Searching as a Learning Process – What am I looking for?

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Beijing Normal University, China

Everybody who is here attending this talk in person and those watching online.

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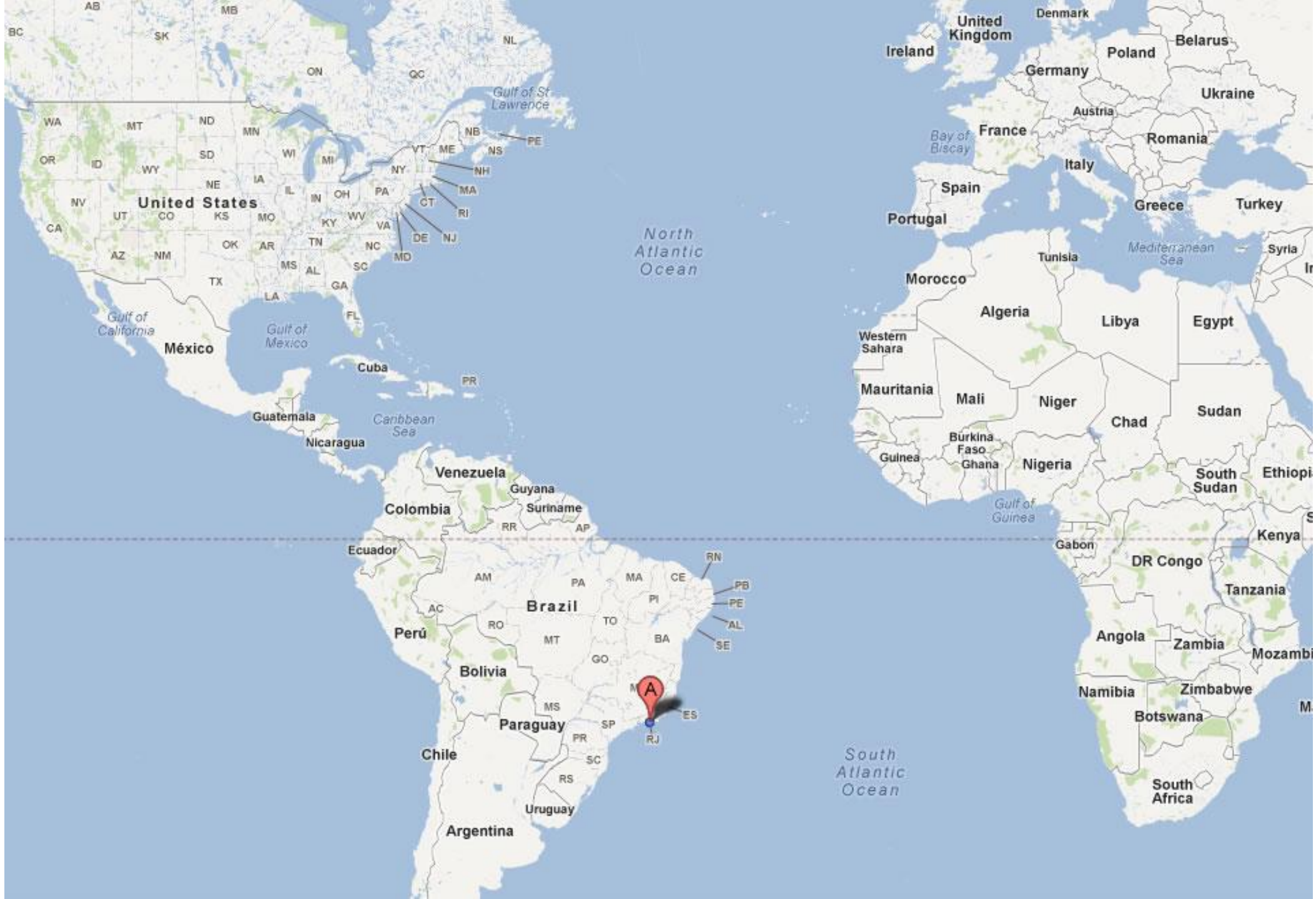
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North Atlantic Ocean
South Atlantic Ocean
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Mediterranean Sea
Gulf of Guinea
Venezuela
Guyana
Suriname
Colombia
Ecuador
Perú
Brazil
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Chile
Uruguay
Argentina
Ireland
United Kingdom
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Algeria
Libya
Egypt
Western Sahara
Mauritania
Mali
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Chad
Sudan
Burkina Faso
Guinea
Ghana
Nigeria
South Sudan
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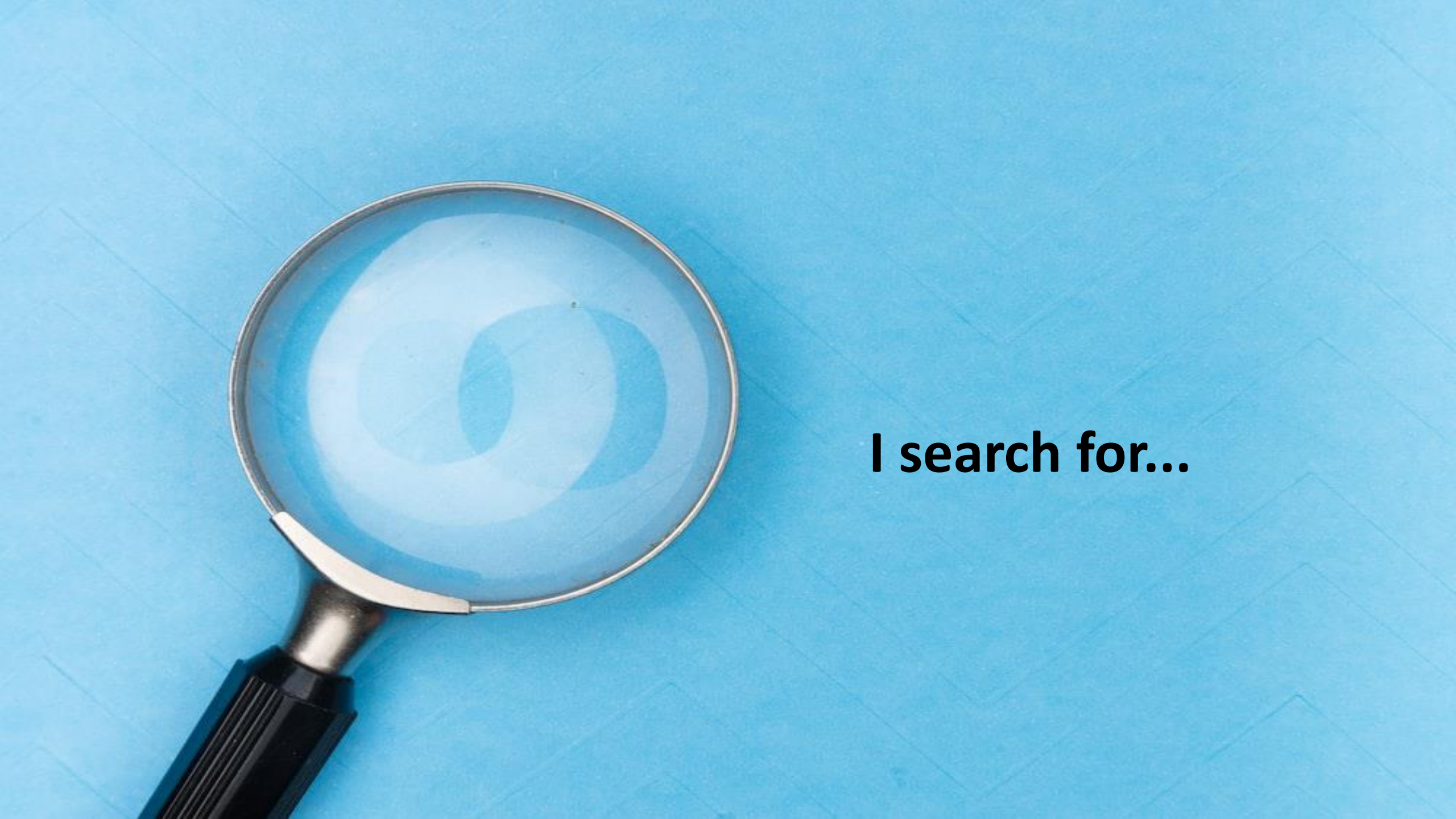
UNIRIO

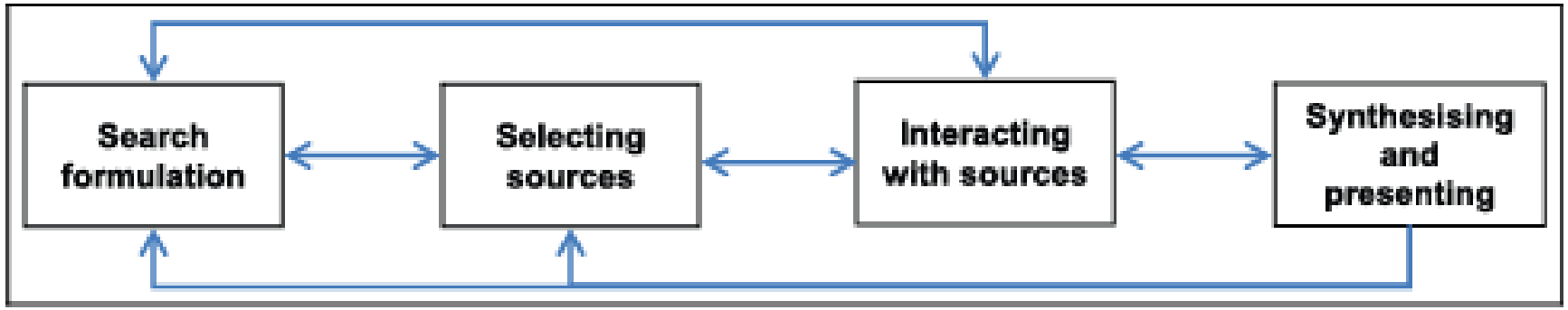
What do you do when you don’t know something?


I search for...

Find the information, solve the problem


LEARN
WESTCOTT
TAZO

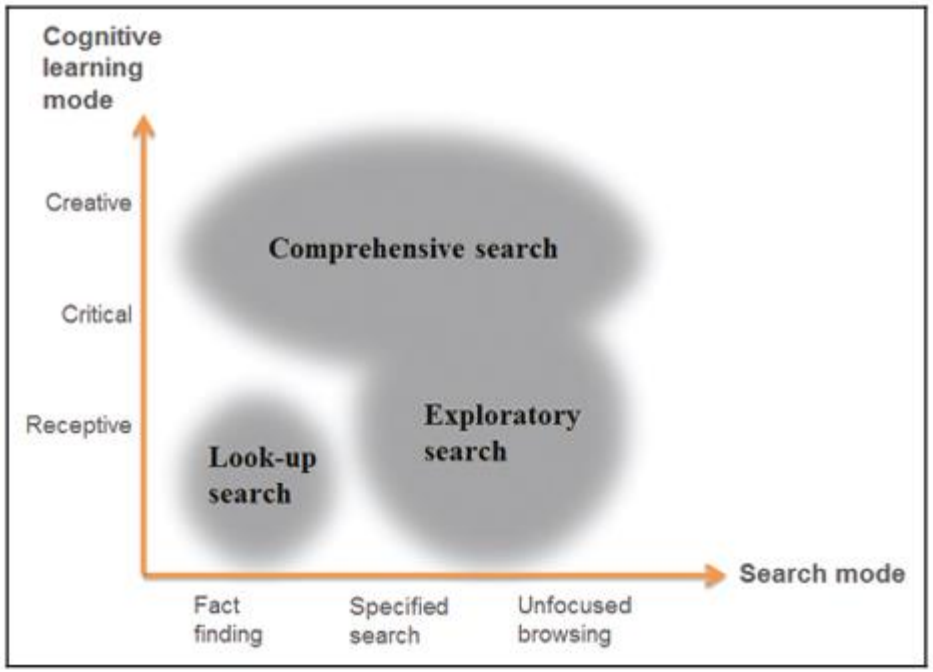
Searching as Learning



Vakkari, Pertti. "Searching as learning: A systematization based on literature." *Journal of Information Science* 42, no. 1 (2016): 7-18.

Search stage	Modification of knowledge structures Restructuring	Tuning	Assimilation
Search formulation	Few general terms	Increase in the number and specificity of terms	Increase in number and specificity of terms
	Many new terms from results	Increase in the number of terms	Fewer new terms from results
Source selection	Varying tactics Much reformulatio A few synonyms Long search sessio Vague relevance cri Number of result p is large Number of source large Share of selected s consulted sources i Share of probably r		

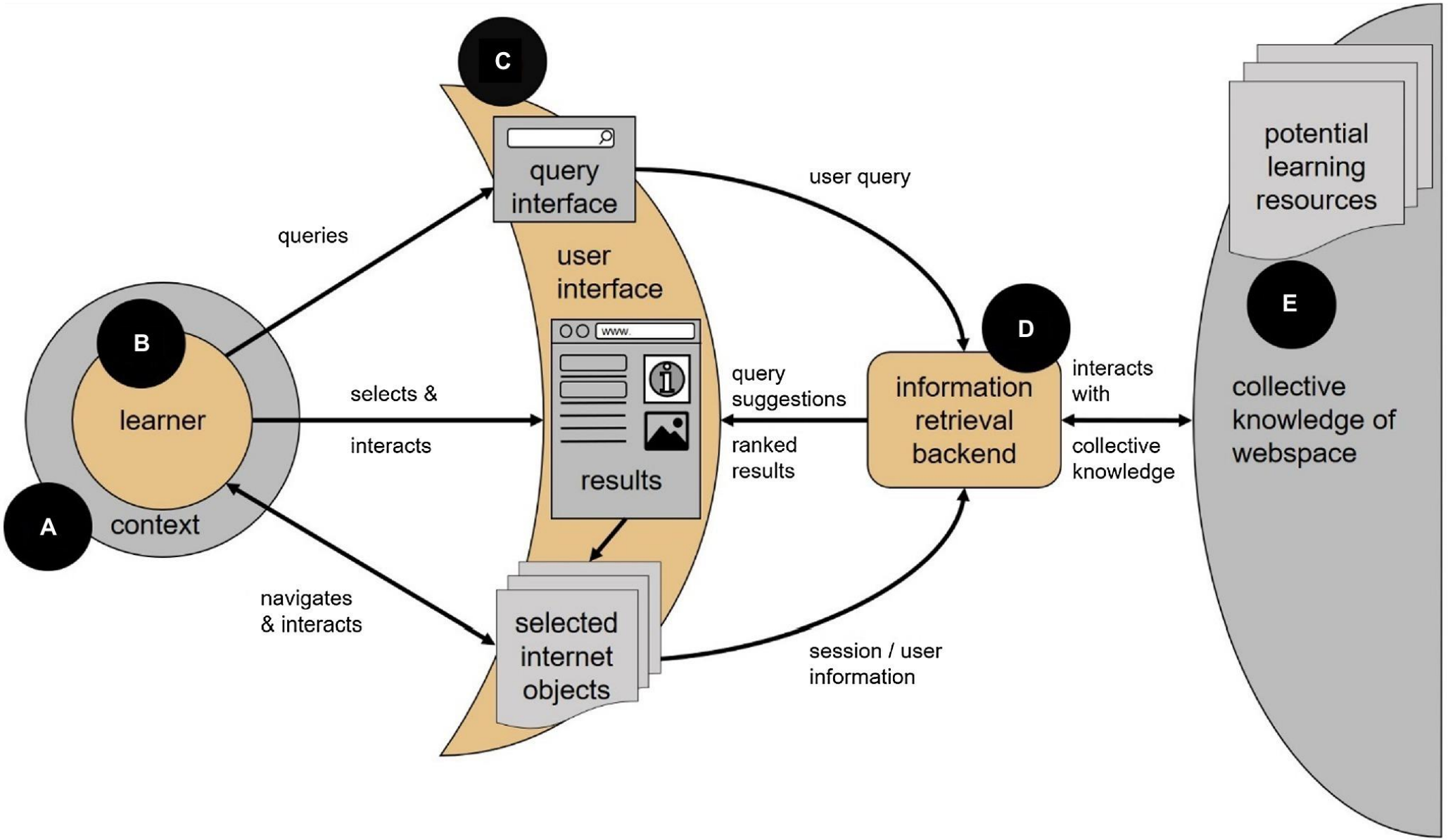
Search stage	Criteria of learning (and search success)
Search formulation	Increase in number and specificity of terms
	Increase in number of terms with associative relations (facets)
	Increase in number of synonyms
	Decrease in number of reformulated queries
	Decrease in variability of tactics
	Decreased time use per search sessions
Source selection	Increased clarity in relevance criteria = increased ability to distinguish between relevant and non-relevant sources
	Decrease in number of sources viewed in result list
	The proportion of sources selected of sources viewed decreases (greater decrease in precision, increase in CG)
	The number of sources selected decreases
	The share of probably relevant sources decreases, and that of relevant sources increases for all sources selected
	The proportion of general background information and theoretical information decreases



Rieh, Soo Young, Kevyn Collins-Thompson, Preben Hansen, and Hye-Jung Lee. "Towards searching as a learning process: A review of current perspectives and future directions." *Journal of Information Science* 42, no. 1 (2016): 19-34.

Cognitive learning mode	Bloom's cognitive learning taxonomy	Learning behaviour	Search behaviour
Receptive	remembering, understanding	recalling, presenting, identifying, matching, labelling, comprehending, demonstrating	known-item searching, specifying, modifying, obtaining, selecting, acquiring, judging relevance
Critical	applying, analysing, evaluating	separating, sorting, critiquing, distinguishing, contrasting, defending, attributing, probing, aggregating, integrating, synthesizing	evaluating usefulness, assessing credibility, comparing, extracting, differentiating
Creative	creating	hypothesizing, designing, discovering, planning, producing, generating, forecasting, inventing, composing, revising, building	prioritizing, sense-making

Column 1 from Lee et al. [49] and column 2 from Bloom and Krathwohl [50].



von Hoyer, Johannes, Anett Hoppe, Yvonne Kammerer, Christian Otto, Georg Pardi, Markus Rokicki, Ran Yu, Stefan Dietze, Ralph Ewerth, and Peter Holtz. "The search as learning spaceship: Toward a comprehensive model of psychological and technological facets of search as learning." *Frontiers in Psychology* 13 (2022): 827748.


Searching as Learning

Searching

User intent

Concept, learning

Type of content

Text, video, iot, code…

Methods

Systematic, databases

Information Retrieval

Indexing, storing, ranking, optimizing

User satisfaction

Leaves, access a link

Algorithms

Linear, binary, hashing, pagerank,

Techniques

phrasing, wildcards & boolean operators
basic, advanced, key word, subject, truncation, boolean

User Behavior

Interaction, search knowledge, domain knowledge

Models

Boolean, vector space, probabilistic

Searching as Learning

Student role

Teacher role

Knowledge

Content

Learning

Pedagogical intentionality

Teaching method

Mediation

Formative experience

Learning situations

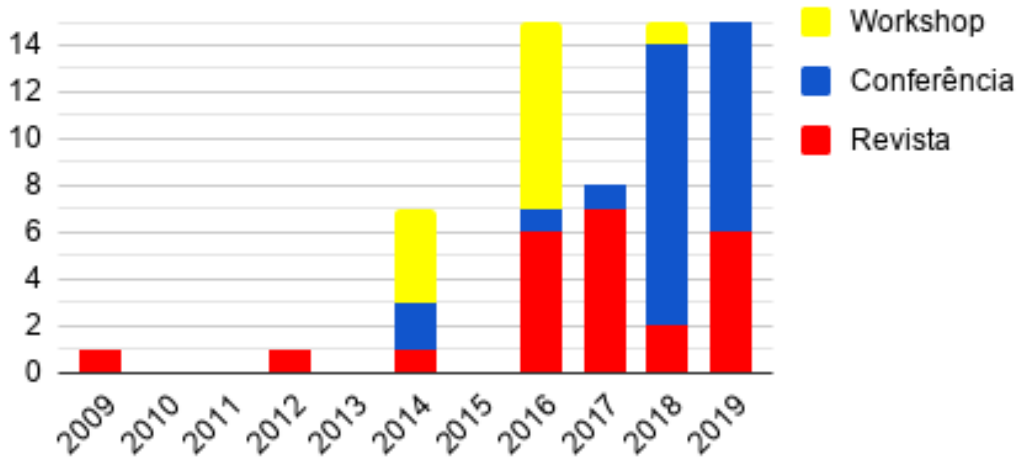
Social relation

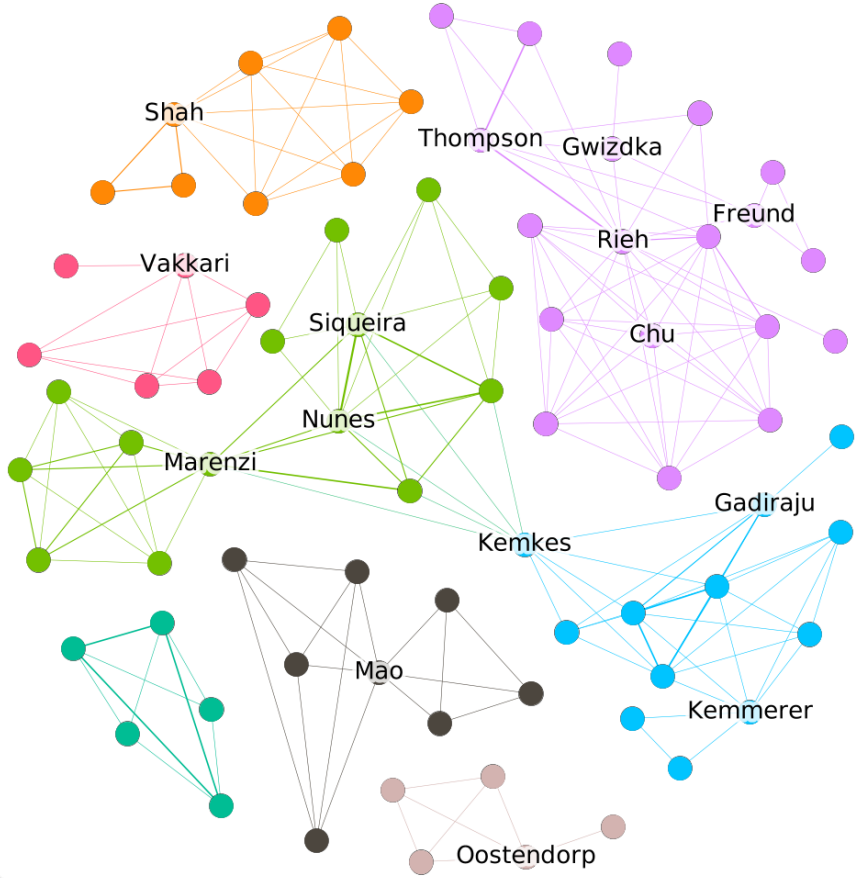
Technological resources

Assessment & evaluation

Searching as Learning

Mapping SAL





Machado, M., Pinelli, C. and Siqueira, S., 2019, November. A evolução da área de busca como um processo de aprendizagem com base em um mapeamento sistemático. In *Anais dos Workshops do Congresso Brasileiro de Informática na Educação,* v. 8, p. 833). http://dx.doi.org/10.5753/cbie.wcbie.2019.833

learning paradigms

LP	Studies
Behaviorist	(Lu and Hsiao, 2017), (Zhuang et al., 2016), (Mao et al., 2016), (Moraes et al., 2018), (Wilson and Wilson, 2013)
Cognitivist	(Kodama et al., 2017), (Moraes et al., 2018), (Taibi et al., 2017), (Wilson et al., 2016), (Syed and Collins-Thompson, 2016), (Bhattacharya and Gwizdka, 2019), (Al-Tawil et al., 2019), (Azpiazu et al., 2017), (Crescenzi, 2016), (Han et al., 2019), (Liu and Song, 2018), (Johnson, 2018), (Jansen et al., 2007), (Smith and Rieh, 2019)
Constructivist	(Ghosh et al., 2018), (Tibau et al., 2018b), (Freund et al., 2016), (Komlodi and Caidi, 2016), (Weingart and Eickhoff, 2016), (Tibau et al., 2018a), (Yu et al., 2018b), (Al-Tawil et al., 2019) (Ibieta et al., 2019), (Zapata et al., 2015), (Zhang, 2017), (Meyers, 2018), (Cho et al., 2017), (Vakkari et al., 2019), (Ibieta et al., 2019)

Gimenez, P.J.A., Machado, M.D.O.C., Pinelli, C.P. and Siqueira, S.W.M., 2020. Investigating the learning perspective of Searching as Learning, a review of the state of the art. *In XXXI Simpósio Brasileiro de Informática na Educação*, pp.302-311. http://dx.doi.org/10.5753/cbie.sbie.2020.302

mechanisms that influence the learning process

MILP	Studies
Reinforcements	(Zapata et al., 2015)
Rewards	(Taibi et al., 2017), (Gadiraju, 2018), (Zhuang et al., 2016), (Yu et al., 2018a), (Gadiraju et al., 2018)
Evaluation	(Rieh et al., 2012), (Tibau et al., 2018b), (Liu and Song, 2018), (Johnson, 2018), (Smith and Rieh, 2019), (Wilson and Wilson, 2013), (Vakkari et al., 2019)
Assistance or guidance	(Han et al., 2019), (Hinostroza et al., 2018), (Cho et al., 2017), (Moraes et al., 2018), (Ibieta et al., 2019)

sessions designed for learning

SDL	Studies
Controlled Session	(Kodama et al., 2017), (Freund et al., 2016), (Azpiazu et al., 2017), (Gadiraju, 2018), (Komlodi and Caidi, 2016), (Mao et al., 2016), (Weingart and Eickhoff, 2016), (Bhattacharya and Gwizdka, 2019) (Han et al., 2019), (Hinostroza et al., 2018), (Gadiraju et al., 2018), (Gadiraju et al., 2018), (Cho et al., 2017), (Wilson and Wilson, 2013), (Ibieta et al., 2019)
Not Controlled Session	(Han et al., 2019), (Johnson, 2018), (Vakkari et al., 2019)
Individual Session	(Han et al., 2019), (Meyers, 2018), (Gadiraju et al., 2018), (Gadiraju et al., 2018), (Cho et al., 2017), (Wilson and Wilson, 2013), (Vakkari et al., 2019), (Ibieta et al., 2019)
Group Session	(Meyers, 2018), (Moraes et al., 2018)
Community-centered	(Liu and Song, 2018)
Knowledge-centric	(Yu et al., 2018a), (Tibau et al., 2018b), (Zapata et al., 2015), (Gadiraju et al., 2018), (Smith and Rieh, 2019), (Wilson and Wilson, 2013)
Student-centric	(Han et al., 2019), (Meyers, 2018), (Gadiraju et al., 2018), (Moraes et al., 2018), (Vakkari et al., 2019), (Ibieta et al., 2019)
Overlapping (mixed)	(Jansen et al., 2007), (Cho et al., 2017)

measurement records of learning

MRL	Studies
Pre and post-tests	(Rieh et al., 2012), (Meyers, 2018), (Gadiraju et al., 2018), (Cho et al., 2017)
Assisted Process	(Johnson, 2018), (Hinostroza et al., 2018), (Vakkari et al., 2019), (Ibieta et al., 2019)
Knowledge base	(Yu et al., 2018a), (Tibau et al., 2018b), (Liu and Song, 2018), (Gadiraju et al., 2018)
Ontologies or taxonomies	(Jansen et al., 2007), (Moraes et al., 2018), (Wilson and Wilson, 2013)
Cognition or mind models	(Han et al., 2019), (Smith and Rieh, 2019)

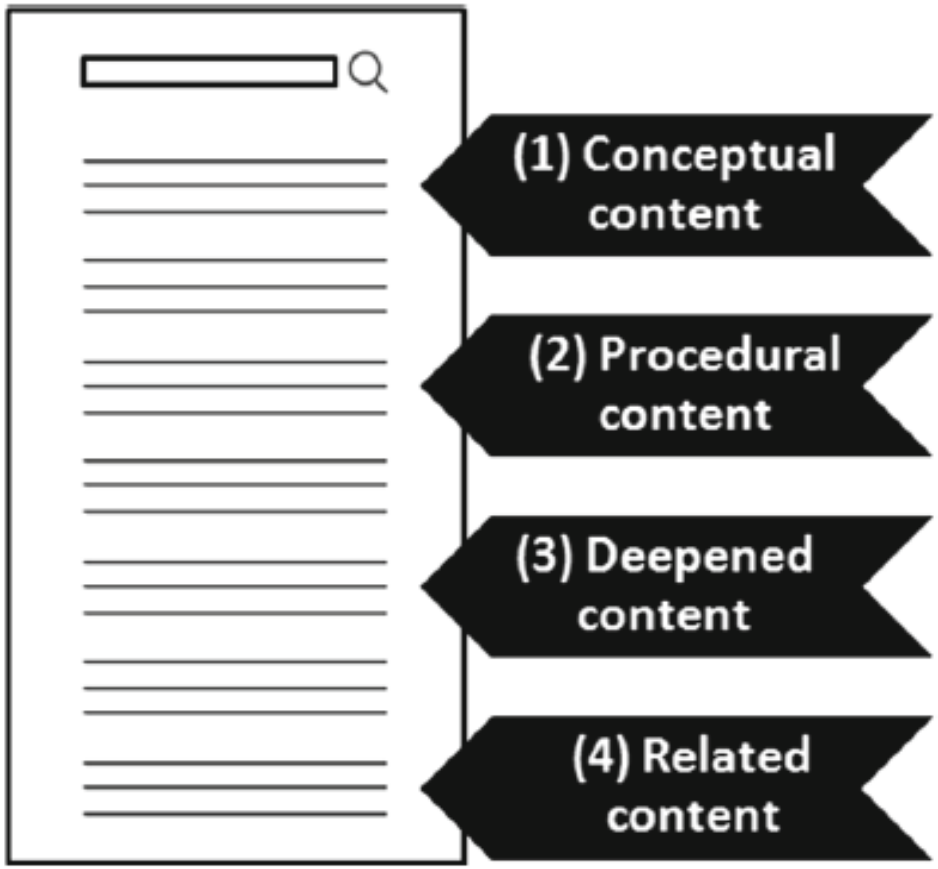
Table 1. Classification of the selected studies according to the variables involved in SAL processes.

Dimension	Variables	Papers
User Dimension	PK	(Lu and Hsiao, 2017), (Taibi et al., 2017), (Syed and Collins-Thompson, 2018), (Syed and Collins-Thompson, 2016), (Jansen et al., 2009), (Yu et al., 2018), (Al-Tawil et al., 2019), (Rieh et al., 2012), (Sendurur et al., 2019) (Tibau et al., 2018), (Azpiazu et al., 2017), (Karanam and van Oostendorp, 2016), (Wilson et al., 2016), (Crescenzi, 2016), (Mao et al., 2016), (Bhattacharya and Gwizdka, 2019), (Ibieta et al., 2019), (Biletskiy et al., 2009), (Pereira et al., 2019)
	DI	(Taibi et al., 2017), (Azpiazu et al., 2017), (Ibieta et al., 2019), (Yilmaz et al., 2019), (Biletskiy et al., 2009), (Lu and Hsiao, 2017), (Moraes et al., 2018)
Interaction Dimension	ESA	(Tibau et al., 2018), (Lu and Hsiao, 2017), (Moraes et al., 2018), (Ghosh et al., 2018), (Bhattacharya and Gwizdka, 2019), (Yu et al., 2018), (Ibieta et al., 2019), (Vakkari et al., 2019), (Biletskiy et al., 2009)
	AV	(Bhattacharya and Gwizdka, 2019), (Yu et al., 2018), (Rieh et al., 2012), (Karanam and van Oostendorp, 2016), (Ibieta et al., 2019), (Vakkari et al., 2019), (Wilson and Wilson, 2013), (Maxwell et al., 2019)
	SEF	(Azpiazu et al., 2017), (Syed and Collins-Thompson, 2016), (Weingart and Eickhoff, 2016), (Ibieta et al., 2019)
Knowledge Domain Dimension	KDR	(Taibi et al., 2017), (Al-Tawil et al., 2019), (Biletskiy et al., 2009), (Syed and Collins-Thompson, 2018), (Ibieta et al., 2019), (Ghosh et al., 2018), (Karanam and van Oostendorp, 2016), (Vakkari et al., 2019), (Tibau et al., 2019a), (Tolmachova et al., 2019)
	RCL	(Ghosh et al., 2018), (Syed and Collins-Thompson, 2018), (Syed and Collins-Thompson, 2016), (Smith and Rieh, 2019), (Yu et al., 2018), (Al-Tawil et al., 2019), (Pereira et al., 2019)
	RF	(Syed and Collins-Thompson, 2018), (Biletskiy et al., 2009), (Moraes et al., 2018), (Taibi et al., 2017), (Ghosh et al., 2018), (Weingart and Eickhoff, 2016), (Vakkari et al., 2019), (Wilson and Wilson, 2013), (Shi et al., 2019), (Fails et al., 2019)

Machado, M.D.O.C., Gimenez, P.J.A. and Siqueira, S.W.M., 2020, November. Raising the dimensions and variables for searching as a learning process: a systematic mapping of the literature. In *Anais do XXXI Simpósio Brasileiro de Informática na Educação* (pp. 1393-1402). SBC. http://dx.doi.org/10.5753/cbie.sbie.2020.1393

- PK: User Prior Knowledge
- DI: Demographic Information
- ESA: Exploratory Search Activities
- AV: Activities Variables
- SEF: Search Engine Feedback
- KDR: Knowledge Domain Representation
- RCL: Resource Cognitive Level
- RF: Resource Features

Grouping and Reordering Search Results



Representation of relevance criteria embedded in a Search Engine Result Pages (SERP)

Survey exploring different scenarios (181 answers):

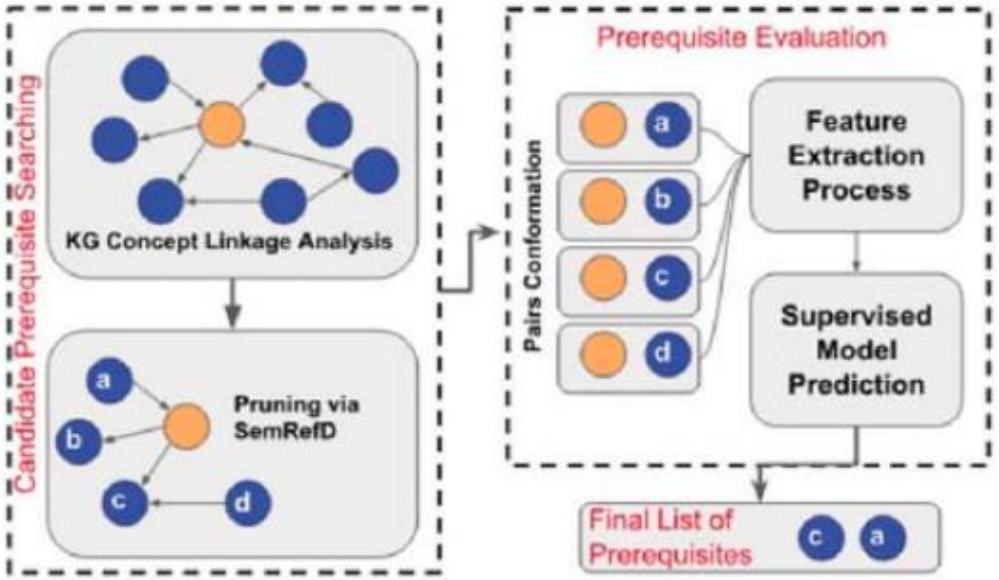
Pinelli, C., Tibau, M. and Siqueira, S., 2019, November. Google, se reordene e me ajude a aprender: Critérios de relevância para reordenar resultados de busca como um processo de aprendizagem. In *Brazilian Symposium on Computers in Education (Simpósio Brasileiro de Informática na Educaçao-SBIE)* (Vol. 30, No. 1, p. 576). http://dx.doi.org/10.5753/cbie.sbie.2019.576

Interviews with specialists exploring scenarios:

Teixeira, C.P., Tibau, M., Siqueira, S.W.M. and Nunes, B.P., 2020. Reordering search results to support learning. In *Emerging Technologies for Education: 4th International Symposium, SETE 2019, Held in Conjunction with ICWL 2019, Magdeburg, Germany, September 23–25, 2019, Revised Selected Papers 4* (pp. 361-369). Springer International Publishing. https://doi.org/10.1007/978-3-030-38778-5_39

Grouping and Reordering Search Results

1. Conceptual content
   - How to identify concepts?
   - What are the best sources?
2. Procedural content
   - How to present procedures/processes?
     - Learners prefer multimodal content, but tend towards video
3. Deeper content
   - How to capture the best sequence?
     - Information complexity
4. Related content



$$RefD(c_a, c_b) = \frac{\sum_{i=1}^{k} i(c_i, c_b)s(c_i, c_a)}{\sum_{i=1}^{k} s(c_i, c_b)} - \frac{\sum_{i=1}^{k} i(c_i, c_a)s(c_i, c_b)}{\sum_{i=1}^{k} s(c_i, c_b)} \quad (1)$$

$$HW(c_i, c_j) = \max_{cat_i \in A, cat_j \in B} taxsim(cat_i, cat_j) \quad (2)$$

$$taxsim(cat_i, cat_j) = \frac{\delta(root, cat_{lca})}{\delta(cat_i, cat_{lca}) + \delta(cat_j, cat_{lca}) + \delta(root, cat_{lca})}$$

$$NHW(c_i, c_j) = \sum_{n_c \in (LC_{c_i} \cup LC_{c_j})} \beta^{l_{c_i, n_c}} * \beta^{l_{c_j, n_c}} \quad (3)$$

$$JW(c_i, c_j) = HW(c_i, c_j) + NHW(c_i, c_j) \quad (4)$$

$$i(c_i, c_j) = \begin{cases} 0 & \text{if } c_j \notin LC_{c_i} \\ 1 & \text{if } c_j \in LC_{c_i} \end{cases} \quad (5)$$

TABLE III
RESULTS OF THE COMPLETE PROCESS FOR 15 TARGET CONCEPTS USING AS EVALUATION METRICS P (PRECISION), TP (TRUE POSITIVES), AND FP (FALSE POSITIVES).

		FP	TP	P
CM	$SemRefD_{HW} > 0.1$	**66**	99	0.600
	$SemRefD_{HW} > 0.2$	38	60	0.612
	$SemRefD_{HW} > 0.3$	4	8	0.667
	$SemRefD_{NHW} > 0.1$	21	**104**	0.832
	$SemRefD_{NHW} > 0.2$	10	52	0.839
	$SemRefD_{NHW} > 0.3$	2	24	**0.923**
	$SemRefD_{JW} > 0.1$	47	102	0.685
	$SemRefD_{JW} > 0.2$	20	59	0.747
	$SemRefD_{JW} > 0.3$	8	23	0.742
$LC\ (l_{max} = 1)$	$SemRefD_{HW} > 0.1$	**49**	74	0.602
	$SemRefD_{HW} > 0.2$	12	26	0.684
	$SemRefD_{HW} > 0.3$	4	10	0.714
	$SemRefD_{NHW} > 0.1$	14	**93**	0.869
	$SemRefD_{NHW} > 0.2$	8	51	0.864
	$SemRefD_{NHW} > 0.3$	2	26	**0.929**
	$SemRefD_{JW} > 0.1$	29	88	0.752
	$SemRefD_{JW} > 0.2$	16	47	0.746
	$SemRefD_{JW} > 0.3$	6	18	0.750
$LC\ (l_{max} = 2)$	$SemRefD_{HW} > 0.1$	**77**	102	0.570
	$SemRefD_{HW} > 0.2$	42	62	0.596
	$SemRefD_{HW} > 0.3$	10	16	0.615
	$SemRefD_{NHW} > 0.1$	26	**130**	0.833
	$SemRefD_{NHW} > 0.2$	13	65	0.833
	$SemRefD_{NHW} > 0.3$	2	26	**0.929**
	$SemRefD_{JW} > 0.1$	60	127	0.679
	$SemRefD_{JW} > 0.2$	27	82	0.752
	$SemRefD_{JW} > 0.3$	6	23	0.793

MANRIQUE, RUBEN ; PEREIRA, BERNARDO ; MARINO, OLGA ; CARDOZO, NICOLAS ; WOLFGAND, SEAN . Towards the Identification of Concept Prerequisites Via Knowledge Graphs. In: 2019 IEEE 19th International Conference on Advanced Learning Technologies (ICALT), 2019, Maceió. p. 332-336. http://dx.doi.org/10.1109/ICALT.2019.00101

Features related to complexity

Method: Knowledge Graph – DBpedia
Textual Corpus – Wikipedia article

Feature-based categorization

Graph-based features

- Number of elements
- Novelty
- Diversity/variety
- Uncertainty
- Ambiguity
- ...

Information variety

Step I: We created a Wikipedia Category Graph

Step II: We extracted concepts from Wikipedia articles (https://en.wikipedia.org/wiki/Apartheid)

Step III – For each concept in a Wikipedia article, we obtained the shortest paths between the article categories and the top categories of the graph

Step IV: A document representation of the categorization of concepts is generated

Calculation of the coefficient of variation

Uncertainty

Step I: Extraction of concepts – Wikipedia article

Step II: Extraction of concepts categories

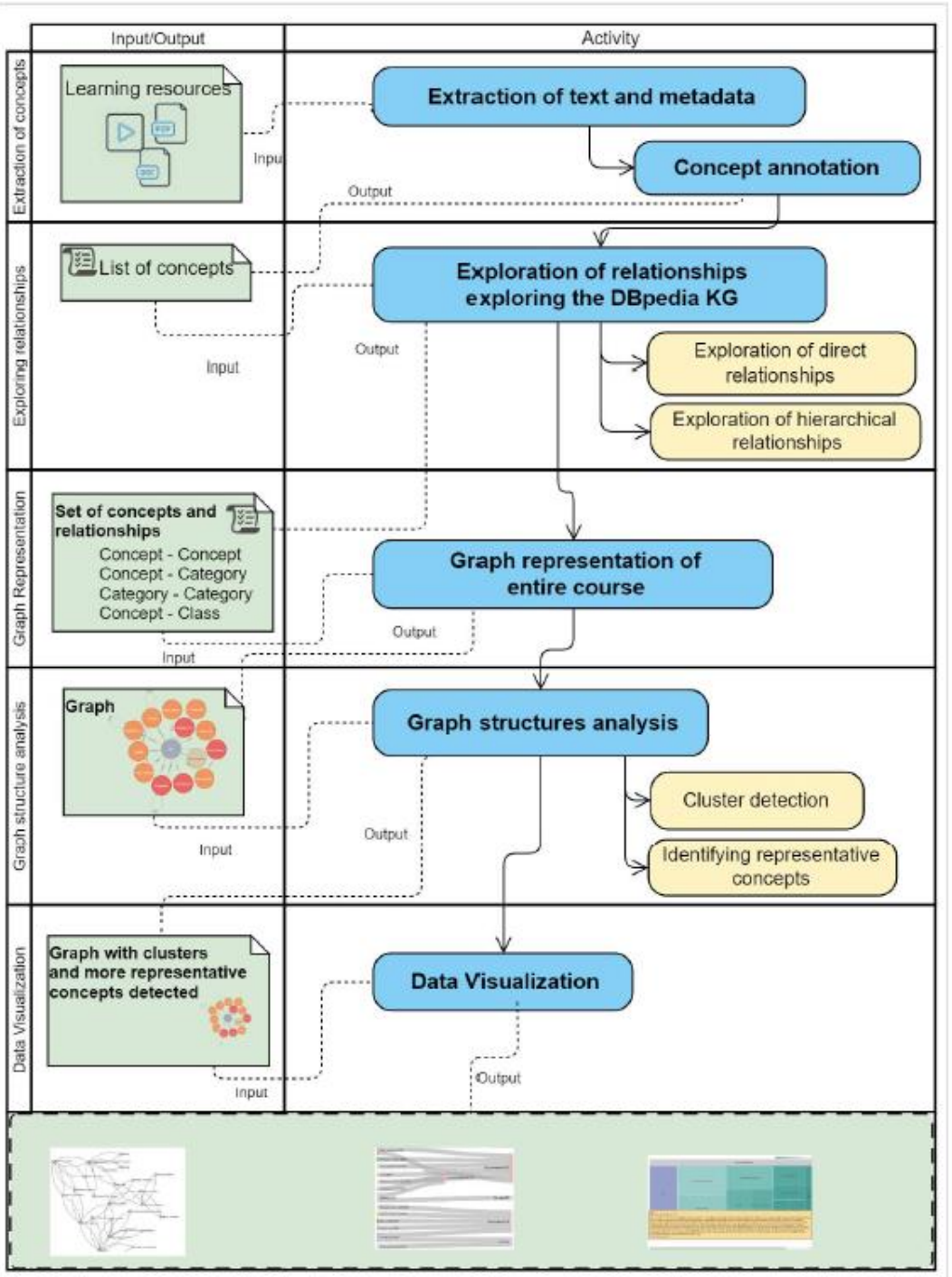
Step III: Grouping of concepts by category

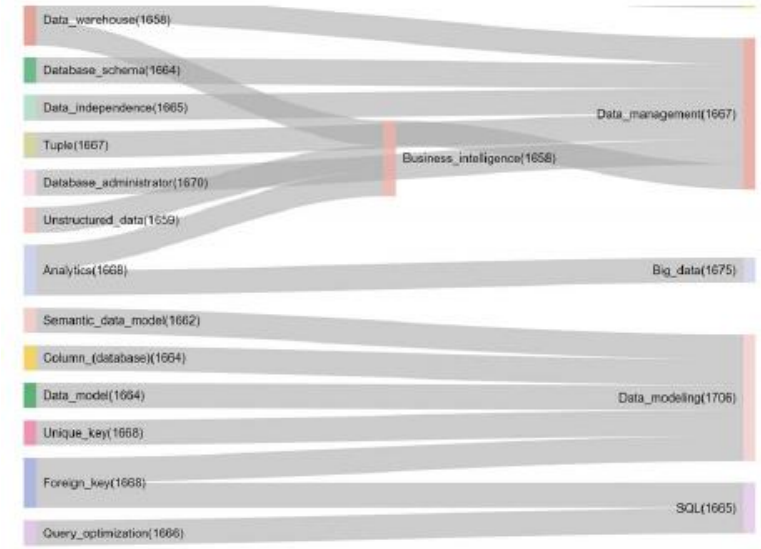
Step IV: Calculation of Shannon Index

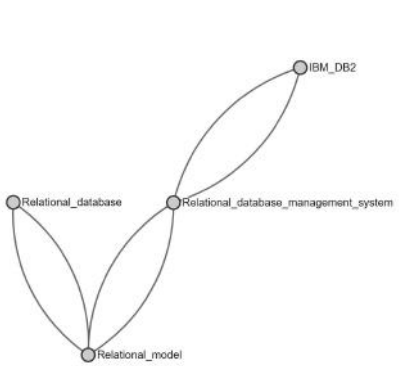
Graph-based Features

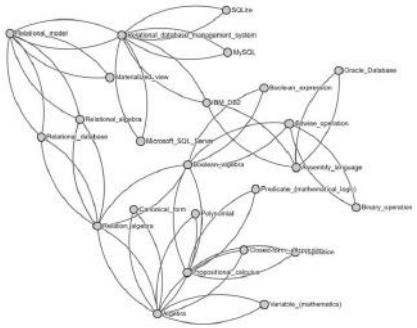
- LinkPage
- Direct Links
- OneIntermediateLink
- Triples Incoming
- Triples outgoing
- Path Length One
- Path Length Two
- The number of vocabularies in A (or B)
- The number of triples in A (or B)
- The number of domains in A (or B)

Pereira, C.K., Medeiros, J.F., Siqueira, S.W. and Nunes, B.P., 2019, July. How complex is the complexity of a concept in exploratory search. In *2019 IEEE 19th International Conference on Advanced Learning Technologies (ICALT).* pp. 17-21. http://dx.doi.org/10.1109/ICALT.2019.00008









PEREIRA, CRYSTIAM KELLE ; NUNES, BERNARDO PEREIRA ; SIQUEIRA, SEAN W. M. ; MANRIQUE, RUBEN ; MEDEIROS, JERRY FERNES . `A Little Knowledge is a Dangerous Thing?: A method to automatically detect knowledge compartmentalization and oversimplification. In: 2020 IEEE 20th International Conference on Advanced Learning Technologies (ICALT), 2020. p. 140-144. http://dx.doi.org/10.1109/ICALT49669.2020.00048

ESKiP Taxonomy of Query States

	Query State	Definition
★	Initial State (IS)	Qi contains a set of terms representing the start of a search.
★	Return State (RS)	Qi contains at least one term and represents the start of a search or a previous search query; Qi+n contains exactly the same term of Qi.
	Generalization (GE)	Qi and Qi+1 contain at least one term in common; Qi+1 contains fewer terms than Qi.
	Specialization (SC)	
	Repeat (RP)	
	Word Substitution (WS)	
	New (NW)	
★	Related (RE)	

Query State	Overall Frequency Learn Web dataset	Overall Frequ Yahoo! datase
Initial State (IS)	24.61%	32.09%
Return State (RS)	1.24%	0.23%
Generalization (GE)	2.63%	3.46%
Specialization (SC)	6.19%	12.31%
Repeat (RP)	43.03%	3.00%
Word Substitution (WS)	2.63%	20.09%
New (NW)	12.85%	20.93%
Related (RE)	6.81%	7.90%

Domain	Description	Strategies
Behavioral Domain	Concerned with basic skills required for manipulating and searching the Web.	– **Control:** skills required for manipulating Web searching applications – **Disorientation:** learner's self-awareness about their searching orientation
Procedural Domain	Concerned with content-general searching approaches and overcoming problems that occur during the searching process	– **Trial and error:** skills in trying different searching approaches – **Problem-solving:** skills and commitment to overcome problems or frustrations resulting from searching
Metacognitive Domain	Concerned with monitoring the searching process, identifying key information, as well as interpreting and evaluating the information retrieved	– **Purposeful thinking:** skills required to self-monitoring the searching process – **Selection of the main ideas:** skills to identify key information concepts from the retrieved batch – **Evaluation:** skills to judge and organize the retrieved information

Marchionini, Gary. "Search, sense making and learning: closing gaps." *Information and Learning Sciences* 120, no. 1/2 (2019): 74-86.

TIBAU, MARCELO ; SIQUEIRA, SEAN W. M. ; PEREIRA NUNES, BERNARDO ; NURMIKKO-FULLER, TERHI ; MANRIQUE, RUBEN FRANCISCO . Using Query Reformulation to Compare Learning Behaviors in Web Search Engines. In: 2019 IEEE 19th International Conference on Advanced Learning Technologies (ICALT), 2019, Maceió. p. 219-223. http://dx.doi.org/10.1109/ICALT.2019.00054

DIAS, M. T. V. ; SIQUEIRA, S. W. M. ; NUNES, B. P. . Think-Aloud your Exploratory Search: Understanding Search Behaviors and Knowledge Flows. In: Research & Inovation Forum (RII-Forum 2020), 2020, Athens. Proceedings, 2020. p. 303-315. https://doi.org/10.1007/978-3-030-62066-0_23

Macro-SRL Process: **Planning**

Micro-SRL Process	Description
Planning	Stating two or more subgoals simultaneously
Recycle Goal in Working Memory	Restating the goal (e.g., question or parts of a question) in working memory.
Subgoals	Learner articulates a specific subgoal that is relevant to the overall goal.
Time Planning	Participant refers to the number of minutes remaining AND indicates whether a

Macro-SRL Process: **Monitoring**

Micro-SRL Process	Description
Content Evaluation	Realization that what was just read and/or seen is or is not useful for the overall goal or subgoal; i.e., recognition of relevance.
Emotion monitoring	Participant realizes that he/she is having an emotional response due to some aspect of the learning task.
Emotion regulation	Participant actively attempts to control emotional response to some aspect of the learning task.
Evaluate Content as Relevant to Task Goal	Statement that what was just read and/or seen is or is not useful for a *specific* subgoal.
Expectation of adequacy of content	Expecting that a certain type of representation will prove either adequate or inadequate given the current goal.
Feeling of Knowing (FOK)	Learner is aware of having read something in the past and having some understanding of it, but is not able to recall it on demand or learner states this is information not before seen.
Judgment of Learning (JOL)	Learner becomes aware that they do or do

Macro-SRL Process: **Strategy Use**

Micro-SRL Process	Description
Comparing & contrasting	Examining two separate representations or ideas (i.e., text, picture, simulation, etc.) to determine how they are similar and/or different.
Coordinating information/text sources	Using pointing, highlighting, or verbalizing the matching elements of two different representations, e.g., drawing and notes. Either representation can be in the environment or in participant's notes.
Corroborating sources	Comparing information from two separate sources, in the search environment, to verify their content as accurate.
Draw	Making a drawing or diagram to assist in learning.
Establishing Chronology	Participant determines when a historical event occurred; often in relation to another event but not necessarily.
Historical Perspective Taking	Participant puts self in position of a historical figure; infers that figure's perspective, thinking, emotions; expresses understanding of that figure's decision making at that time.
Hypothesizing	Making a tentative conclusion or informed guess (about content relevant to the task) based upon information either in the environment or from prior knowledge.
Inference	Drawing a conclusion based on two or more pieces of information that were read,
Inferring Sou	
Knowledge a	with prior knowledge.

Urgo, Kelsey, and Jaime Arguello. "Capturing Self-Regulated Learning During Search." In the 3rd International Workshop on Investigating Learning During Web Search (IWILDS 2022), 2022

DIAS, M. T. V. ; SIQUEIRA, S. W. M. ; NUNES, B. P. . Accounting for the knowledge gained during a Web search: An empirical study on learning transfer indicators. LIBRARY & INFORMATION SCIENCE RESEARCH, v. 45, p. 101222, 2023. http://dx.doi.org/10.1016/j.lisr.2022.101222

Highlights

••It is important to understand the searching process of finding and deciding information's usefulness.

••**Think-aloud protocol** and observation were used to identify learning indicators in Web searching.

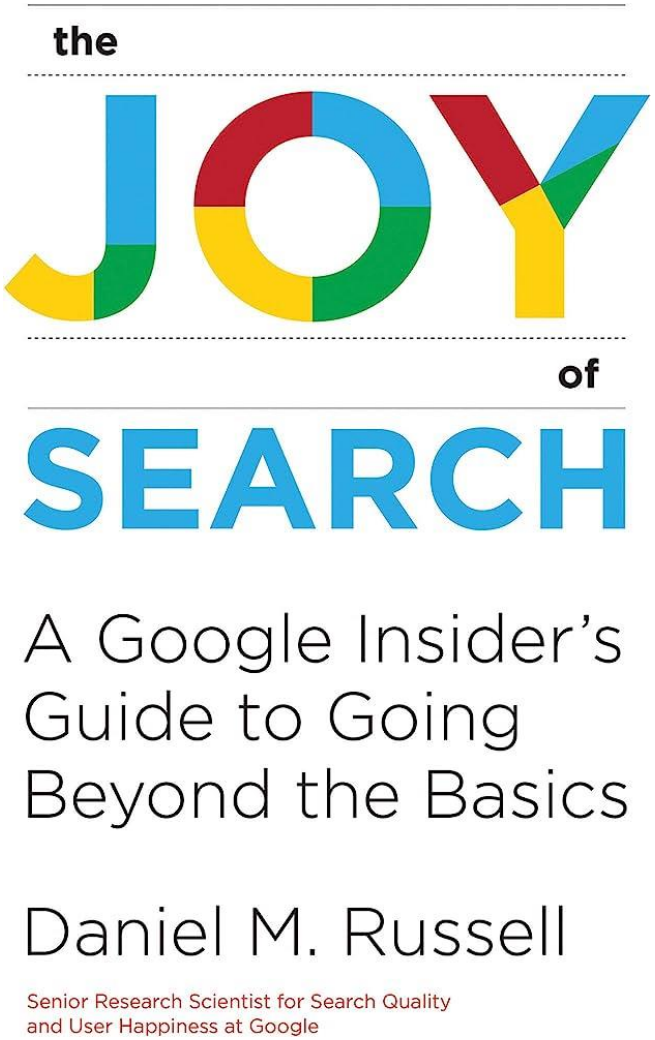
••**Learning indicators can aid at the understanding of how users gain knowledge online**.

••Knowledge is gained online when information is added by users that determine the retrieved information's usefulness.

••**Information added may be used as a learning attribute in Web searching**.

Table 4
Online information searching strategies' indicators.

Behavioral (Behav)
Control
C1: Using the most familiar or known search engine in the first place.
C2: Searching by typing the name of the search engine on the browser.
C3: Entering the name of the website on the search engine.
C4: Entering the name of the website on the address bar.
C5: Using the "home" button to return to the beginning of the search.
C6: Using the "next" and "previous" buttons of the browser.
C7: Using Boolean logic operators for narrowing/widening the search parameters.
C8: Doing a customized search with the help of the images, videos, maps, and other similar features of the search engine.
C9: Utilizing the advanced search options of images, videos, maps, and other similar features of the search engine.
C10: Utilizing the advanced search options of the search engine.
Disorientation
D1: Giving up in the case of failure to find an answer.
D2: Using search terms that are not given in the search task.
D3: Not having any idea about what to do when doing an Internet search.
D4: Feeling bad in the case of failure to retrieve the desired information.
Procedural (Proced)
Trial and Error
TE1: Modifying the keywords.
TE2: Using different search engines.
TE3: Opening different websites.
Problem-Solving
PS1: Doing one's best to resolve any problem that occurs during a search.
PS2: Trying to find out the possible reasons for any problem that occurs during a search.
Metacognitive (Metacog)
Purposeful Thinking
PT1: Narrowing down the searching field (subject).
PT2: Accessing additional websites from a main website.
PT3: Simultaneous information searching from different sources.
PT4: Doing in-site search.
Select Main Ideas
SMI1: Directly opening a website that is known to be relevant to a given search task.
SMI2: Typing specific terms about the search task.



-> Guidelines to support SAL with ChatGPT

Facilitators		Constraints	
Providing more technical explanations; answers complementing each other	52.9%	Inappropriate language; disorganized complex answer	17,6%
Greater focus on discussion and conversation	41.2%	Content focusing more on syntax	11.7%
Debate of opinions; more objective text (greater objectivity)	23.5%	It provides solution rather than knowledge; The text is more subjective when addressing conceptual issues; it is not structured for learning; lack of consistent references	5.9%
More elaborate answers	17.6%		
Presents different points of view	11.8%		
Variety of possible ordering of answers, clarity of content allowing quick understanding	5.9%		

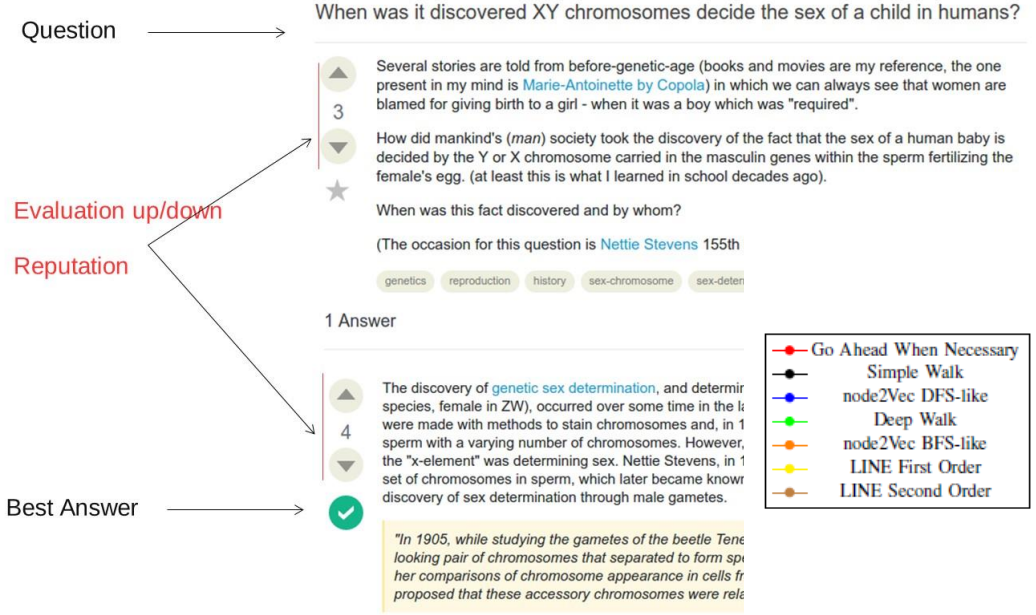
Using trails for learning:

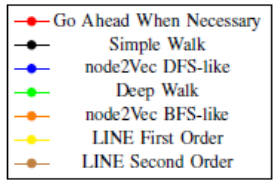
- Only for advanced students;
- For advanced topics or aspects of programming;
- For debating concepts, language syntax and semantics;
- It misses application examples

Reason for using Q&A:

- 55,6% Stack Overflow due to necessity
- Searching for solving problems
- Searching information
- Solving doubts
- For work

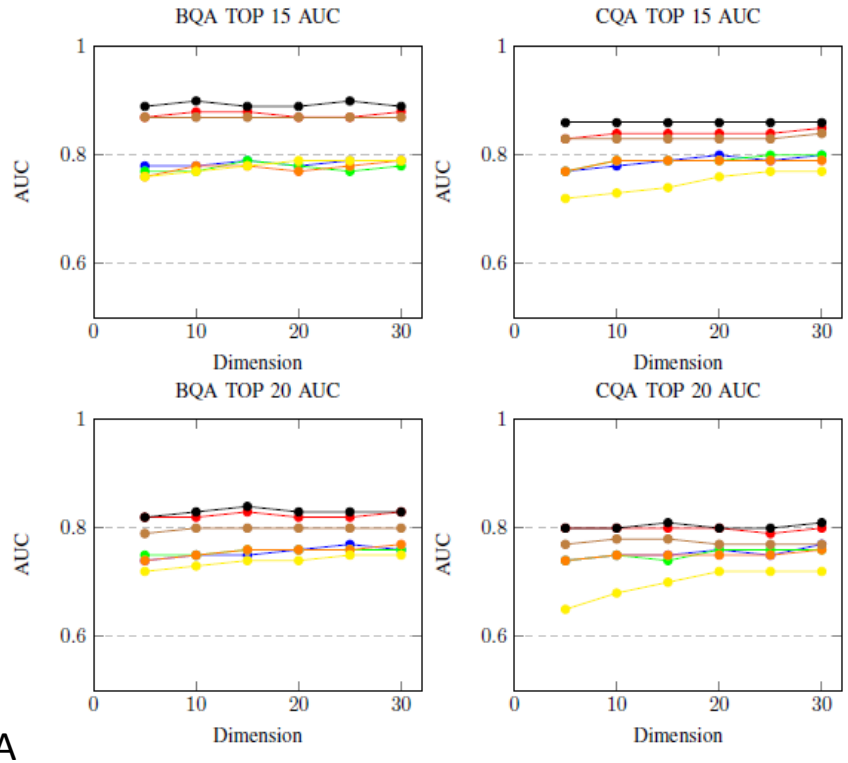
GIMENEZ, P. J. A. ; SIQUEIRA, S. W. M. . Uso de Comunidades de Perguntas e Respostas para Explorar Conceitos na Aprendizagem de Computação. In: XXXIII Simpósio Brasileiro de Informática na Educação ? SBIE 2022. p. 162-174. http://dx.doi.org/10.5753/sbie.2022.225026





Algorithm 1: Simple Walk

```
simpleWalk (Graph g, Node startNode)
    List walk ← [ ];
    List neighbors ← g.neighbors(startNode);
    int i ← 0 ;
    while i < length(neighbors) do
        Node neighbor ← neighbors[i] ;
        int startNodeId ← startNode.id ;
        int neighborId ← neighbor.id ;
        append startNodeId to walk ;
        append neighborId to walk ;
```



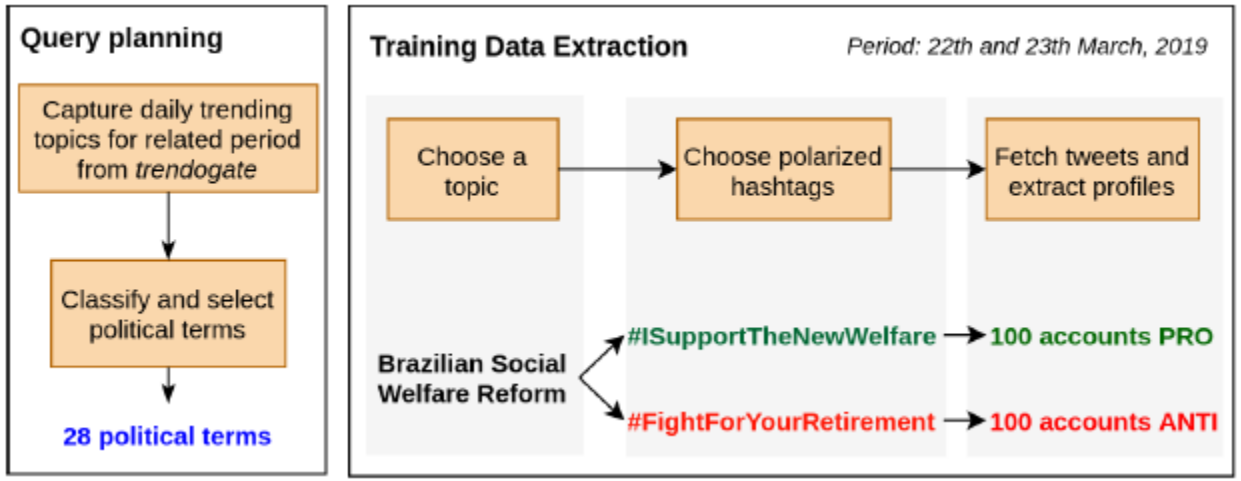
Necessary

```
rNode, int maxLevel)

avgDegree() then
startNode, maxLevel) ;

Valk(g, startNode) ;
```

With Go Ahead When Necessary

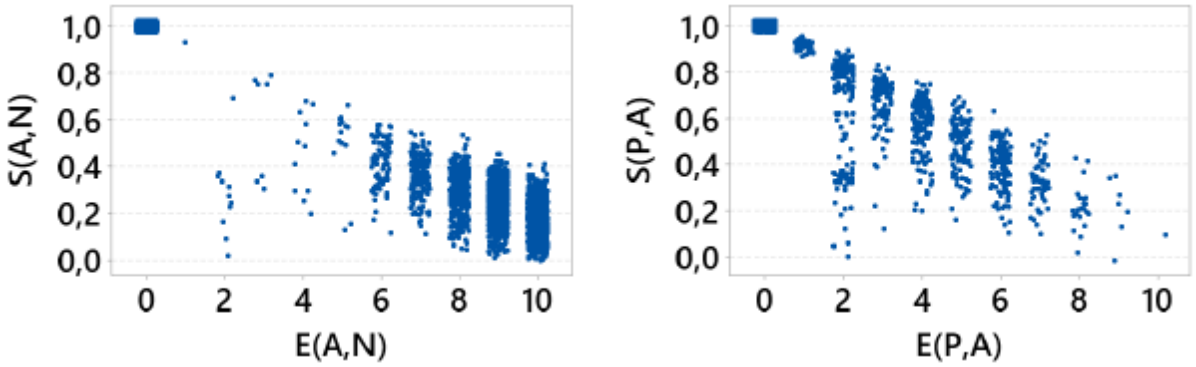
```
(Graph g, Integer dimensions, int maxLevel)

();

:s) do
les[i];
head(g, node, maxLevel);
        append walk to walkList;
        i ← i + 1;
    end
    Word2Vec(walkList, dimensions);
end
```

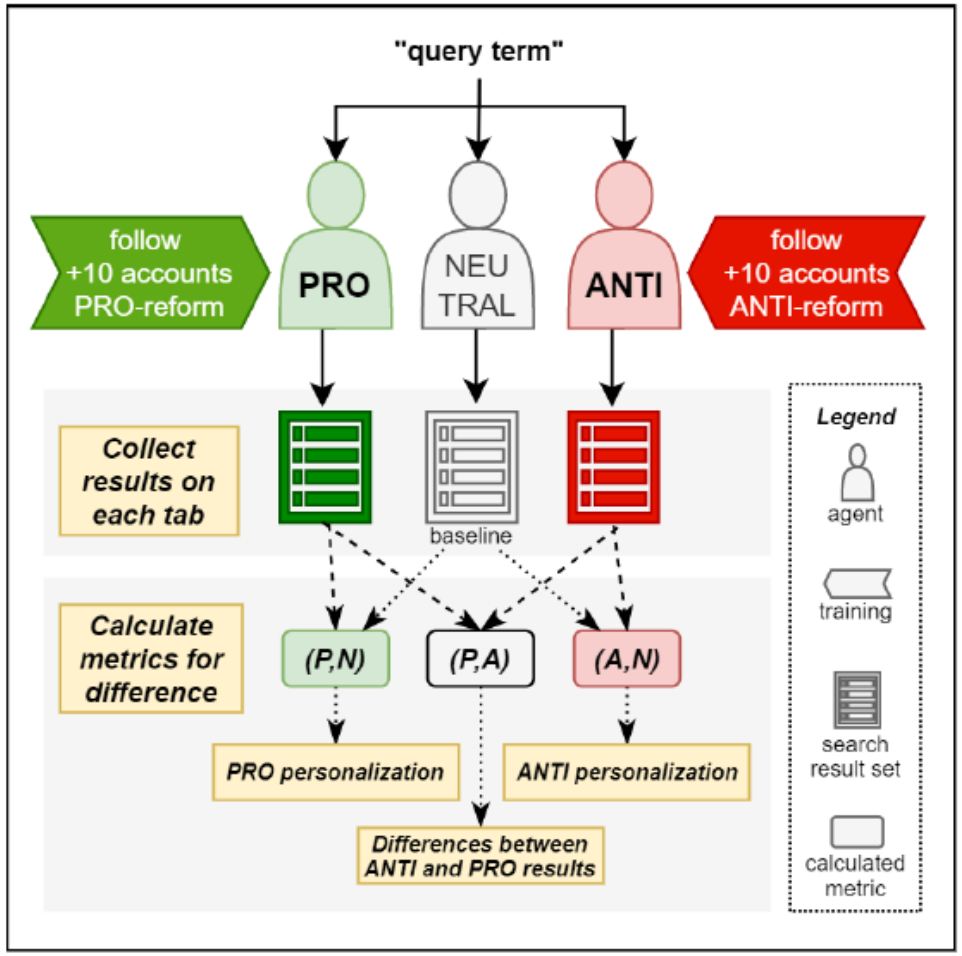
BAESSO PROCACI, THIAGO ; SIQUEIRA, Sean W. M. ; PEREIRA NUNES, BERNARDO . Trust Investigation in Communities Using Feature Learning. In: 2019 IEEE 19th International Conference on Advanced Learning Technologies (ICALT), 2019, Maceió. p. 212-216. http://dx.doi.org/10.1109/ICALT.2019.00051



$$s(u,v) = 1 - arccos\left(\frac{uv}{\|u\|\,\|v\|}\right) \quad (1)$$

$$S(A,B) = \frac{\sum_{j=1}^{n} s(A_i,B_i)}{n} \quad (2)$$





C. DOS SANTOS, JONATAS ; W. M. SIQUEIRA, SEAN ; PEREIRA NUNES, BERNARDO ; P. BALESTRASSI, PEDRO ; R. S. PEREIRA, FABRÍCIO . Is There Personalization in Twitter Search? A Study on polarized opinions about the Brazilian Welfare Reform. In: WebSci '20: 12th ACM Conference on Web Science, 2020. p. 267-276. http://dx.doi.org/10.1145/3394231.3397917

YANG, C. ; XU, X. ; NUNES, B. P. ; SIQUEIRA, S. W. M. . Bubbles Bursting: Investigating and Measuring the Personalisation of Social Media Searches. TELEMATICS AND INFORMATICS, v. 82, p. 101999, 2023. http://dx.doi.org/10.1016/j.tele.2023.101999

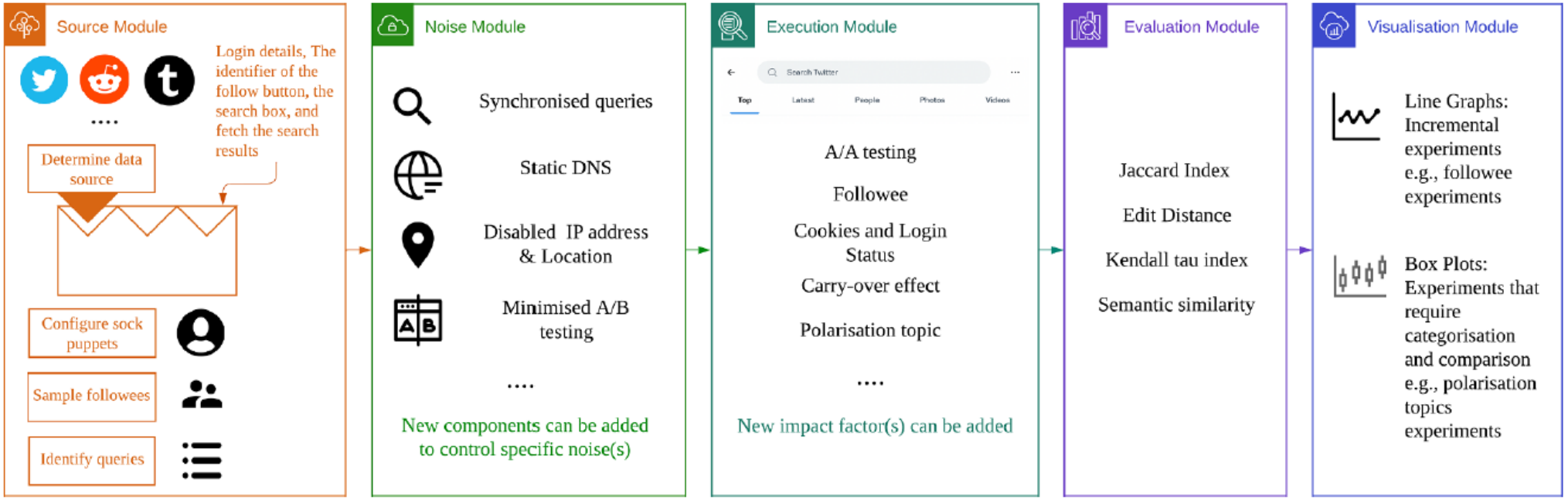
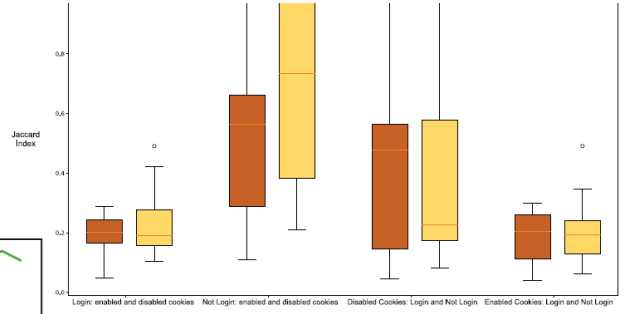


Fig. 1. The SNEEV Framework.



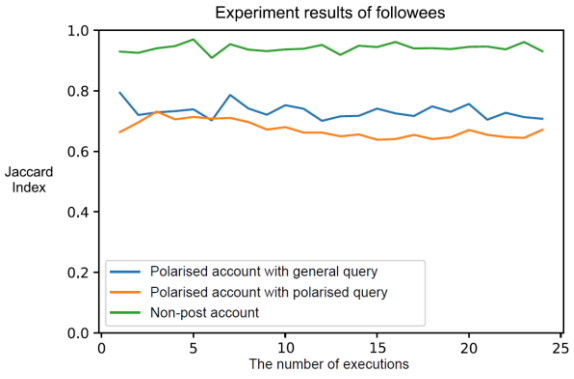


Fig. 7. Results for the Followees Experiments ($m = 25$ and $e = 10$).

The key contributions presented in this paper are outlined as follows:
(i) an open, extensible, and reproducible framework for controlling the noises and investigating the factors that affect personalisation in search results on various social media platforms.
(ii) a comprehensive set of experiments that demonstrates the impact of the hypothesised factors on the personalised search results.
(iii) a summary of guidelines to assist users in avoiding being trapped in filter bubbles and an appeal for social media platforms and policymakers to take responsibility for cultivating a healthier online information ecosystem.

SILVA, F. C. D. ; BICHARRA GARCIA, A. C. ; SIQUEIRA, S. W. M. . Sentiment Gradient, An Enhancement to the Truth, Lies and Sarcasm Detection. In: Ana Cristina Bicharra Garcia; Mariza Ferro; Julio Cesar Rodríguez Ribón. (Org.). IBERAMIA 2022: Advances in Artificial Intelligence ? IBERAMIA 2022. 1ed.Cham: Springer, 2022, v. 13788, p. 107-118.
http://dx.doi.org/10.1007/978-3-031-22419-5_10

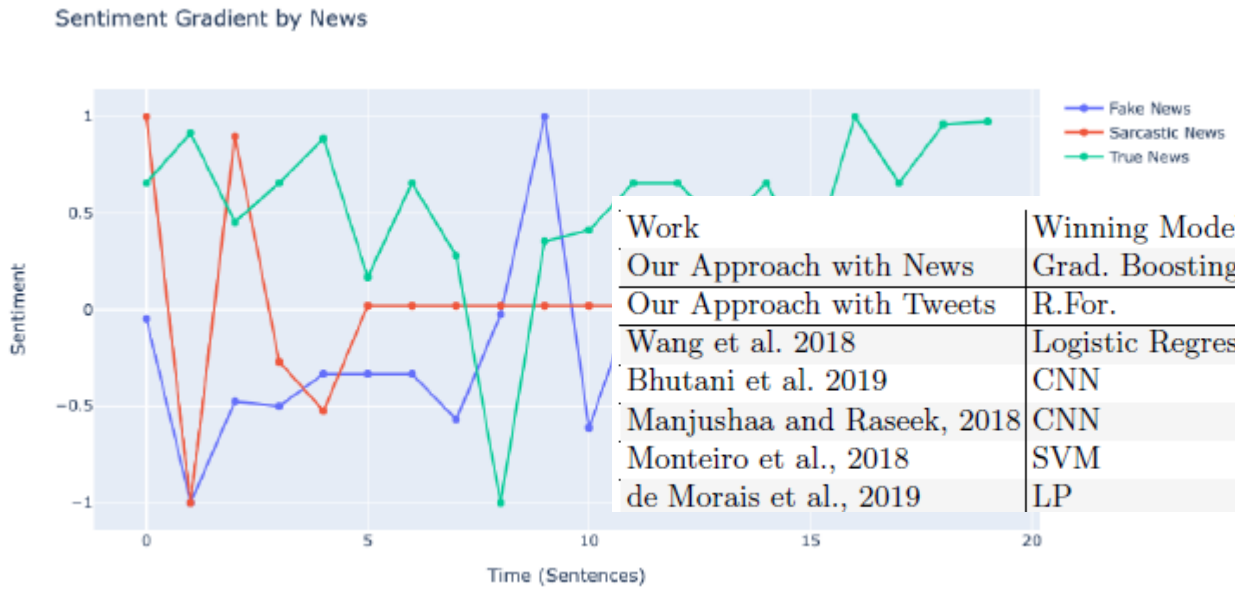
Algorithm 1: Sentiment Gradient Algorithm

```
Result: Sentiment Gradient of the News
sentiment_timeseries = empty array;
sentence_array = SentenceTokens(News);
if Length(sentence_array) > 1 then
    for each sentence in sentence_array do
        sentiment_rate =
          sentence[sentiment_charge]\Length(sentence[tokens])
          sentiment_timeseries.append(sentiment_rate)
    end
    return mean(getGradients(sentiment_timeseries))
else
    return sentence_array[0][sentiment_charge]
end
```

$$\text{Sentiment}(A) = \frac{1}{N}\sum_{k=1}^{N} f(a_k) \quad (1)$$

$$S(A) = (Y_t : t \epsilon N) \quad (2)$$

$$Y_t = f(x) = \begin{cases} Y_1 = f(a_1), & i = 1 \\ Y_i = g(\frac{\partial f(a_{i-1})}{\partial \text{sentiment}}), & i > 1 \end{cases} \quad (3)$$



Work	Winning Model	Score
Our Approach with News	Grad. Boosting Classifier	0.949
Our Approach with Tweets	R.For.	0.893
Wang et al. 2018	Logistic Regression	0.942
Bhutani et al. 2019	CNN	0.847
Manjushaa and Raseek, 2018	CNN	0.797
Monteiro et al., 2018	SVM	0.890
de Morais et al., 2019	LP	0.800

Model	Feature Choice	F1(+/-Stdv)
Adaboost	Basic + Sentiment	0.736(+/-0.007)
Adaboost	Basic + SentimentGradient	0.739(+/-0.007)
DecTree	Basic + Sentiment	0.757(+/-0.007)
DecTree	Basic + SentimentGradient	0.754(+/-0.008)
GNB	Basic + Sentiment	0.612(+/-0.019)
GNB	Basic + SentimentGradient	0.594(+/-0.011)
GradientBoost	Basic + Sentiment	0.778(+/-0.005)
GradientBoost	**Basic + SentimentGradient**	**0.832(+/-0.008)**
KNN	Basic + Sentiment	0.748(+/-0.007)
KNN	Basic + SentimentGradient	0.661(+/-0.008)
LNR	Basic + Sentiment	0.551(+/-0.003)
LNR	Basic + SentimentGradient	0.632(+/-0.007)
LSTM	Basic + Sentiment	0.656(+/-0.016)
LSTM	Basic + SentimentGradient	0.677(+/-0.011)
MLP_ADAM	Basic + Sentiment	0.756(+/-0.013)
MLP_ADAM	Basic + SentimentGradient	0.769(+/-0.012)
MNB	Basic + Sentiment	0.24(+/-0.000)
MNB	Basic + SentimentGradient	0.24(+/-0.000)
R.For.	Basic + Sentiment	0.788(+/-0.007)
R.For.	**Basic + SentimentGradient**	**0.846(+/-0.006)**
SVM	Basic + Sentiment	0.554(+/-0.005)
SVM	Basic + SentimentGradient	0.577(+/-0.008)

What Am I Looking For?

Searching as Learning

Searching as Learning

How to search?

How to find the right piece of information?

How can the search support learning?

Searching as a Learning Process

Searching as a Learning Process

How to learn while searching?

What are the searching and the learning processes?

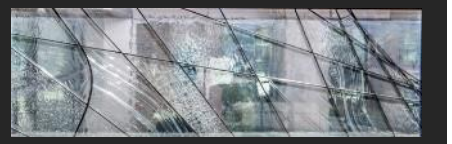
How to evolve search engines to support the learning process?

It was still about getting the right piece of information and learning it, with it.

It was still about getting the right piece of information and learning it, with it.

I still haven't found what I'm looking for…

What am I looking for?



It shouldn’t be about information

Some may think it’s about **knowledge**

… maybe **wisdom**

The Tree of Life and the Tree of Knowledge

What future are we building?

What society should we have as a dream?

What kind of education can support this future society?

What future are we building?

What society should we have as a dream?

What kind of **<u>educational technology</u>** can support this future society?

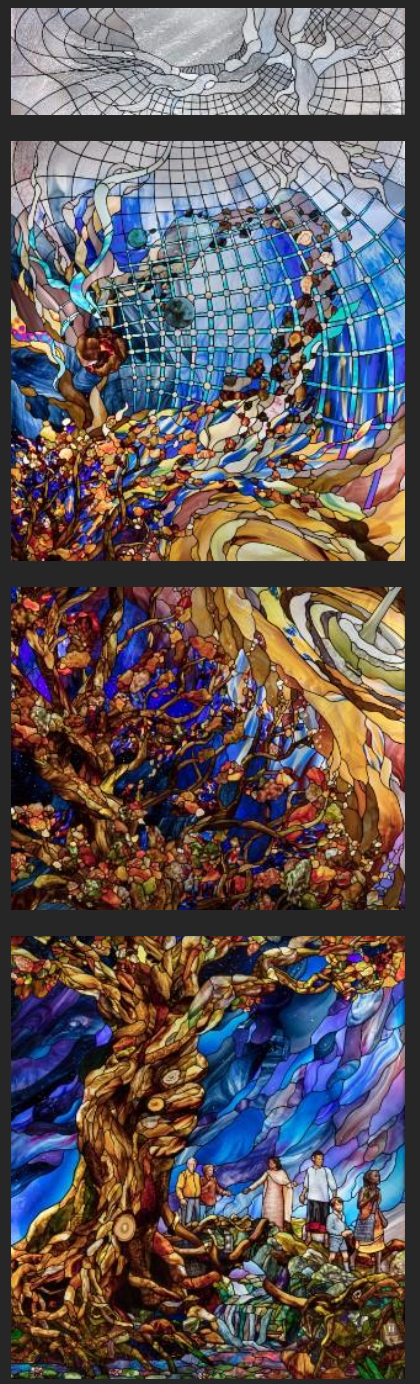
From the Tree of Knowledge (and Tree of Life),

we go full circle to the **Tree of Hope for Humanity**

From the Tree of Knowledge (and Tree of Life),

we go full circle to the **Tree of Hope for Humanity**

It "symbolizes the transfer of knowledge and wisdom to the subsequent generations, who will carry with them the light to illuminate the world in the future".



“Living is the art I want to teach you.”

Edgar Morin

JULY 10 - 13, 2023

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OREM, UTAH, USA

Thank you very much!

Sean Siqueira

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