 – Picture-based Question (Three Options): The correct rate was 75.68% ($\sigma = 43.50$), with 86.36% ($\sigma = 35.13$) for Y-SEN with HF and 60.00% ($\sigma = 50.71$) for Y-SEN with LF. As shown in Table III, the outcomes of Y-SEN with HF dropped from $\bar{M} = 100.00$ ($\sigma = 0.00$) in Week 2 to $\bar{M} = 72.73$ ($\sigma = 46.71$) in Week 10 (change = -27.27%, $F = 3.75$, $p = .07$). Y-SEN with LF also declined from $\bar{M} = 85.71$ ($\sigma = 37.80$) in Week 2 to $\bar{M} = 37.50$ ($\sigma = 51.75$) in Week 10 (change = -56.25%, $F = 4.13$, $p = .06$). These results revealed that both groups encountered challenges in memory retention.

c) Level 3 – Picture-based Question (Four Options): The correct rate was 59.26% ($\sigma = 49.60$), with 64.52% ($\sigma = 48.64$) for Y-SEN with HF and 52.17% ($\sigma = 51.08$) for Y-SEN with LF. As shown in Table III, the scores of Y-SEN with HF fell from $\bar{M} = 70.00$ ($\sigma = 48.30$) in Week 2 to $\bar{M} = 50.00$ ($\sigma = 52.70$) in Week 10 (-28.57%, $F = .78$, $p = .39$). Y-SEN with LF remained stable at $\bar{M} = 50.00$ ($\sigma = 53.45$) in Week 2 and $\bar{M} = 50.00$ ($\sigma = 53.45$) in Week

TABLE I
THE OVERVIEW OF QUESTION DISTRIBUTION: TYPES, OPTIONS, DIFFICULTY, AND REPEATED QUESTIONS. THE ACRONYM Q DENOTES QUESTION.

Week/Q	Type	Options	Difficulty	Repeated Qs
W1, Q1	Picture	3 options	Level 2	–
W1, Q2	Text	4 options	Level 5	–
W1, Q3	True/False	2 options	Level 1	–
W1, Q4	Functional	4 options	Level 4	–
W1, Q5	Text	4 options	Level 5	–
W2, Q1	Text	4 options	Level 5	W1, Q2
W2, Q2	Picture	3 options	Level 2	–
W2, Q3	True/False	2 options	Level 1	–
W2, Q4	Functional	4 options	Level 4	–
W2, Q5	Functional	4 options	Level 4	W1, Q4
W2, Q6	Functional	4 options	Level 4	–
W2, Q7	Functional	4 options	Level 4	–
W3, Q1	Functional	4 options	Level 4	–
W3, Q2	Text	4 options	Level 5	W1, Q2
W3, Q3	True/False	2 options	Level 1	–
W3, Q4	Functional	4 options	Level 4	–
W3, Q5	Functional	3 options	Level 4	–
W3, Q6	Functional	4 options	Level 4	W1, Q7
W3, Q7	Functional	4 options	Level 4	–
W3, Q8	Functional	4 options	Level 4	–
W4, Q1	Text	4 options	Level 5	–
W4, Q2	Text	4 options	Level 5	W1, Q2
W4, Q3	True/False	2 options	Level 1	–
W4, Q4	Functional	4 options	Level 4	W1, Q4
W4, Q5	Functional	3 options	Level 4	W1, Q5
W4, Q6	Picture	4 options	Level 3	–
W4, Q7	Functional	4 options	Level 4	–
W4, Q8	Text	4 options	Level 5	–
W5, Q1	Functional	4 options	Level 4	–
W5, Q2	Text	4 options	Level 5	W1, Q2
W5, Q3	True/False	2 options	Level 1	–
W5, Q4	Functional	4 options	Level 4	W1, Q4
W5, Q5	Functional	3 options	Level 4	W3, Q5
W5, Q6	Text	4 options	Level 5	W4, Q8
W5, Q7	Picture	4 options	Level 3	–
W5, Q8	Functional	4 options	Level 4	–
W6, Q1	True/False	2 options	Level 1	–
W6, Q2	Functional	4 options	Level 4	–
W6, Q3	Text	4 options	Level 5	W1, Q2
W6, Q4	Functional	4 options	Level 4	W1, Q4
W6, Q5	Functional	4 options	Level 4	–
W6, Q6	Functional	4 options	Level 4	–
W6, Q7	Functional	4 options	Level 4	W5, Q8
W6, Q8	Functional	4 options	Level 4	–
W7, Q1	Text	4 options	Level 5	–
W7, Q2	True/False	2 options	Level 1	–
W7, Q3	Text	4 options	Level 5	W1, Q2
W7, Q4	Functional	4 options	Level 4	–
W7, Q5	Functional	4 options	Level 4	W1, Q4
W7, Q6	Functional	4 options	Level 4	W6, Q8
W7, Q7	Functional	4 options	Level 4	–
W7, Q8	Text	4 options	Level 5	–
W8, Q1	Text	4 options	Level 5	–
W8, Q2	True/False	2 options	Level 1	–
W8, Q3	Text	4 options	Level 5	W1, Q2
W8, Q4	Functional	4 options	Level 4	W1, Q4
W8, Q5	Picture	4 options	Level 3	–
W8, Q6	Text	4 options	Level 5	–
W8, Q7	Functional	4 options	Level 4	–
W8, Q8	Functional	4 options	Level 4	–
W9, Q1	Functional	4 options	Level 4	W1, Q4
W9, Q2	Functional	4 options	Level 4	W3, Q6
W9, Q3	Functional	3 options	Level 4	W3, Q5
W9, Q4	Text	4 options	Level 5	W4, Q8
W9, Q5	Functional	4 options	Level 4	W5, Q8
W9, Q6	Functional	4 options	Level 4	W8, Q7
W9, Q7	Functional	4 options	Level 4	W6, Q8
W9, Q8	Text	4 options	Level 5	W8, Q1

TABLE II
THE OVERVIEW OF SINGLE-FACTOR ANOVA FOR THE SDT PERFORMANCE OF Y-SEN. "*" DENOTES $p < .05$.

		M	σ	Changes	P-value	F-value
Behavioural Engagement	Pre	77.54	18.62	8.14	0.22	1.56
	Post	83.86	11.83			
Emotional Engagement	Pre	74.74	16.42	14.55	*	6.00
	Post	85.61	10.25			
Cognitive Engagement	Pre	75.09	16.61	13.08	*	4.97
	Post	84.91	9.65			
Intrinsic Motivation	Pre	73.33	20.61	16.75	*	5.46
	Post	85.61	10.00			

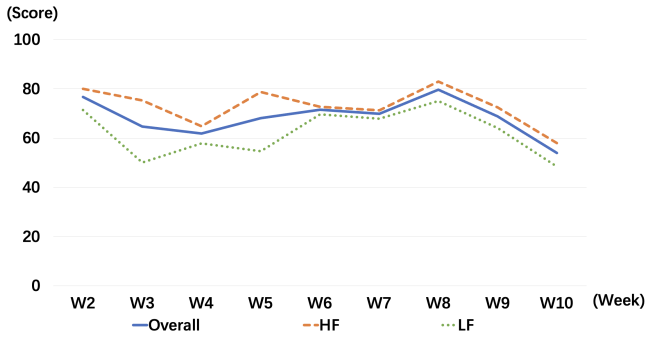

Fig. 3. The overview of weekly performance in general, Y-SEN with HF and LF. The y-axis denotes performance from 0 to 100 points. X-axis denotes the weeks, from Week 2 (W2) to Week 10 (W10).

TABLE III
THE OVERVIEW PERFORMANCE OF Y-SEN WITH HF AND LF IN FIVE LEVELS OF QUESTIONS. "*" DENOTES $p < .05$

		M	σ	Change	F-value	P-value
Level 1	True/False Question (Two Options)					
HF	Week 2	72.73	46.71	10.00	0.14	0.71
	Week 10	80.00	42.16			
LF	Week 2	85.71	37.80	2.08	0.01	0.93
	Week 10	87.50	35.36			
Level 2	Picture-based Question (Three Options)					
HF	Week 2	100.00	0.00	-27.27	3.75	0.07
	Week 10	72.73	46.71			
LF	Week 2	85.71	37.80	-56.25	4.13	0.06
	Week 10	37.50	51.75			
Level 3	Picture-based Question (Four Options)					
HF	Week 2	70.00	48.30	-28.57	0.78	0.39
	Week 10	50.00	52.70			
LF	Week 2	50.00	53.45	0.00	0.00	1.00
	Week 10	50.00	53.45			
Level 4	Functional-based (Four Options)					
HF	Week 2	72.73	46.71	-12.50	0.19	0.67
	Week 10	63.64	50.45			
LF	Week 2	28.57	48.80	206.25	7.32	*
	Week 10	87.50	35.36			
Level 5	Text-based Question (Four Options)					
HF	Week 2	72.73	46.71	0.00	0.00	1.00
	Week 10	72.73	46.71			
LF	Week 2	71.43	48.80	-12.50	0.12	0.74
	Week 10	62.50	51.75			

10 (0.00%, $F = 0.00$, $p = 1.00$). Four-option pictures proved consistently moderate, with Y-SEN with LF stability, but the decline of Y-SEN with HF indicated differential difficulty.

d) Level 4 – Functional-based Question (Four Options): The correct rate was 63.09% ($\sigma = 48.47$), with 68.35% ($\sigma = 46.57$) correct for Y-SEN with HF and 55.79% ($\sigma = 49.75$) for Y-SEN with LF. As shown in Table III, the scores of Y-SEN with HF were slightly declined from $\bar{M} = 72.73$ ($\sigma = 46.71$) in Week 2 to $\bar{M} = 63.64$ ($\sigma = 50.45$) in Week 10 (-12.50%, $F = 0.19$, $p = .67$). Y-SEN with LF showed marked gains from $\bar{M}$= 28.57 (σ = 48.80) in Week 2 to $\bar{M}$ = 87.50 (σ = 35.36) in Week 10 (+206.25%, $F = 7.32$, $p < .05$). Functional questions supported the progress of Y-SEN with LF, highlighting the format's suitability for practical skill-building over time.

e) Level 5 – Text-based Question (Four Options): The correct rate was 73.33% ($\sigma = 44.29$), with 76.96% ($\sigma = 42.22$) correct for Y-SEN with HF and 68.35% ($\sigma = 46.68$) for Y-SEN with LF. As shown in Table III, the performance of Y-SEN with HF held steady at $\bar{M} = 72.73$ ($\sigma = 46.71$) in both weeks. Y-SEN with LF slightly declined from $\bar{M} = 71.43$ ($\sigma = 48.80$) in Week 2 to $\bar{M} = 62.50$ ($\sigma = 51.75$) in Week 10 (-12.50%, $F = 0.12$, $p = .74$). Text-based questions yielded the highest accuracy with consistency, favouring Y-SEN with HF stability across sessions.

C. Weekly Performance

a) Kahoot *Gap Dynamics:* Fig. 3 illustrated Y-SEN students' weekly correctness in nine *Kahoot* sessions. Performance fluctuated over time, with peaks in Weeks 2, 5, and 8. These weeks corresponded to relatively simple, single-concept questions on newly introduced IT topics. Therefore, they placed lower cognitive demands. In subsequent weeks on the same topics, the correctness declined. The condition suggested that maintaining performance on similar content remained challenging without additional support.

Y-SEN with HF consistently outperformed those with Y-SEN with LF throughout the course. The gap of Y-SEN with HF and LF was widest in Week 3 and narrowed by Week 7. The gap expanded again from Weeks 8 –– 10 when many items were at Levels 4 – 5, which were especially demanding for Y-SEN with LF. Despite these differences in weekly performance, both groups followed broadly similar trajectories. The outcome indicated that *Kahoot* supported parallel learning paths while still revealing ability-related performance gaps.

b) Performance of Repeated Questions: For the repetition questions, Y-SEN's performance was based on the complexity. For questions with a single and simple concept (e.g., Is Word a text-processing software), they can consolidate core knowledge with *Kahoot*. Both Y-SEN with HF and LF reached ceiling accuracy (e.g., 90 – 100% in Post-W4). However, complex and procedural questions (e.g., bold button and insert table) showed substantial gains but high fluctuation. Y-SEN with HF progressed faster due to the demands of icon-action mapping, resulting in persistent HF-LF gaps.

Moreover, complex layout questions (e.g., page numbering and margins) showed limited progress (40-60%) and remained unstable despite repeats. The performance of Y-SEN with LF was inconsistent, suggesting insufficient mastery without

additional scaffolding.

IV. Discussion

A. Motivation and engagement in a SEN IT course

Weekly performance and interviews showed that *Kahoot* can keep a high level of engagement among Y-SEN. *Kahoot* boosted competence (e.g., immediate feedback and leaderboards) [24] and relatedness (peer competition and humour) [25]. Y-SEN reported that the scores could motivate them to improve their performance and prepare for class. They described *Kahoot* as fun, interesting, and exciting. Y-SEN also mentioned that *Kahoot*-embedded lessons were more enjoyable and helped focus as a warm-up revision.

Moreover, TAs observed that Y-SEN increased students' interest in learning and concentration. Their observation aligned with studies showing *Kahoot* enhances classroom dynamics and reduces off-task behaviour [26]. However, TAs noted that Y-SEN with LF repeatedly chose the wrong answers weekly. Also, some were even discouraged from ranking. This echoes the literature limitation that *Kahoot* motivates most but may undermine Y-SEN with LF competence without scaffolding, despite behavioural participation [27].

B. IT Knowledge and Skills Impact

Category analysis showed that True/False (Level 1) and three-option picture-based questions (Level 2) achieved the highest accuracy, with low complexity and visual cues suited to SEN basic understanding [28]. Four-option picture-based (Level 3) and functional-based questions (Level 4) were proven to be challenging due to multi-step demands [29], especially for Y-SEN with LF. Repeated questions demonstrated positive learning outcome [30]. In general, the questions related to classification (e.g., distinguish among *Word*, *Excel*, and *PowerPoint*) demonstrated the best performance. For functional questions (e.g., bold and page setting), performance fluctuated (Y-SEN with HF remained stable, while Y-SEN with LF remained variable).

V. Conclusion and Future Works

This study demonstrated the efficacy of *Kahoot* as a gamified revision tool for 19 Y-SEN in an introductory IT-based training course. They showed statistically significant improvements in emotional, cognitive engagement, and intrinsic motivation. Although high cognitive load prevented consistent weekly performance and HF-LF gaps persisted, certain topics narrowed ability differences. Leaderboard discouragement affected some learners. When calibrated for cognitive load and motivational equity, *Kahoot* equitably supports SEN IT learning. However, a small sample and a short-term design may limit generalisability. In the future, we will establish non-gamified baselines and replicate with diverse SEN subgroups using larger samples and longitudinal designs.

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