

Strategies for Online Information Search by University Students: the Relationship between Educational Use of the Internet and Cognitive Styles

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Abstract. The paper presents the results of experimental study of students' information searching strategies on the Internet. The study was aimed to analyze the relationship between university students' strategies of information Internet search for educational tasks and style characteristics of their cognitive activities (styles of information coding, styles of information processing and styles of cognitive regulation). The study was based on the Level model of cognitive-style characteristics (Kholodnaya, 2002). Main methods of study were experimental modelling of educational situations and testing for assessment of students' styles of information coding, information processing and cognitive regulation. The results of experimental study allowed to identify two strategies of educational online searching ("direct online searching" and "improving online searching") and their relationship with students' cognitive characteristics and academic achievements: students' strategies of educational online search are determined primarily by the characteristics of cognitive regulation. The results did not reveal a direct link between strategies educational online search and academic achievement.

1 Introduction

The search for information on the Internet is now a part of the daily educational activity of university students. Today students perceive the Internet as the main source of educational information [1]. At the same time, the ease of access to information raises the problem of its reliability. Students often distrust the quality of information on the Internet [2], but they do not have ready-made tools to filter it [3].

The results of empirical studies indicate that the effectiveness of searching behavior on the Internet has no unambiguous relationship with the level of knowledge about the subject area in which the searching is carried out [4]), but it is determined by experience in online information searching [5]. Probably, Internet information searching is an integrated cognitive process, which is significantly different from reading traditional printed sources.

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In this regard, there is a need to study strategies for educational information search and their cognitive prerequisites.

According to Level model of cognitive-style characteristics by M.A. Kholodnaya [6], there are three levels of cognitive activity: styles of information coding, styles of information processing and styles of cognitive regulation, which can be carried out in two aspects: the aspect of cognitive goals and the aspect of mental experience structuring. In relation with the problem of online information search, the most studied levels are processing and regulation of cognitive activity. Thus, M.-J. Tsai et al. note that an important stylistic characteristic of online search is the time of information processing [7]. The main differences in perceptive and regulative aspects of searching strategies are not related to procedural characteristics of the search, but are connected with behavioral and metacognitive spheres [8]. In general, the reviewed studies demonstrate the relationship between the preferred strategies for the online information search and particular levels of personal cognitive organization.

2 The present study

The present study was aimed to analyze the relationship between the strategies for online information Internet search applied by University students' while doing educational tasks and style characteristics of their cognitive activities. The theoretical basis was the M.A. Kholodnaya's concept of the cognitive organization. The study considered three research questions: 1) Which strategies for online information search might be identified in the analysis of students' performance of the educational tasks on little-known topic? 2) Is there relationship between these strategies and the styles of students' cognitive activity? 3) Are these strategies relevant for successful learning? The main hypothesis suggested that the strategies of online educational search are determined by the styles of students' cognitive activity. Thirty university students aged 18-21 ($M=19.44$; $SD=0.47$, 86.6% female) took part in the study.

3 Method

Assessment of online information searching strategies was carried out in the experimental modeling of performing educational tasks. To exclude the influence of academic achievement, students got a task which did not correspond to their educational profile but at the same time allowed a variety of ways to perform it. The task was formulated as follows: "List the significant events in world history that in the period between 1950 and 1990, and write down your answers on a blank sheet of paper in any way which would be convenient for you". The time to complete the task was not limited. The experimenter set such parameters of online information search strategies as time to complete the task (in minutes), number of sites viewed (in absolute units), average time to work with one site (in minutes), number of searching queries (in absolute units). These parameters were extracted of the "History" in the browser after the students had passed the completed written papers.

Assessment of the students' cognitive styles involved the evaluation of the coding styles and the styles of information processing, as well as the styles of cognitive regulation both in the target aspect and in the aspect of mental experience structuring. Styles of information coding were evaluated using the "Ball" method [6]. The assessment of information processing styles was carried out using "Stroop Test" [9], "Embedded Figures Test" [10]; "The Matching Familiar Figures Test" [11]. The styles of cognitive regulation in the target aspect were assessed using "Thinking styles" questionnaire [12; 13]. The evaluation of the

styles of mental experience structuring was carried out by “Ideal computer” method with index of cognitive openness as a final indicator [6]. The assessment of educational achievement was realized by the analysis of exam record lists.

Data analysis included cluster analysis (Ward's method), criteria analysis (U Mann-Whitney test) correlation analysis (r , Spearman coefficient) and regression analysis. Statistical procedures were carried out with Statistica 12.0.

4 Results

The analysis of students' online searching activity while working on the educational task showed that students spent from 6 to 32 minutes to complete their written papers ($M=13.17$; $SD=4.03$). Some students formulated a single information request, while others refined the request up to 6 times ($M=2.04$; $SD=1.12$). The range of the indicator “number of viewed sites” varied from 1 to 31 ($M=12.77$; $SD=5.16$). The time of the work on one site was from 0.1 to 11 minutes ($M=1.98$; $SD=0.89$). Using cluster analysis, we divided the sample into two subgroups ($LD=4.3$) with different parameters of online information searching (Table 1).

Table 1. Characteristics of online information searching in subgroups

| Parameters | Subgroup 1 (n=8) | Subgroup 2 (n=22) | U |
|----------------------------------|---------------------|----------------------|--------|
| Time to complete the task | 15.25 | 12.41 | 39.5* |
| Number of viewed sites | 14.63 | 10.72 | 54.0** |
| Number of searching queries | 3.01 | 1.32 | 43.0* |
| Average time to work on one site | 1.19 | 2.26 | - |

Note. * - $p < .05$, ** - $p < .01$

In accordance with these results, we have identified two strategies of online information searching: “the improving strategy of online searching” (subgroup 1, $n=8$) and the “direct searching strategy” (subgroup 2, $n=22$). The first strategy involved taking enough time to complete the educational task. It consisted in consistent refinement of the search query based on the analysis of the previous search and aimed at improving the quality of information. The second strategy was characterized by a single query that was rarely refined. The results of the first search query were largely used to perform the task; the formulation of the query was directly corresponded to the educational task.

The next step of analysis showed that these groups differ primarily in the styles of cognitive regulation, while the styles of information coding and processing do not have a significant difference (Table 2).

Table 2. Characteristics of cognitive styles in subgroups (Statistically significant differences between subgroup 1 and subgroup 2)

| Characteristics | Means | | U |
|---|------------|------------|---------|
| | Subgroup 1 | Subgroup 2 | |
| Pragmatic style of cognitive regulation | 52.75 | 48.82 | 52.0 ** |
| Analytic style of cognitive regulation | 55.62 | 60.45 | 56.0 ** |
| Index of cognitive openness | 0.68 | 0.50 | 49.5** |

Note. * - $p < .05$, ** - $p < .01$

Criteria analysis showed the absence of significant differences between educational achievement of subgroups with improving and direct online searching strategies ($M=4.14$; $SD=0.56$ in the subgroup 1, $M=4.11$; $SD=0.49$ in the subgroup 2). Despite this fact, the results of correlation analysis suggested that groups with different online searching strategies varied in relationship between educational achievement and cognitive-style characteristics. Educational achievement was correlated with pragmatic ($r_s=0.61$, $p < .05$) and synthetic ($r_s=0.67$, $p < .05$) thinking styles in the subgroup of students with improving online searching strategy. In the group of students with the strategy of direct online searching we found correlations between educational achievement and analytic thinking style ($r_s=0.59$, $p < .01$) and cognitive openness ($r_s=0.61$, $p < .01$).

Regression analysis did not allow us to obtain significant results for identifying predictors of educational achievement in the subgroup 1 ($r^2 < 0.23$), probably due to the small size of this subgroup. The regression model for subgroup of students with direct online searching strategy was significant ($F(2,21) = 11.26$, $p < .01$). Analytic thinking style and cognitive openness explain 51.4 % of the variation in educational achievement, adjusted $r^2 = .46$ (Table 3).

Table 3. Summary of multiple regression analysis for predicting educational achievement in the subgroup of students with direct online searching strategy

| Variable | B | SE B (std. error) | B (beta score) | Sig. (p) |
|-------------------------|------|----------------------|-------------------|----------|
| Analytic thinking style | 3.16 | 2.77 | 8.87 | .01 |
| Cognitive openness | 3.65 | 2.98 | 11.02 | .01 |

According to these results, we concluded that online searching strategies did not directly determine students' educational achievement. Probably, the link between preferred online searching strategies and educational achievements was mediated by the students' regulation of cognitive activity.

5 Discussion

The first question was about strategies of online information Internet search, which could be identified using the analysis of students' performance of educational tasks. Modeling the educational situation with little-known tasks, we had identified two strategies of educational online searching: "direct online searching" and "improving online searching". The strategy of direct online searching was probably more popular than the strategy of improving online searching (73.3% students used this strategy in the experimental situation). The strategy of direct online searching involved formulating a minimum number of queries to the search engine, a quick viewing of the first few links and selecting 1-2 information sources to perform the educational task. Students who used a direct online searching strategy did not tend to summarize information from several sources. The strategy of improving online searching involved a consistent refining of the search query, viewing a large amount of information, tending to synthesize information from different sources.

With regard to the second research question, we studied the relationship between online information searching strategies and cognitive styles of students. In the subgroup of students with direct online searching strategy the indicators of the analytic thinking style turned out to be significantly higher and the indicators of the pragmatic thinking style – to be significantly lower than in the subgroup of students with improving online searching strategy. These facts were unexpected because they suggested that students who had

preferred direct online searching strategy tended to systematically review the task and thoroughly analyze it. However, we explained this result by drawing attention to the fact that there was a tendency to pragmatic cognitive activity, as well as a higher level of cognitive openness, in the subgroup of students who had used improving online searching strategy. As whole, these results suggested that students who preferred direct online searching had the skills necessary to search and process information but they were less sensitive to the current task and more dependent on their mental constructs.

The third research question tested the relevance of identified online searching strategies for educational achievement. Contrary to our expectations, we found no difference in educational achievement among subgroups. At the same time, we revealed relationship between educational achievement and styles of students' cognitive regulation. Positive correlations between indicators of educational achievement, pragmatic and synthetic thinking styles were revealed in the subgroup of students with improving online searching strategy. In the other subgroup educational achievement was determined by analytic thinking and cognitive openness. We concluded that direct online searching strategy didn't prevent high educational achievement if the student had the ability to set goals for his / her cognitive activity and select relevant information from the Internet.

6 Conclusion

Thus, our hypothesis was partially confirmed. The strategies used by students to search for online information when solving educational problems are determined by their cognitive styles, first of all, by the styles of cognitive regulation, but do not have a direct impact on the educational achievement. Educational achievement is predicted primarily by the styles of cognitive regulation. These results create prerequisites for developing new methodological tasks aimed to improving the efficiency of teaching at university. It is necessary to contribute forming students' ability to set cognitive goals and to determine the criteria of information relevance for current educational tasks.

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