Analytics of Temporal Patterns of Self-regulated Learners: A Time Series Approach

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Outlines

- Overview of Study.
- Research Gaps.
- Research Questions.
- Methodology.
- Main Findings.
- Discussion.
- Limitations and Future Work.
- Questions.

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Temporality in SRL

- What are temporal dimensions?

  1) Sequentiality, 2) Passage of time [6].

- Why should we study SRL as temporal processes?

  SRL processes are dynamic and change frequently.

- Time-series objective in relation to SRL.

  To comprehend and monitor dynamic changes.

- Analytical approaches to studying temporal patterns.

  Example: First-Order Markov Model (FOMM) [8].

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Research gaps

- Prior research contributions.

  Examined process transitions, frequencies, and durations [6, 8].

- Existing gaps.

  1) Handling both temporal dimensions from a time-series perspective.

  2) Shortage of research on detecting SRL strategies based on temporality.

- How do we intend to fill this gap?

  By employing a time-series approach to detect meaningful strategies.

Research questions

RQ1: What are the learning strategies, and what are the temporal sequences of those strategies, that students enact as they engage in a learning task?

RQ2: To what extent are the learning strategies that learners enact during a task associated with their achievement?

Methodology

- Participants.

  134 undergraduate students.

- Study Context.

  Writing an essay using multiple sources using FloRA.

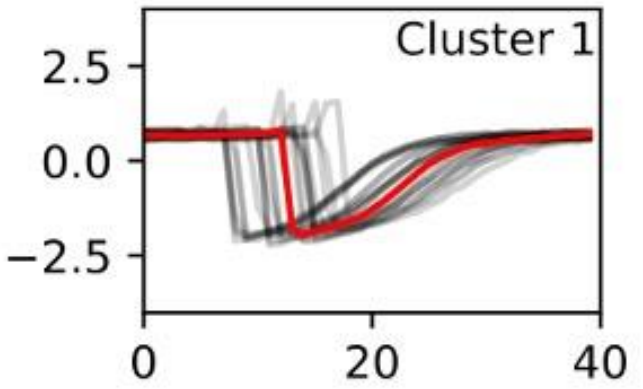
- Trace Data Measurement.

  Converting the raw trace data into meaningful actions following [2].

- Data Analysis

  RQ1: Dynamic Time Warping (DTW) technique.

  RQ2: ANOVA, ANCOVA.



An example of DTW clustering [3].

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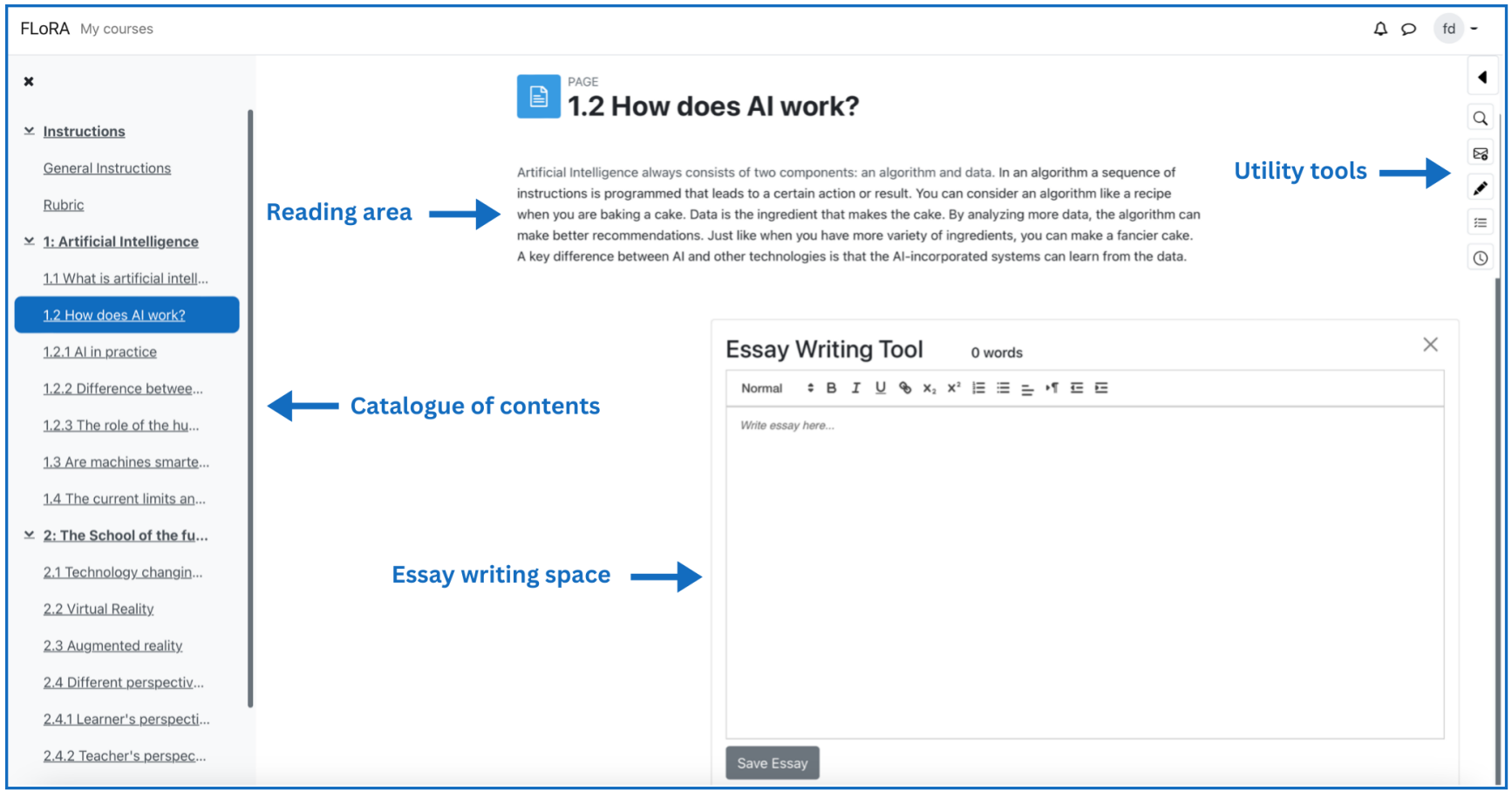
Cont. Methodology

- The learning environment.



Cont. Methodology

- The adopted trace data parser [2].

Action patterns

event	time	raw log	mouse coordinates	Action label	Action pattern
1	41:09.3	Start learning environment experiment		GENERAL_INSTRUCTION	GENERAL_INSTRUCTION* /RUBRIC* -> NAVIGATION -> RELEVANT_READING
2	41:09.3	screen_mouse_click	X: 965, Y coords: 372	GENERAL_INSTRUCTION	
3	42:58.8	scroll_contentpage_16		GENERAL_INSTRUCTION	
4	43:34.8	screen_mouse_click	X: 132, Y coords: 78	NAVIGATION	
5	43:44.6	nav_content_1.1		RELEVANT_READING	
6	43:44.6	screen_mouse_click	X: 149, Y coords: 115	RELEVANT_READING	

Mapping

Regular Expression example for this action pattern:
((GENERAL_INSTRUCTION)|(RUBRIC))*(NAVIGATION)(RELEVANT_READING)

SRL processes

event	time	raw log	mouse coordinates	Action label	Action pattern	SRL process
1	41:09.3	Start learning environment experiment		GENERAL_INSTRUCTION	GENERAL_INSTRUCTION* /RUBRIC* -> NAVIGATION -> RELEVANT_READING	MC.O.1 (Orientation)
2	41:09.3	screen_mouse_click	X: 965, Y coords: 372	GENERAL_INSTRUCTION		
3	42:58.8	scroll_contentpage_16		GENERAL_INSTRUCTION		
4	43:34.8	screen_mouse_click	X: 132, Y coords: 78	NAVIGATION		
5	43:44.6	nav_content_1.1		RELEVANT_READING		
6	43:44.6	screen_mouse_click	X: 149, Y coords: 115	RELEVANT_READING		

Results

- **RQ1:** We detected five meaningful SRL strategies.

Based on metacognitive and cognitive temporal engagement.

The detected SRL strategies:

Cluster 1 -- Incremental Metacognitive Engagement.

Cluster 2 -- Transitional Cognitive Engagement.

Cluster 3 -- Inactive Metacognitive and Occasional Cognitive Engagement.

Cluster 4 -- High Cognitive Engagement.

Cluster 5 -- Consistent Cognitive Engagement.

The plots are available here link.

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Cont. Results

- **RQ2:** Examined the association between clusters and scores.

- No statistically significant association was found (p-value = 0.514).
- CET6 English test scores had a statistically significant effect on scores (p-value = 0.005).

	coef	std err	t	P > | t |
Intercept	4.6123	3.351	1.376	0.172
C(Q("Cluster No")) [T.2]	0.3031	1.081	0.280	0.780
C(Q("Cluster No")) [T.3]	-0.4434	1.166	-0.380	0.705
C(Q("Cluster No")) [T.4]	0.5606	1.253	0.447	0.656
C(Q("Cluster No")) [T.5]	0.6865	1.135	0.605	0.547
Q("English CET6")	0.0170	0.006	2.849	0.005

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Discussion

- **Providing empirical evidence via a time-series approach.**

Detecting meaningful strategies using temporal patterns of SRL.

- **Our findings aligning with prior studies.**

Example: Students engaged more with cognitive processes to maximize learning [5].

- **Applying multiple techniques provided deeper insights.**

Example: Dividing learners into groups (e.g., high and low) offers deeper understanding.

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Limitations and future work

- The language proficiency can lead to varying outcomes.

  Replicate this study with recruiting native speakers to compare findings.

- Other factors may impact the detected SRL strategies.

  Investigate how factors such as motivation impact SRL temporality.

- The implemented time-series approach could be further enhanced.

  By adding adding input features for finer-grained analysis.

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Questions

Thank you for your attendance.