

# Effects of a think-aloud method on university students' understandings of complexities of information search processes

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**Summary:** This study explores the complex interrelatedness of learning and information inquiry in the context of Japanese university students' Think-aloud searching activity, specifically from the perspective of learning that occurs outside of the formal teaching context of education and training. In this study, we attempt to have Japanese university students aware of the complexity of information search for learning by using the think-aloud method. Students were engaged in a group activity where one participant searched for information while thinking-aloud and the other members took notes of the verbal reports and recorded the behaviors on screen. Our analyses reveal the usefulness of this method to raise students' awareness of information search as complex and intertwined processes.

**KeyWords :** Information search, Think-aloud, Complexities

## 1. Introduction

Over the past years, the coronavirus pandemic or the COVID-19 has ushered in a transition full of uncertainties on a global scale. Daily routines are disrupted, regular schedules are reassessed, and even social mobility becomes unpredictable. This dynamically uncertain environment requires individual abilities to entail a set of the skills, knowledge, and ethical values for informative decision making. However, we are not often aware that knowing “what we know” and “what we don't know” is an important yet very difficult task. Despite such informationally and cognitively demanding circumstances becoming a part of “new normal,” our day-to-day attitudes toward information including seeking and searching for information remain extrinsic to those instant and convenient technologies and experiences of responsibility in using them. We extend this view by exploring the interconnectedness of learning and information inquiry through the lens of a conceptual framework of searching as a learning process (Rieh et al., 2016) and epistemic cognition (Chinn et al., 2014).

## 2. Background

*"Understanding" may be an extremely complex phe-*

*nomenon involving thousands of "facts," strategies, and conditions for applying knowledge" (p. 294, Hawkins and Pea, 1987).*

Unlike most students' simplistic conceptualizations and behaviors, information search has different modes and consists of complex processes. Rieh, Collins-Thompson, Hansen and Lee (2016) proposes a conceptual framework of association between search mode and cognitive learning outcome. In their framework, there are three kinds of search modes, which are fact finding, specified search and unfocused browsing, and three kinds of cognitive learning, which are receptive, critical and creative modes. Epistemic cognition is also involved in information search. Chinn, Rinehard, and Buckland (2014) elaborate a model of epistemic cognition called the AIR model consisting of three components of epistemic cognition; aims and value, epistemic ideals, and reliable processes for achieving epistemic ends.

It is difficult for students to realize that information search involves these kinds of intertwined processes and to examine their simplistic conceptualizations and behaviors of information search. The questions that we want to ask are phenomenological, and we use the think-aloud method (Charters, 2003). In this study, students were engaged in a group activity where one participant searched for information while thinking-aloud and the other members took notes of the

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searcher's narrative and recorded the behaviors on screen. While the think-aloud approach has been developed as a method to investigate cognitive processes of thinking and problem solving (Ericsson & Simon, 1984), it has also been applied for a means to promote interactive instruction and learning outcomes (for example, Li, 2010). Not only conducting think-aloud activities but also observing peer's reactivity are expected to enhance meta-cognitive awareness of thinking processes among all the group members (Baumann, et al., 1992). Also, reflective writing starts with the student-self, involving self-questioning and restating and revisiting prior experience and knowledge of the topic (Holly, 1989). We incorporate this phase of thinking into our analysis in order to examine what the think-aloud activities brought to the students' awareness of information search.

### 3. Methodology

#### 3.1 Procedures and subjects

This study draws on the analysis of Think-aloud activity data and reflective writings collected during the second last week of the spring semester in 2021 in the regular class period. The participants were students from an introductory course at a private university in Japan. Students were required to participate in the in-class exercise and submit reports as a part of the course requirements. However, their participation in providing their activity report for the research data analysis were asked voluntarily. All students were informed in writing and in oral instructions, of their right to refuse to permit their reports to be used for the research purposes. Data were collected through three phases: 1) pre-activity questionnaire, 2) Think-aloud searching activity, and 3) post-activity reflections.

The class session was made available both in a classroom on campus and via video conferencing system due to the ongoing COVID-19 pandemic situation. This mixed mode of instruction offered students choices of either in-person or online class time. Therefore, all the students participated in the Think-aloud searching activity in the video conferencing platform.

A total of 57 students participated in the classroom session for this study the Think-aloud searching activity. The participants included 33 freshmen, 15 sophomores, 7 juniors and 2

senior students. All the participants were from Department of Education, and only one student identified himself as a non-native Japanese speaker. The class session was made available both in a classroom on campus and via video conferencing system.

#### 3.2 Pre-Activity Questionnaire

This questionnaire aims to gather understanding of the participants' skills and experiences with information technology (IT) as well as general awareness on information search. Topics covered include, for example search strategies, technical problem-solving approaches, home IT environment, and history of IT device and application usage. The questionnaire also asked about attitudes toward the COVID-19 pandemic and lockdown situations. We designed the instruments based on the search tasks that we used later in the experimental task.

#### 3.3 Think-aloud searching activity

First, the researcher explained the aim and purpose of the activity, as well as introduced the outline of the procedures including the concept of "think aloud." Using a demonstration video in which a group of three was undertaking an unrelated topic of search tasks, the researcher illustrated key components in each player's scope of actions. After the instruction and the following Q and A session, students were randomly assigned to groups of three or four using the automatic breakout room function. In each group breakout room, students freely decided to pick their preference of searcher, notetaker, and observer roles. Then each group practiced thinking-aloud information search, observing on-screen behaviors and taking notes of narratives. In this practice phase, students were given an unrelated topic of the experimental task, for example "Where to take a visitor from overseas who is leaving Japan next week?"

Then, students were given ten minutes to work on the experimental search task: "Suppose your friend from the same university living in your neighborhood (i.e., the same district) told you that she is thinking of getting the COVID-19 vaccines and wanted to hear your advice. Decide what you would tell her by searching for necessary information." One of each group thought aloud while searching for information, the others recorded the verbal reports and on-screen behaviors.

### 3.4 Post-activity reflections

Once they were able to upload all the writing and report that they produced during the Think-aloud session on the course management digital space, either a photo of the hand-written memo or digital documents, all the participants were asked to start writing a brief reflection essay. Once these were ready, students submitted their files through the course management system.

## 4. Results

A total of 57 students completed the questionnaire, of which 51 students participated in the search activity, resulting in 17 groups of three or four members being formed. As a group, students were asked to submit dictation of the searcher's words and observation notes taken from the searching processes. Individually, students were asked to submit a reflection report afterwards. Either or both products or individual reflection reports from six groups contained excessive missing data or were spoiled to follow the directions. Consequently, 12 of each dictation write-up and observation notes from 11 groups consisting of 35 participants were used for analysis.

In terms of questionnaire results, the students identified longer and richer experiences with smartphones than personal computers and had very limited uses of tablet PCs. When they search for information, most of them use Google and Yahoo! through browser apps on their smartphones. Many of the students stated, in response to the question regarding what they care about when searching for information, that they input many words combined, instead of sentences, though only two students mentioned search operators. About 15% of students responded that they always look at more than one pages in search results and about 55% frequently, while about 20% seldom and about 10% never. In response to the question about how many pages they usually look at from search results, two students out of the 27 participants said they look at only one. About a third of them look at two pages, about 44% three pages and about 20% more than three. When they don't find the kind of information that they want, according the questionnaire responses, 93% of them change search keywords, 40% add search keywords, and 18% use different search tools or apps, while only 4%

use search operators and 7% would give up.

From in-depth analysis of the verbal reports and on-screen behavior records from each group, we extract several characteristics of the information search processes of the participants of this study and their thinking processes. And we analyzed how these characteristics are related to and reflected in the post-activity reflection essays.

First, a wide variety of search words and their combinations were used across and within searchers. Each searcher used different words and two- to three-word combinations during search. From the post-activity essays the searchers themselves had not had clear strategies of how to select search words and word-combinations. Instead this Think-aloud activity was a good opportunity for the searchers to notice what they were conscious about during search word selections. Also, by observing searchers' selections of search words and word combinations, the observers and note-takers were able to learn that there are various ways of choosing search words and word combinations and complexities in thought processes behind those choices. In the classroom activity for this study, we did not give students opportunities of observing differences across searchers, but the usefulness of them would be suggested from this analysis too.

Second, some discrepancies were observed between pre-activity questionnaire responses, search behaviors and post-activity reflections. To the questionnaire, about 15% of students responded that they always look at more than one pages in search results and about 55% frequently. On the other hand, very few searchers looked at more than one pages during this activity. The time constraint might be relevant, but still the searchers did not go deep into detailed information often. Instead, most searchers looked at a small number of pages from a search result and then quickly change search words and word combinations to look at different information, moving horizontally instead of vertically in the information space. Some students, however, mentioned the searchers' processes of changing search words and word combinations and noted the possible complexity of the trial-and-error processes of information search.

Third, in the post-activity reflections, most participants appreciated the value of this kind of activity. Most of them admitted the necessity of improving information literacy and information search skills and the think-aloud information

search activity is useful for searchers, observers and note-takers.

## 5. Conclusion

Information search is quite an important skill in this age in many ways. Search processes, which are complex and intertwined in nature, are often reduced to simplistic skills not only in educational settings but in everyday situations. From our experimental practice and its in-depth analysis, we conclude that the Think-aloud activity is useful to raise students' awareness in terms of the complex and intertwined nature of information search processes.

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