Effect of Disfluency on Learning Outcomes, Metacognitive Judgements and Cognitive Load in Computer Assisted Learning Environments

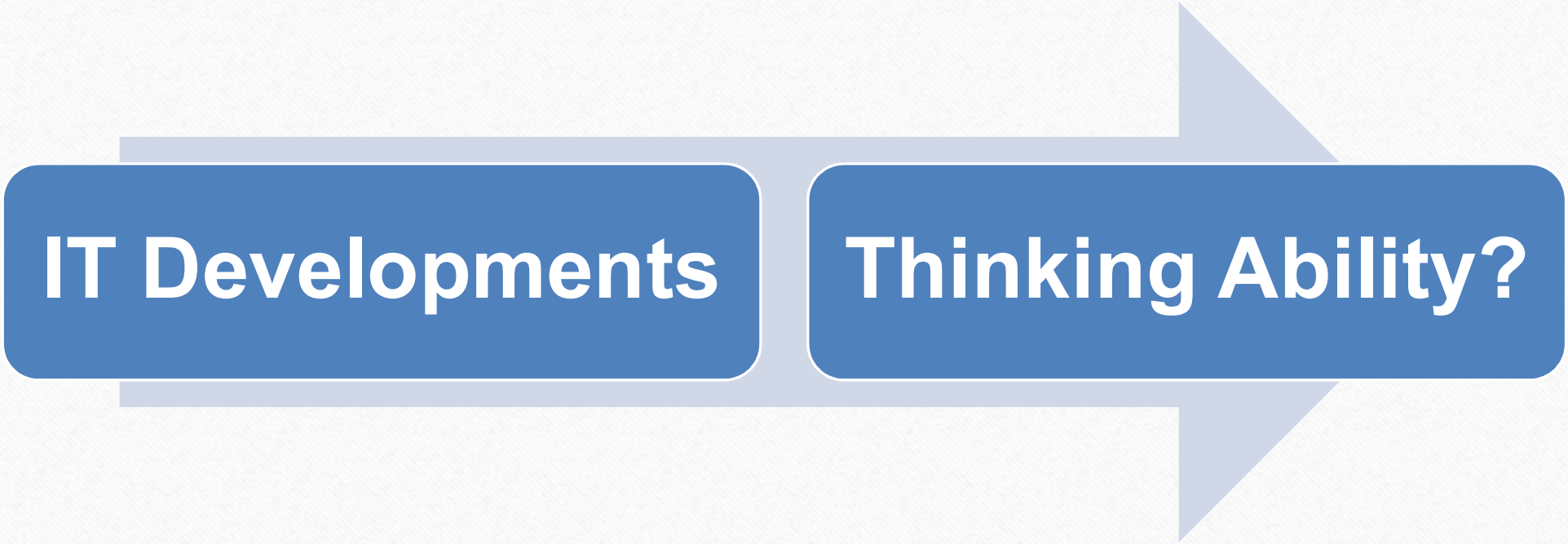
Ulaş İLİC

Yavuz AKBULUT

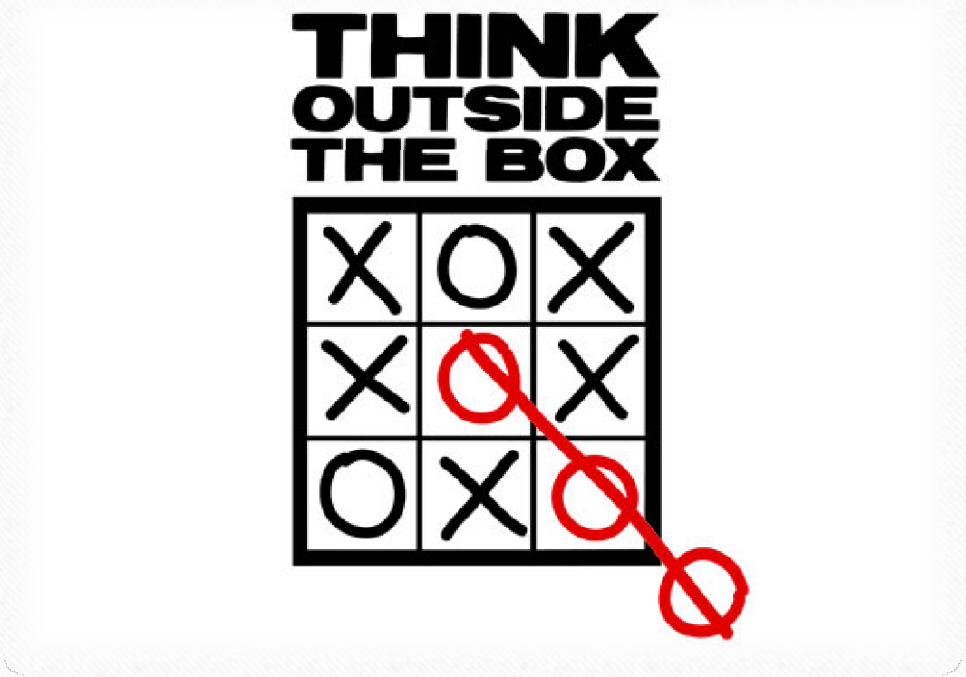
International Conference The Future of Education

This study is the summary of the first author's PhD dissertation, which is supervised by the second author and financially supported by Anadolu University (Grant ID: 1609E617).

Introduction

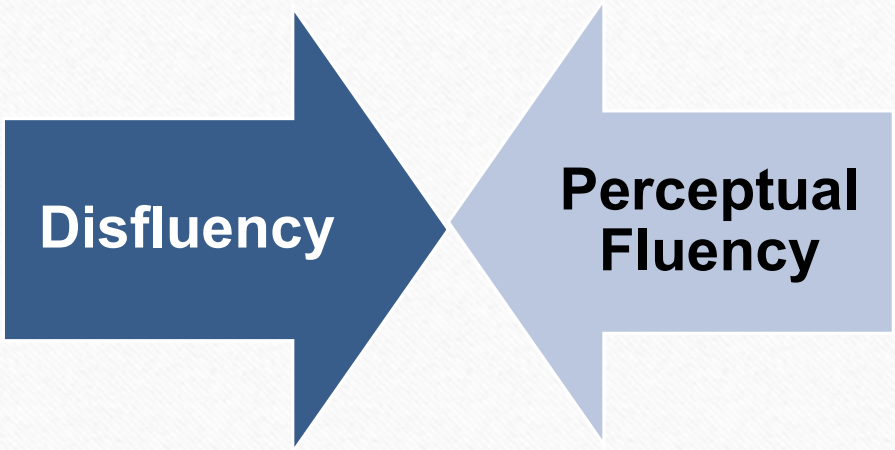


Introduction



- Going beyond the usual teaching patterns is useful.
- Making the material slightly difficult for learning is useful for retention.
- Accelerating performance is a failure in terms of retention, but difficulties to slow down learning are fruitful.

Fluency vs. Disfluency



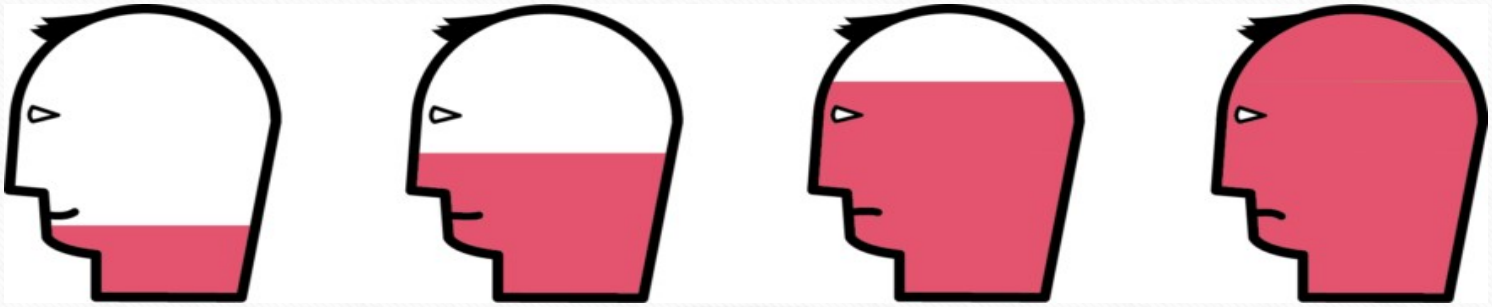
- Fluency: is a metacognitive experience that reflects the ease or difficulty experienced by an individual in performing a cognitive task.

- Disfluency: is subjective and metacognitive difficulties experienced while performing cognitive tasks.


SHOE STORE
SHOULD I BUY THEM?
SYSTEM 1 SAYS YES
BUT SYSTEM 2 SAYS NO...
(BIG SIGH)

Cognitive Load Theory of Multimedia Learning

- Cognitive Load: A stress or tension in the working memory due to the cognitive processes required by a learning task.
- Cognitive Load Theory: How can limited working memory capacity be used more efficiently for effective instruction?

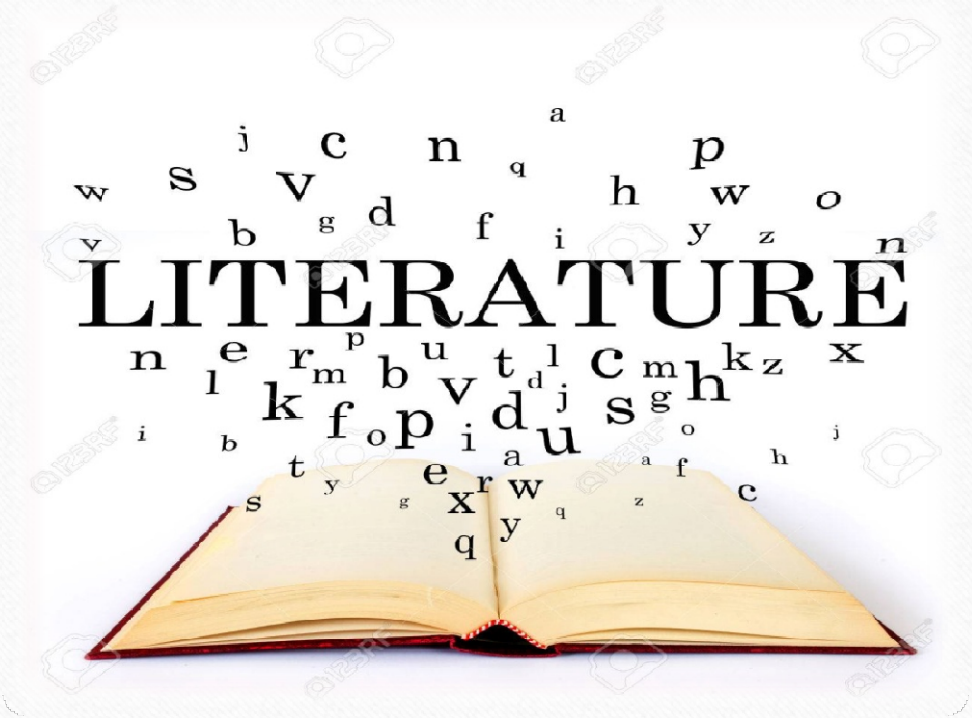


Metacognition

• Metacognitive judgements are decisions that reflect the process of monitoring, which is the end result of the individual's monitoring their own cognitive activities.

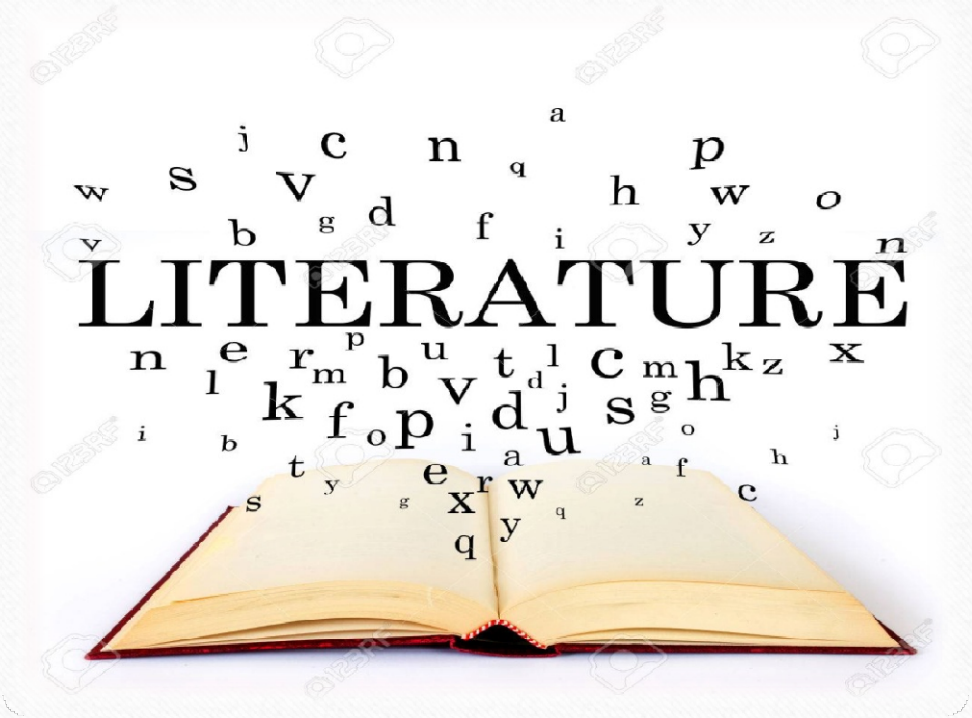
- Ease Of Learning (EOL)
- Judgements Of Learning (JOL)

Literature



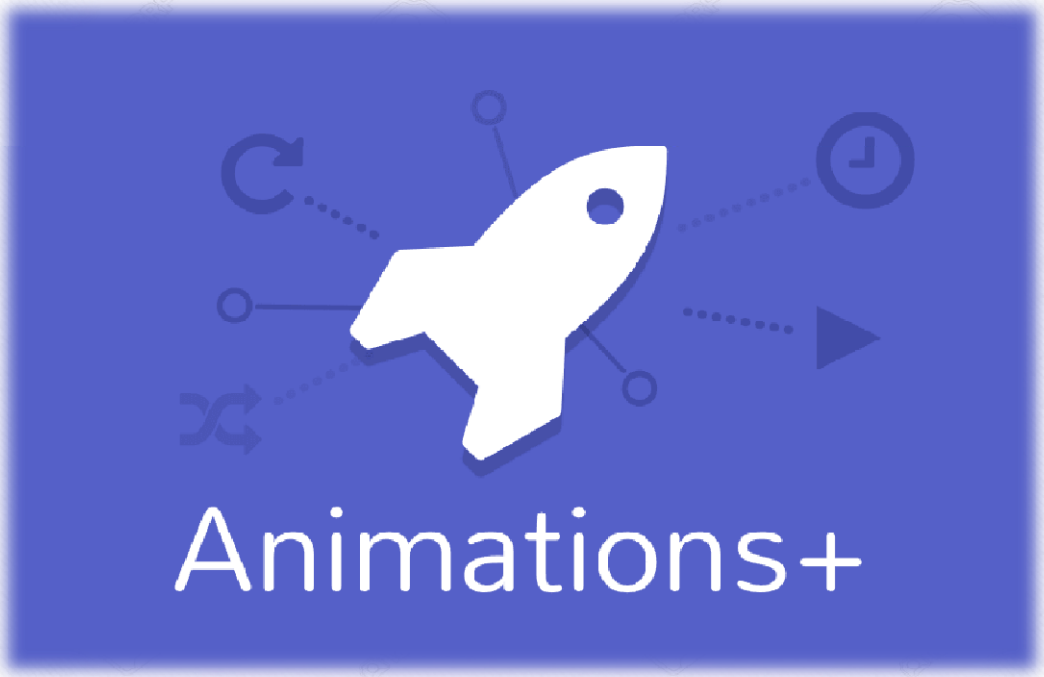
- No effect on learning outcomes
- Positive effects under certain conditions
- New studies are needed

Interventions



- Applied to the whole text or not applied at all
- Fluent + Disfluent (word lists)
- Longer materials are needed.
- Attracting attention to important parts of the material is fruitful.
- Fluent + Disfluent

Role of Animations



- Picture + text
- It is cognitively useful to include pictures in material even for a short period of time.
- Animations contribute to the learning when it is applied in accordance with the cognitive theory of learning with multimedia.

Metacognitive Judgements

- JOLs are lower in disfluent groups.
- Has an effect on JOLs.
- Has an effect on EOLs.

Cognitive Load

- Lack of objective measurements
- Use of subjective measurements
- Perceived difficulty and material difficulty
- Emphasis on the importance of objective measurements in studies
- The need for research into the relationship between perceived difficulty and actual difficulty

Purpose

To investigate the effect of fluency-related interventions on learning outcomes, metacognitive judgements and cognitive load

Research Questions

- Is there a significant difference between groups in terms of;
  - achievement, recall, and comprehension?
  - EOL and JOL?
  - subjective and objective cognitive load?
- How is the relationship between learning outcomes and cognitive load?

Importance

- Providing fluent and disfluent text types on the same screen
- Including animations in addition to text
- The emphasis on the objective cognitive load
- Providing teaching and material design implications

Method

Group	Pre-Tests	Process	Post-Tests
Fluent-Fluent (FF) (Control)	- Achievement Test for Prior Knowledge - Text Manipulation Check (For 3,4,5 and 6th scenarios) - Animation Manipulation Check (For 2,4 and 5th scenarios) - Working Memory Capacity Test - EOL	Application in computer assisted environment	- CL Test - Extraneous CL Test - JOL - Off-Topic Activity - Recall Test - Comprehension Test - Achievement Test
Fluent-Disfuent (FD)			
Mixed-Fluent (MF)			
Mixed-Disfuent (MD)			
Disfuent-Disfuent (DD)			
Disfuent-Fluent (DF)			

Participants

Department of	f	%
English Language Teaching	58	18.5
Computer Education and Instructional Technology	58	18.5
Primary School Mathematics Teaching	52	16.6
Social Studies Education	46	14.6
Special Education	39	12.4
Primary School Education	32	10.2
Guidance and Physhological Counseling	20	6.4
French Language Teaching	8	2.5
Arts and Crafts in Education	1	0.3

Analysis of Data

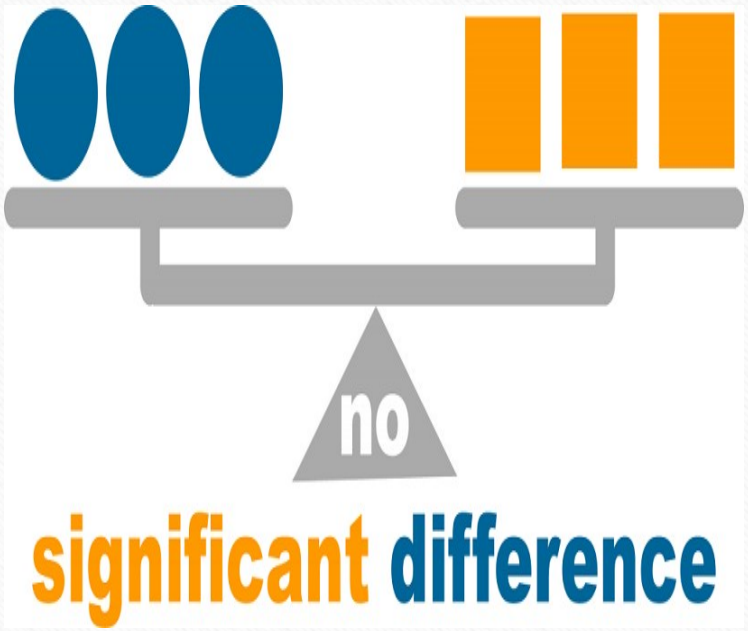
Sub problem	Type of Analysis
Difference between achievement, recall, and comprehension?	One-way MANCOVA
Difference between EOL and JOL?	One-way ANCOVA
Difference between subjective and objective cognitive load?	One-way ANOVA
Relationship between learning outcomes and cognitive load?	Correlation

Descriptive Findings

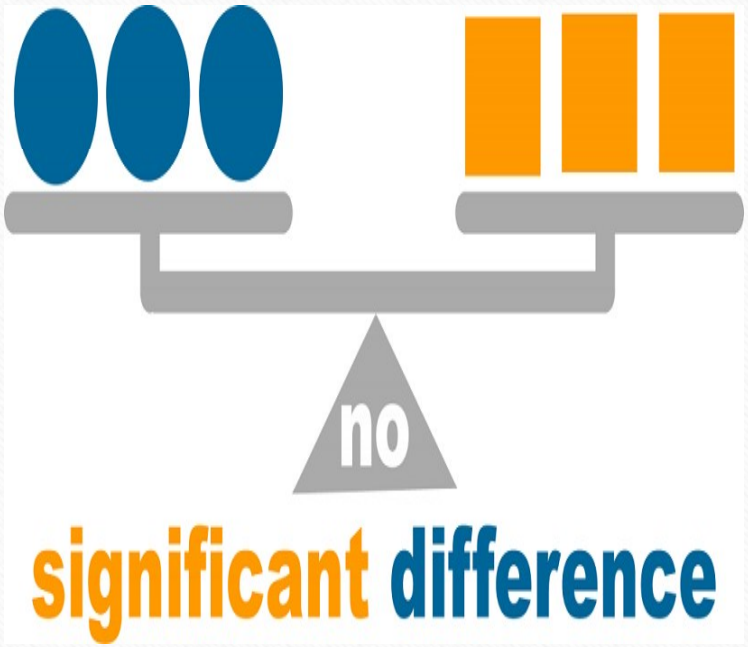
Font Type	f	%
Haettenschweiler	200	96.6
Monotypecorsiva	3	1.4
Comic Sans MS	4	1.9
Total	207	100.0

Manipulation Type	f	%
Squirelleblur	72	45.0
Amplush	88	55.0
Total	160	100.0

Learning Outcomes



Metacognitive Judgements



Cognitive Load

- ✓ Extraneous CL
- ❑ CL
- ❑ Secondary Task Performance
- ❑ Total Animations Watched

Relationship between Learning Outcomes and Cognitive Load

		Cognitive Load	Total Animations Watched
Total Animations Watched	**r**	.252**	-
	p	0	
	n	314	
Achievement Test	**r**	.248**	.209**
	p	0	0
	n	314	314
Recall Test	**r**	.308**	.332**
	p	0	0
	n	314	314
Comprehension Test	**r**	.195**	.122*
	p	0.001	0.031
	n	314	314

Suggestions

- Disfluency should not be used in learning environments that contain animations where the texts will appear as subtitles.
- Consideration of different issues
- Practice of developed material in learning environments
- Regression models
- Eye tracking and EEG
- Transfer tests


International Conference
THANKS
The
Future
of Education