



November 2023 Public International Meeting (Gamification Day)



① The Effects of Gamified Interleaved Spaced Repetition
on Vocabulary Learning

by Louis Lafleur

(Kwansei Gakuin University)



② Using Games, VR, and AI
to Learn Uncommon Languages

by Liang Xu (Charlie, 许亮)

(Dublin City University)



Sunday, November 19th, 2023
1:30PM-4:30PM (JST: UTC+09:00)
Venue: Zoom (Free registration needed)

More information on
<http://let-kansai-fmt-sig.blogspot.com/>

twitter

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The Japan Association
for Language Education
& Technology

Sunday, November 19th, 2023 (13:30~14:30),
LET Kansai Fundamental Theory SIG, November Meeting
Louis Lafleur, Kwansei Gakuin University



The Effects of Gamified Interleaved Spaced Repetition on Vocabulary Learning



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<https://kaken.nii.ac.jp/en/grant/KAKENHI-PROJECT-19K00899/>

(Background) Typical Flashcard study

Frontside

e.g., L1 word/phrase prompt



Thanks

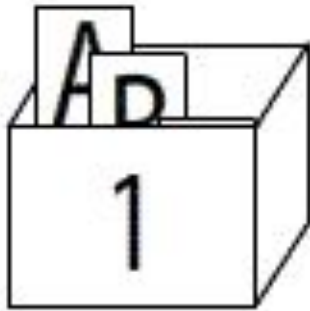
Backside

e.g., L2 word/phrase answer

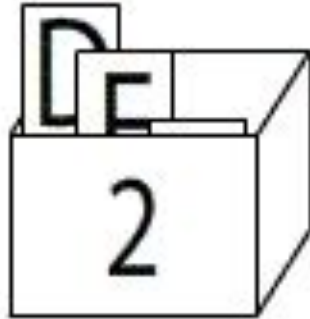


Takk

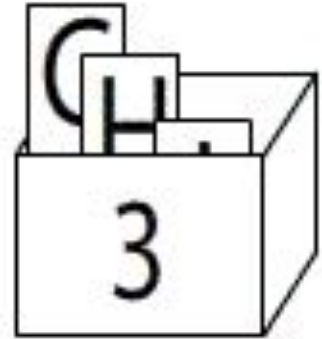
Interleaved Spaced Repetition Study (Leitner System or Box system, 1972)



Daily
Meaning



Weekly
Form



Monthly
Use

*Simplified schedule example

If 3 groups of students only have 25 minutes to study new words/phrases within 9 days, **which group will perform best on post-tests?**

Table 1. Typical Comparative Example of Expanded, Uniform, and Massed Algorithms

Main Algorithm Types & Intervals	Initial Study	Interval ①	Interval ②	Interval ③	Interval ④
“Expanded” (x type) (~12h start → x 2)	day 1 (start point)	day 1 or 2 (~12 hours)	day 3 (1 day)	day 5 (2 days)	day 9 (4 days)
“Uniform” (same) (→ every 2 days)	day 1 (start point)	day 3 (2 days)	day 5 (2 days)	day 7 (2 days)	day 9 (2 days)
“Massed learning” or (cramming)	(Total study time compressed into a single session) E.g. If a study session lasts 5 minutes: 5 consecutive sessions x 5 = 25 minutes total.				

A →

B →

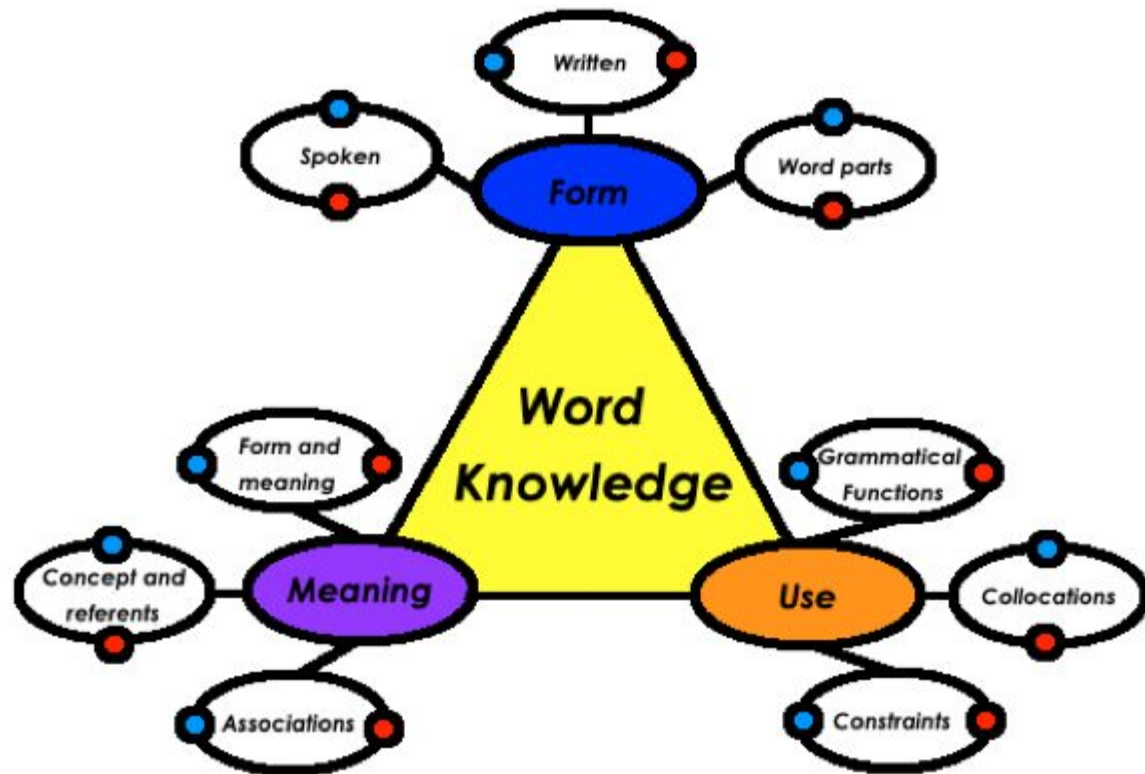
There are actually multiple types of “Expanded Algorithms”,
Perhaps it would be interesting to compare these in future studies

(Table 2) Schedule Example for Comparison between (+, x and a^b) Expanded Algorithms

Factor of 2 (5 Intervals)	Initial Study	Interval ①	Interval ②	Interval ③	Interval ④	Interval ⑤
“Expanded” (+ type) (previous# \rightarrow + 2 days)	day 1 (start point)	day 3 (2 days)	day 7 (4 days)	day 13 (6 days)	day 21 (8 days)	day 31 (10 days)
“Expanded” (x type) (\rightarrow x 2)	day 1 (start point)	day 1 (later)	day 3 (2 days)	day 7 (4 days)	day 15 (8 days)	day 31 (16 days)
“Expanded” (a^b type) (E.g. \rightarrow $\sim 19\text{sec}^{(\#)}$ *)	day 1 (start point)	day 1 (19 secs)	day 1 (6 mins)	day 1 (2 hours)	day 3 (36 hours)	\sim day 31 ($\sim 28\frac{1}{2}$ days)

*the more precise a^b number here was 18.9 seconds

The Molecular Level of "Word Knowledge"

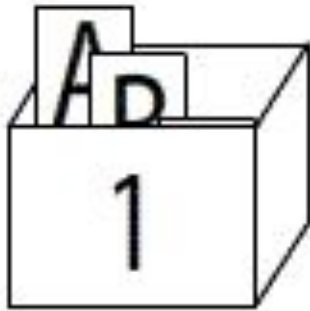


- = Receptive knowledge
- = Productive knowledge

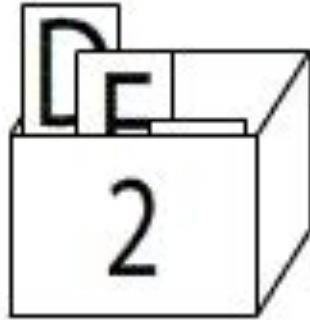
What is involved in "word knowledge" (Nation, 2001)



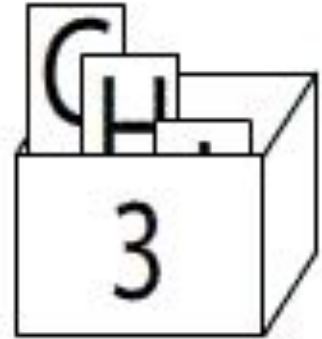
Interleaved Spaced Repetition Study (Leitner System or Box system, 1972)



Daily
Meaning



Weekly
Form



Monthly
Use

*Simplified schedule example

Spaced-Interleaved Task Examples and Interval Breakdown for Indirect Spaced Repetition Software/System (ISRS)

Tier Q# level	Flow L1 = native language L2 = second language	Task Type	Task/Interval Route :		
			↓ when recalled/answered successfully ↻ or ← when recalled/answered unsuccessfully (cooldown timer before next review, h = hour, d = day)		
Ⓜeaning Q#1 word or phrase	L2 audio to L1 recall	Recall Check	↻ Session 1 (initial) ↓	← Session 7 (6d) ↓	← Session 13 (162d) ↓
Ⓜeaning Q#2 word or phrase	L1 word/phrase to L2 recall	Recall Check	↻ Session 2 (8h) ↓	← Session 8 (9d) ↓	← Session 14 (243d) ↓
ⓕorm Q#1 word or phrase	L2 audio to L2 word/phrase	Spelling	↻ Session 3 (16h) ↓	← Session 9 (18d) ↓	← Session 15 (486d) ↓
ⓕorm Q#2 sentence	L2 (blank) to L2 sentence	Fill-in-the-blank	↻ Session 4 (1d) ↓	← Session 10 (27d) ↓	← Session 16 (729d) ↓
Ⓛse Q#1 sentence	L2 sentence to L1 sentence	Writing	↻ Session 5 (2d) ↓	← Session 11 (54d) ↓	← Session 17 (1458d) ↓
Ⓛse Q#2 sentence	L1 sentence to L2 sentence	Writing	↻ Session 6 (3d) ↓	← Session 12 (81d) ↓	← Session 18 (2187d) ↓ end
(Optional)* Q#7 Text	Reading and Listening (L2 to L2)	(Voiced) Reading	↻ back to top ↑ ↻ back to top ↑ or end (option)		

*For increased effectiveness, ISRS can be combined with a fluency-building (voiced) reading task. For example, studying a set of word items, which compose a text could trigger such an activity.

Interleaved Spaced Repetition Software (ISRS)

Demonstration Video & User Feedback

Wikipedia

Wikipedia (11/11)
Wikipedia (11/11)

Q1

Wikipedia (11/11)
1/111

Wikipedia
&

Study

Wikipedia

Wikipedia

Wikipedia

Wikipedia

Think of the missing (translate)

Test: 30 P
Level: 205 2 (18)

☒ 長 ☒ 式 ☒

See answer

RQ1:

What are the participants' impressions and thoughts related to ISRS?

Software Satisfaction, Likert Mean/SD & Comments

1= Very low; 5= Very high (n = 57)

Software (ease of use) = 3.70 (1.03)

Software (interest) = 3.32 (1.14)

Software (usefulness) = 3.84 (0.90)

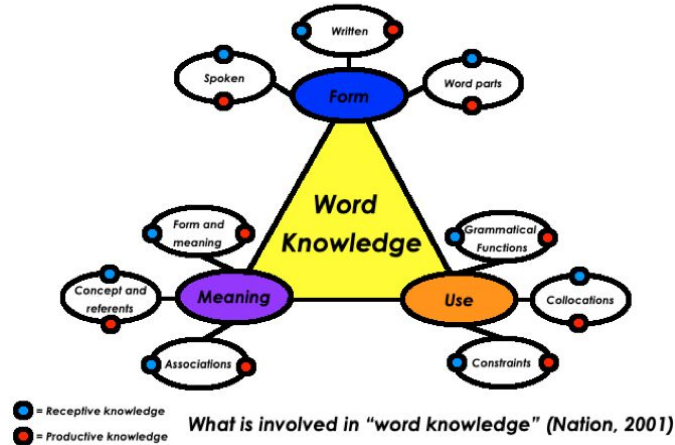
“I could use eigomemo easily, and I had a very wonderful time studying while commuting on the train. (P#50)”

“Thanks to the various question types it was easy to study [with eigomemo], but the smartphone version had some bugs. (P#14)”

“The [vocabulary study] content was a little difficult. (P#46)”

Research Questions

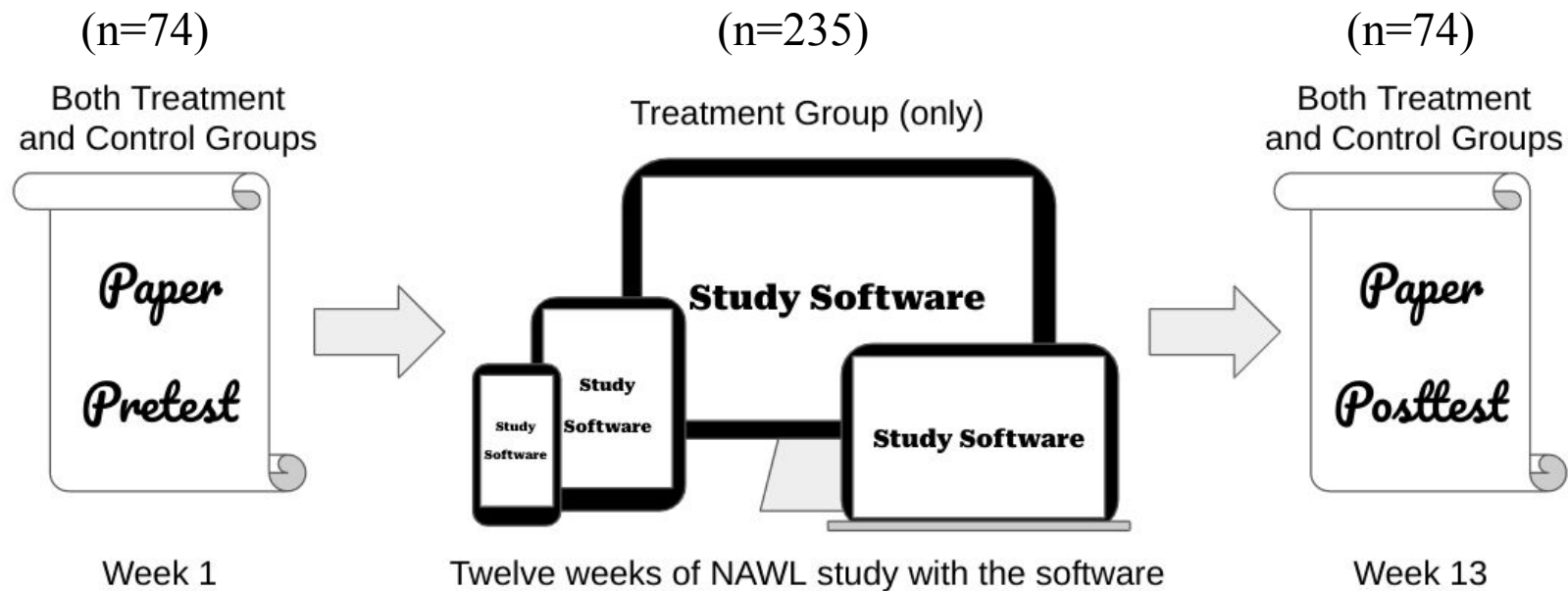
The Molecular Level of "Word Knowledge" 



RQ2: What aspects of word knowledge are more likely to be known?

RQ3: What aspects of word knowledge are acquired with/without the treatment software?

Methodology



RQ2: What aspects of word knowledge are more likely to be known?

RQ3: What aspects of word knowledge are acquired with/without the treatment software?

$k = 117$ (39 selected NAWL word items x 3 question types)

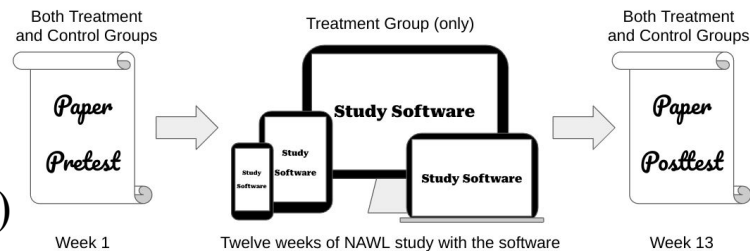


Table 4. Pre/Posttest Sections and Task Flow

Test sections	Task flow	Similar Test Format
(1) “Meaning” Listening Recall	After listening to a sentence and target word audio in English, the participant was asked to translate the target word in Japanese.	(McLean et al., 2021) Spoken Receptive Meaning-Recall /Listening meaning-recall
(2) “Form” Dictation Recall	After listening to the target word audio in English, the participant was asked to write its basic/dictionary form in English.	(Cheng & Matthews, 2018) Testing productive / phonological (ProPhon) vocabulary knowledge
(3) “Use” Listening Recall	After listening to the sentence audio in English of the target word, the participant was asked to write its translation in Japanese.	None, but inspired by Nation’s (2001) suggestion to enable a more “in-depth” learning/testing of vocabulary to assure the correct “use” of the words.

RQ2: What aspects of word knowledge are more likely to be known?

RQ3: What aspects of word knowledge are acquired with/without the treatment software?

Table 12. ISRS eNAWL word study effect according to Pre/Posttest Score Results

Group n =	Test	“Meaning” test score Median % (IQR %)	“Form” test score Median % (IQR %)	“Use” test score Median % (IQR %)	Total test score Median % (IQR %)
Group 0 n=10	Pretest	28.75% (25.00%)	32.50% (25.00%)	13.75% (29.38%)	24.17% (30.62%)
	Posttest	35.00% (30.00%) +6.25% (+5.00%) +21.74% relative. diff.	42.50% (21.25%) +10.00% (-3.75%) +30.77% relative. diff.	21.25% (16.15%) +7.50% (-13.23%) +54.55% relative. diff.	33.75% (26.67%) +9.58% (-3.95%) +39.64% relative. diff.
Group 1 n=64	Pretest	24.34% (19.21%)	20.53% (21.05%)	13.16% (21.78%)	17.98% (19.82%)
	Posttest	41.05% (24.61%) +16.71% (+5.40%) +68.65% relative dif.	35.92% (32.96%) +15.39% (+11.91%) +74.96% relative dif.	26.32% (32.53%) +13.16% (+10.75%) +100.00% relative dif.	31.58% (29.38%) +13.60% (+9.56%) +75.64% relative dif.
Mann-Whitney p value z-derived r		U = 543.000 p = <.001 r = .411	U = 397.000 p = .222 r = .142	U = 514.500 p = .002 r = .359	U = 515.500 p = .002 r = .360

Note. Group 0= control group; Group 1= treatment group.

Also a special thanks to:

My friends at MAGE Montreal (javascript programming)



My teachers



JALT Vocabulary SIG

Also, Yu Kanazawa, Tatsuya Nakata, Jeff Stewart, Raymond Stubbe, Stuart McLean, Charles Browne, Phil Bennett, Tim Stoeckel and JALT Vocab Sig committee members

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Leitner system animation (gif), Zirguezzi, CC0 1.0 Public Domain, retrieved on 23rd September 2019
https://en.wikipedia.org/wiki/Leitner_system#/media/File:Leitner_system_animation.gif

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Interleaved Spaced Repetition System
is a free public domain concept:

 **creative
commons**



4.0

Louis Lafleur

(ISRS) is also freely accessible for
students & researchers to use on
the author's website:
eigomemo.com

Thank you and feel free to contact me anytime!



Second Study
on
Daily Gamified Awards



WHAT IS GAMIFICATION?

The concept of “game-informed application(s)” or “gamification” is **the inclusion of game-design elements and principles** (e.g., earning points, storylines, game-based thinking) in other fields/areas (e.g., shopping, work, education) **to encourage and retain engagement.**



(presenter’s personal definition)

Structural Gamification



E.g, Magoosh Vocabulary Flashcards
Rizwan & Danesh (2021)

Content Gamification



E.g., Xeropan English Learning App
Thékes & Szilvássy (2021)

Definitions

“Structural gamification is the application of game-elements to propel a learner through content with no alteration or changes to the content” (Kapp et al., 2013)

“Content gamification is the application of game elements, game mechanics and game thinking to alter content to make it more game-like” (Kapp et al., 2013)

Participation-linked gamified daily awards were included the author's digital vocabulary Flashcard Learning software

Bonus Points

12

Consecutive days Bonus !



You've got 1 bonus point!

WOW 10 new cards today !



You've obtained a silver medal!

WOW You reviewed all cards today !



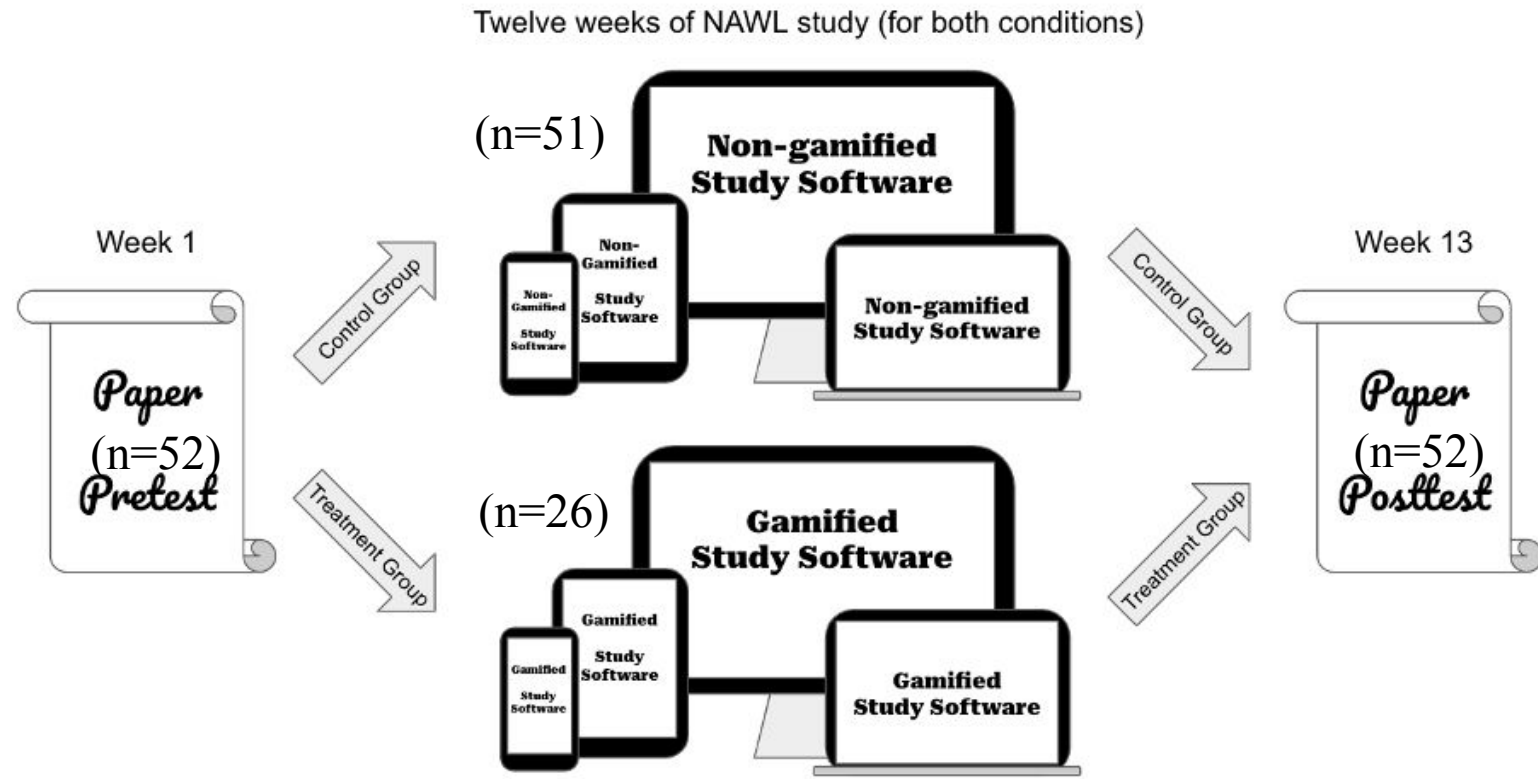
You've obtained a bronze medal!

WOW More than 10 minutes study today !



You've obtained a gold medal!

Comparative study of two groups



Repeated Pre / Posttest audio driven paper-test

$k = 57$ (19 selected NAWL words x 3 question types)

Table 4. Pre/Posttest Sections and Task Flow

Test sections	Task flow	Similar Test Format
(1) “Meaning” Listening Recall	After listening to a sentence and target word audio in English, the participant was asked to translate the target word in Japanese.	(McLean et al., 2021) Spoken Receptive Meaning-Recall /Listening meaning-recall
(2) “Form” Dictation Recall	After listening to the target word audio in English, the participant was asked to write its basic/dictionary form in English.	(Cheng & Matthews, 2018) Testing productive / phonological (ProPhon) vocabulary knowledge
(3) “Use” Listening Recall	After listening to the sentence audio in English of the target word, the participant was asked to write its translation in Japanese.	None, but inspired by Nation’s (2001) suggestion to enable a more “in-depth” learning/testing of vocabulary to assure the correct “use” of the words.

Keywords

Phonetic (L1 1)
WuWuWuWuWu

SL

WuWuWuWuWu
SL/100

WuWuWu
20

Study

WuWuWu

WuWuWuWuWu

WuWuWu

WuWuWu

Text: MFP
Level: BCC 1.0m



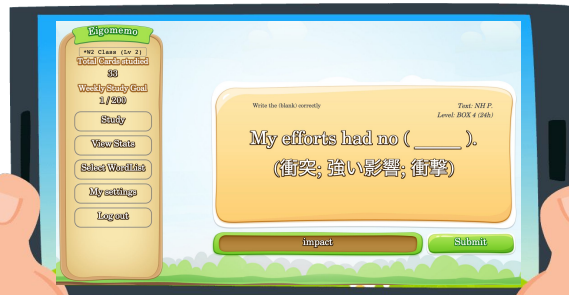
Listen

Play

Both groups had an identical semester goal and recommended weekly study pace

Semester goal: 2400 = Total cards studied (points)

- By the end of week 1 - aim for 200 cards studied or more
- By the end of week 2 - aim for 400 cards studied or more
- By the end of week 3 - aim for 600 cards studied or more
- By the end of week 4 - aim for 800 cards studied or more
- By the end of week 5 - aim for 1000 cards studied or more
- By the end of week 6 - aim for 1200 cards studied or more
- By the end of week 7 - aim for 1400 cards studied or more
- By the end of week 8 - aim for 1600 cards studied or more
- By the end of week 9 - aim for 1800 cards studied or more
- By the end of week 10 - aim for 2000 cards studied or more
- By the end of week 11 - aim for 2200 cards studied or more
- By the end of week 12 - aim for 2400 cards studied or more



Research Questions

RQ1. Do gamified daily awards have an effect on vocabulary software satisfaction?

RQ2. Do gamified daily awards have an effect on digital flashcard study habits?

RQ3. Do gamified daily awards have an effect on vocabulary learning outcomes?

RQ1. Do gamified daily awards have an effect on vocabulary software satisfaction?

Inconclusive, not statistically significant $p = .280$

Table 36. Prior and Treatment-Used Software Satisfaction (Within Groups)

Group#	Prior Soft Satisfaction Mean (SD) [CI]	Study Soft Satisfaction Mean (SD) [CI]	Mann-Whitney <i>p</i> value	Effect size z-derived <i>r</i>
(0) <i>n</i> =23	3.43 (0.95) [3.03, 3.84]	3.39 (0.92) [2.90, 3.88]	<i>U</i> = 258.000 <i>p</i> = .884	<i>r</i> = -.022
(1) <i>n</i> =10	3.40 (0.97) [2.71, 4.09]	3.80 (0.59) [3.22, 4.38]	<i>U</i> = 65.000 <i>p</i> = .280	<i>r</i> = .261▪

Note. (0) Non-gamified Group, (1) Gamified Group

(responses) 5-point Likert scale responses: 1= very low satisfaction ~5= very high satisfaction

(Effect size z-derived *r*) ▪ = .100 ~ .300 Small effect size

RQ2. Do gamified daily awards have an effect on digital flashcard study habits?

Yes, they encouraged a more steady approach to learning.

Significance/Effect :

No effect

Low/little effect

Substantial effect

Table 37. Gamification Level Comparison and Software Participation Results

Data point	Group#	Median (IQR)	[Min, Max]	Mann-Whitney test	Effect size z-derived <i>r</i>
# of tasks completed	(0) <i>n</i> =51 (1) <i>n</i> =26	2313.00 (569) 2228.50 (745)	[1043, 2613] [1141, 2723]	<i>U</i> = 614.500 <i>p</i> = .601	<i>r</i> = -.060
# of active study days	(0) <i>n</i> =51 (1) <i>n</i> =26	20.00 (13) 24.50 (36)	[4, 52] [9, 77]	<i>U</i> = 809.500 <i>p</i> = .114	<i>r</i> = .180*
# of tasks per active study day	(0) <i>n</i> =51 (1) <i>n</i> =26	104.76 (73.14) 82.11 (87.39)	[45.27, 280.75] [33.42, 242.67]	<i>U</i> = 448.000 <i>p</i> = .021**	<i>r</i> = -.264*
# of total task study minutes	(0) <i>n</i> =51 (1) <i>n</i> =26	580.00 (229) 591.00 (205)	[240, 1214] [258, 1344]	<i>U</i> = 672.500 <i>p</i> = .918	<i>r</i> = .012
# of tasks completed per minute	(0) <i>n</i> =51 (1) <i>n</i> =26	3.71 (1.48) 3.58 (1.10)	[1.98, 5.63] [1.79, 5.14]	<i>U</i> = 605.500 <i>p</i> = .536	<i>r</i> = -.071
# of 10+ minute study days	(0) <i>n</i> =51 (1) <i>n</i> =26	12.00 (8) 11.00 (8)	[11.44, 14.60] [9.50, 15.20]	<i>U</i> = 586.500 <i>p</i> = .409	<i>r</i> = -.094
# days where all awaiting review tasks were completed	(0) <i>n</i> =51 (1) <i>n</i> =26	9.00 (7.00) 9.00 (9.00)	[2.00, 20.00] [4.00, 34.00]	<i>U</i> = 766.000 <i>p</i> = .266	<i>r</i> = .127*

Note. (0) Non-gamified Group, (1) Gamified Group
 (Statistical evidence* *p* value) ** = (0.01 ≤ *P* < 0.05) Moderate evidence
 (Effect size* z-derived *r*) * = .100 ~ .300 Small effect size

RQ3. Do gamified daily awards have an effect on vocabulary learning outcomes?

~Yes, p-value = .030
perhaps due to the fact they were informed by the spaced learning principle

Table 39. Gamification Level Comparison and Pre/Posttest Score Results

Total Word gain estimation by group:

Non-gamified
~57 words

Gamified
~102 words

Group #	Test	Meaning score /19 [%] Median (IQR)	Form score /19 [%] Median (IQR)	Use score /19 [%] Median (IQR)	Total score /57 [%] Median (IQR)
Group (0) <i>n</i> = 37	Pre	[15.8%] 3.00 (4)	[10.5%] 2.00 (2)	[5.3%] 1.00 (2)	[10.5%] 6.00 (8)
	Post	[31.6%] 6.00 (4)	[26.3%] 5.00 (4)	[13.2%] 2.50 (3)	[22.8%] 13.00 (8)
	Diff.	[+15.8%] +3.00 (+0)	[+15.8%] +3.00 (+2)	[+7.9%] +1.50 (+1)	[+12.3%] +7.00 (+0)
Group (1) <i>n</i> = 15	Pre	[31.6%] 6.00 (4)	[31.6%] 6.00 (6)	[21.1%] 4.00 (4)	[29.8%] 17.00 (10)
	Post	[55.3%] 10.50 (3)	[52.6%] 10.00 (4)	[42.1%] 8.00 (4)	[51.8%] 29.50 (9)
	Diff.	[+23.7%] +4.50 (-1)	[+21%] +4.00 (-2)	[+21%] +4.00 (+0)	[+22%] +12.50 (-1)
Mann-Whitney		<i>U</i> = 376.500	<i>U</i> = 328.500	<i>U</i> = 416.500	<i>U</i> = 384.500
<i>p</i> value		<i>p</i> = .045**	<i>p</i> = .299	<i>p</i> = .005***	<i>p</i> = .030**
z-derived <i>r</i>		<i>r</i> = .278*	<i>r</i> = .144*	<i>r</i> = .393**	<i>r</i> = .300*

Note. (0) Non-gamified Group, (1) Gamified Group [%] = Median%, Diff.= score difference (Statistical evidence *p* value) ** = (0.01 ≤ *P* < 0.05) Moderate evidence; *** = (0.001 ≤ *P* < 0.01) Strong evidence (Effect size z-derived *r*) * = .100 ~ .300 Small effect size; ** = .300 ~ .500 Medium effect size

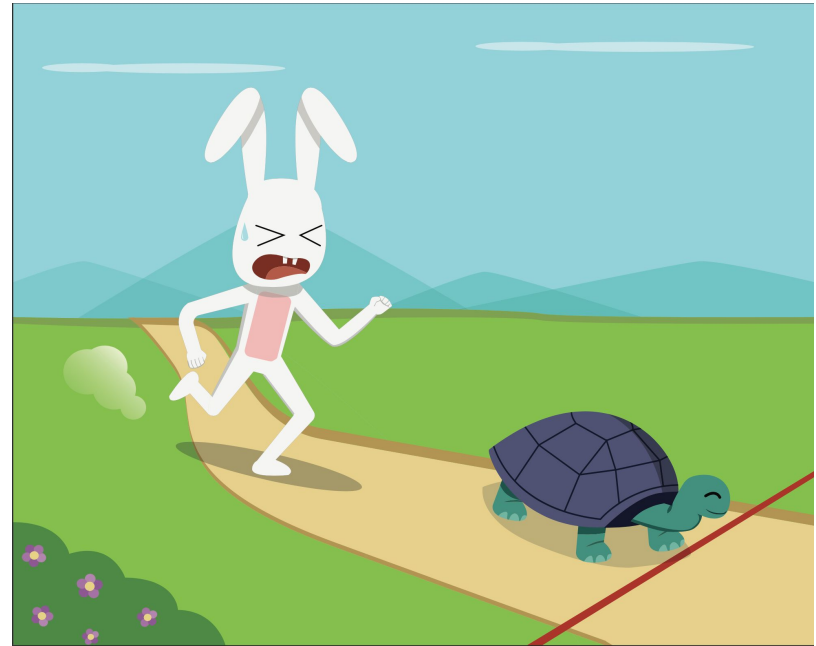
“For a game to be truly successful, development should be informed by theory and practice.”

(Reinhardt, 2019)



In conclusion, the observed positive learning outcomes in regard to this study were in all probability due to the fact that the gamified elements were strongly informed by the principle of spaced learning (that encourages numerous but shorter intervals of spaced study, and is more conducive to a higher efficiency of learning; Kang, Lindsey, Mozer, & Pashler, 2014; Nakata, 2015; Pyc & Rawson, 2007).

Many authors have alluded that the promise of gamification in education is related to its aim in increasing learners' overall learning time and engagement.



However,

perhaps gamification's true promise in education lies more in encouraging a higher quality/efficiency of study than a higher quantity of study.

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Thank you and feel free to contact me anytime!