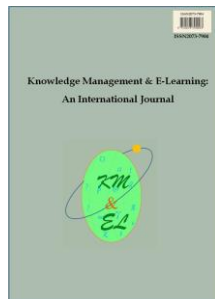# Predicting computer science students' online help-seeking tendencies

Qiang Hao
Brad Barnes
Robert Maribe Branch
The University of Georgia, GA, USA
Ewan Wright
The University of Hong Kong, Hong Kong

Predicting computer science students' online help-seeking tendencies

Qiang Hao*

Department of Career and Information Studies & Computer Science
The University of Georgia, GA, USA
E-mail: neohao@uga.edu

Brad Barnes

Department of Computer Science
The University of Georgia, GA, USA
E-mail: bjb211@uga.edu

Robert Maribe Branch

Department of Career and Information Studies
The University of Georgia, GA, USA
E-mail: rbranch@uga.edu

Ewan Wright

Faculty of Education
The University of Hong Kong, Hong Kong
E-mail: etwright@hku.hk

*Corresponding author

Abstract: This study investigated how computer science students seek help online in their learning and what factors predict their online help-seeking behaviors. Online help-seeking behaviors include online searching, asking teachers online for help, and asking peers online for help. 207 students from a large university in the southeastern United States participated in the study. It was revealed that computer science students tended to search online more frequently than ask people online for help. Five factors, including epistemological belief, interest, learning proficiency level, prior knowledge of the learning subject, and problem difficulty, were explored as potential predictors in this study. It was found that learning proficiency level and problem difficulty were significant predictors of three types of online help-seeking behaviors, and other factors influenced online help seeking to different extents. The study provides evidence to support that online searching should be considered as an integrated part of online help seeking, and gives guidelines for practice of facilitating online help seeking and future studies.

Keywords: Online help seeking; Online searching; Epistemological belief; Learning proficiency level

Biographical notes: Qiang Hao is engaged in research in both instructional

technology and computer science at The University of Georgia. His research focus is on educational data mining and self-regulated learning.

Dr. Brad Barnes is the undergraduate coordinator of Computer Science at the University of Georgia. His research focuses include parallel and distributed computing, computer architecture, operating systems and computer science education.

Dr. Robert Maribe Branch is a Professor of Learning, Design, and Technology at the University of Georgia, and a Past President of the Association for Educational Communications and Technology. He authored the book Instructional Design: The ADDIE Approach, Survey of Instructional Development Models. His research focuses on visualizing complex conceptual relationships.

Ewan Wright is engaged in doctoral research in the Faculty of Education at The University of Hong Kong, where he holds the Hong Kong Postgraduate Fellowship. His research interests are based around the massification of higher education, inequalities within higher education, and transitions from higher education to employment.

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1. Introduction

Help seeking is a cognitive skill which has become crucial for enabling college students to succeed in their studies. Notably, help seeking has been identified as an effective learning strategy and is associated with a capacity for self-regulated learning (Aleven, Stahl, Schworm, Fisher, & Wallace, 2003; Lee, 2007; Newman, 2000; Roll, Aleven, McLaren, & Koedinger, 2011). Nevertheless, there is evidence that college students often encounter significant barriers in help seeking in classroom settings. This may involve, for example, difficulties in identifying a relevant individual who could be supportive or hesitation in approaching potential helpers due to anxiety or a lack of self-confidence (Karabenick, 2003; Kozanitis, Desbiens, & Chouinard, 2007; Ryan & Shin, 2011).

As web technology continues to play an increasingly more important role in learning and teaching, students may not need to face such challenges when seeking help. Instead, students can rely on online resources for information and help. For instance, communication with experts online or the utilization of search engines is arguably less intimidating than face-to-face interactions (Kumrow, 2007). As a result, students seeking online assistance may have fewer concerns about being labeled as incompetent by teachers or fellow students (Cheng & Tsai, 2011; Kumrow, 2007; Karabenick, 2003). Nevertheless, web technology also poses new and emerging challenges for help seeking. As an example, given a wrong or ambiguous query, search engines are likely to only return irrelevant and useless information.

Reflecting these concerns, research into how to best support students in seeking help online has become imperative in the context of the increasing reliance on the Internet in learning. A better understanding of the factors that influence online help-seeking behaviors is essential for an effective facilitation strategy. In response, this study investigated the primary factors that predict online help seeking of college students studying computer science, given the completeness of online reference manuals and abundance of open educational resources in this field (Dichev & Dicheva, 2012). The factors examined in this study include problem difficulty, epistemological belief, interest,

learning proficiency level, and prior knowledge of the subject. The results of this study will inform policy makers, educators, and researchers in better understanding college students' online help-seeking behaviors.

2. Literature review

2.1. Online help seeking

Help seeking is a cognitive skill and refers to a set of actions including realizing the need for help, identifying goals and problems, and forming questions to solicit help (Aleven, McLaren, Roll, & Koedinger, 2006; Newman, 2008). Online help seeking specifically refers to help seeking facilitated by online tools, such as search engines, emails or discussion boards.

Online help seeking has a number of advantages during instructional situations. Firstly, interacting with people online or with search engines is less self-esteem threatening for many students (Karabenick, 2003; Kumrow, 2007). Secondly, given the proper query, search engines can immediately return thousands of relevant answers from experts around the world, which makes just-in-time learning possible (Schmidt-Jones, 2012). In addition, democratic voting systems on discussion boards can help learners identify the most accurate and relevant answers more easily (Boronenko & Alexandrov, 2009). Nevertheless, online help seeking also poses new and significant challenges. Distant communication with other users online can be prone to misunderstandings. Also, search engines have limited capability in helping learners modify and improve their questions. Students often struggle to locate relevant information if improper queries are provided to the search engines.

Online help seeking differs by the nature of helpers, be they human beings or machines, and the relationship between helpers and help seekers, such as students versus teachers (Cheng & Tsai, 2011; Le Bigot, Jamet, & Rouet, 2004; Puustinen & Rouet, 2009). Cheng and Tsai (2011) identified three types of online help-seeking behaviors based on the differences in the nature of helpers and the relationship between helpers and help seekers:

1. Asking human experts, like teachers, for help online
2. Asking peers online for help
3. Online searching, namely searching for relevant information through search engines

Though help seeking has been studied extensively in classroom settings, research on online help seeking is still very thin on the ground (Vighnarajah, Wong, & Abu Bakar, 2009; Cheng, Liang, & Tsai, 2013). This represents a major gap in the literature given the potential advantages and challenges of online help seeking. Indeed, there is a pressing need for educators to understand how to help students acquire online help-seeking skills more effectively. To this end, a thorough understanding of the predictive factors of online help seeking is essential for the design and implementation of successful instructional strategies.

2.2. Factors influencing online help seeking

The factors examined in this study include four individual factors and one contextual factor. The four individual factors are 1) epistemological belief, 2) interest, 3) learning proficiency level, and 4) prior knowledge of the subject. The contextual factor is problem difficulty.

First, epistemological belief refers to individuals' beliefs about the nature of knowledge and knowing. More specifically, beliefs about knowledge are beliefs about certainty of knowledge and structure of knowledge (Hofer, 2000; Muis, 2007), while, beliefs about knowing refer to beliefs about source of knowledge and justification for knowing (Strømsø & Bråten, 2010; Hofer, 2004; Karabenick & Moosa, 2005). This study focused on exploring whether beliefs about sources of knowledge could predict the choices of college students about online help-seeking approaches. Cheng and Tsai (2011), Muis and Franco (2009), and Strømsø and Bråten (2010) indicated that beliefs about the source of knowledge are likely to be related to students' choices of help-seeking approaches. Lee, Chiu, Liang, and Tsai (2014) found that students, who tended to ask for help from teachers, believed that knowledge was transmitted from external authorities, while students who tended to ask their peers or search for relevant information believed that knowledge from different sources should be evaluated and compared.

Second, interest refers to learners' interests in the topic of a course. Students with weaker interests often have fewer incentives to learn, so they may focus only on satisfying performance requirement of the course, and prefer more certain answers from teachers to their questions (Beal, Qu, & Lee, 2008). Students with stronger interests can be motivated to spend more time on learning and often achieve superior learning outcomes. As a result, they may prefer searching online to retrieve abundant relevant information rather than relying on asking other people (Boscolo & Mason, 2003; Schiefele, 1996). That is to say, stronger interests may motivate students to search online rather than asking others for help online.

Third, learning proficiency level refers to the general aptitude and experience of a student, which usually represent the learning duration in a field. Students with little or no learning experience in a field are deemed as novice learners, while students with rich learning experience within a field of study are deemed to be expert learners. Prior research has identified that novice learners are more easily deterred by complex problems, more dependent on authorities, and less effective in deciding on whether or when to seek help (Kitsantas & Zimmerman, 2002; Yang & Taylor, 2013). Expert learners, in contrast to novice learners, may have better self-regulation and well-developed help-seeking strategies (Wirth & Leutner, 2008; Zimmerman, 2008). Moreover, expert learners may also have more experience and skills in soliciting relevant information through online searching (Karlsson et al., 2012). Therefore, novice learners may tend to depend on asking people online, while expert learners may use a combination strategy of online searching and asking people online to maximize their learning.

Fourth, different from learning proficiency level, prior knowledge of the learning subject refers specifically to learners' prior knowledge of the current learning and teaching content of a course. Students with less prior knowledge may need more time to process information and to form questions and queries (Bartholomè, Stahl, Pieschl, & Bromme, 2006; Byström & Hansen, 2005; Li & Belkin, 2010). Search engines are limited in helping an individual modify and improve their queries, so students may fail to solicit relevant information from online searching if they use wrong queries (Puustinen & Rouet, 2009). In contrast, human experts can fully adapt to students' problems or

questions and provide relevant answers. Therefore, students with less prior knowledge are expected to ask help from others online rather than use search engines.

Problem difficulty is the contextual factor examined in this study. Problem difficulty is attributed to 1) problem scale and 2) attainment level of knowledge (Jonassen & Hung, 2008). Problem scale refers to the number of embedded sub-problems (Jonassen & Hung, 2008; Kotovsky, Hays, & Simon, 1985). Attainment level of knowledge refers to the difficulty of the concepts that must be applied to problem solving (Kotovsky et al., 1985). Bigger problem scales and higher levels of knowledge attainment are associated with more difficult problems. The implication is that students may become more dependent on information provided by experts rather than trying to find their own solutions when facing a difficult problem (Li & Belkin, 2010). As a result, students may prefer asking teachers online for help, rather than asking peers or online searching when facing difficult problems.

3. Research questions

The research questions that guided this study were:

1. How do computer science students seek help online?
2. How is computer science students' academic performance related to their online help seeking?
3. How do epistemological belief, interest, learning proficiency level, prior knowledge of the learning subject, and problem difficulty predict computer science students' online help seeking in terms of online searching, asking teachers online for help, and asking peers online for help?

4. Research design

4.1. Participants

Two groups of 219 computer science students from a large research university (> 75% of all current undergraduate computer science students) in the southeastern United States were invited to participate in this study. One group included 169 students enrolled in two same entry-level courses of computer science taught by the same teacher. The other group was comprised of 50 students who enrolled in an advanced course of computer science. The latter group had completed at least 4 different prerequisite courses in computer science prior to the current course. The former group of students were identified as novice learners, while the latter group of students were identified as expert students.

4.2. Survey design

A survey developed by the authors was used to measure participants' frequency of online help-seeking behaviors regarding four proposed factors (epistemological belief, interest, prior knowledge of the learning subject, and problem difficulty). The fifth factor, learning proficiency level, identified which group participants belong to. The survey had 13 questions divided into 2 sections. The first section had questions measuring the frequency of students' online help-seeking activities. The second section had questions measuring

the four potential factors influencing online help seeking, and each factor was measured by two or three questions. All questions adopted a four point Likert-scale format (see Appendix I).

The survey was distributed to all students online by the end of their semester. 207 students (166 novice students and 41 expert students) chose to participate in the study and completed the survey. Participants' final scores of the courses they enrolled in were collected from instructors after the semester.

4.3. Data analysis

Descriptive data analysis and t-tests were applied to answer the first research question "How do computer science students seek help online". Kendall rank correlation analysis was conducted to answer the second research question "How is computer science students' academic performance related to their online help seeking". Explorative factor analysis was conducted to confirm the validity and reliability of the survey used in this study. After that, multiple regression was used to answer the third question "How do epistemological belief, interest, learning proficiency level, prior knowledge of the learning subject, and problem difficulty predict computer science students' online help seeking in terms of online searching, asking teachers online for help, and asking peers online for help".

4.3.1. Factor analysis of survey on online help seeking: Validity and reliability

An exploratory factor analysis was conducted on the 10 survey questions measuring the proposed four factors with oblique rotation (varimax). The Kaiser-Meyer-Olkin (KMO) measure verified the sampling adequacy for the analysis KMO = .65. The overall reliability α is .69. Four factors with eigenvalues over Kaiser's criterion 1 emerged, and explained 52.56% of the variance in total (Table 1).

Table 1
Exploratory factor analysis on 10 questions on online help seeking

| Item | Pattern matrix | | | |
	Interest	Prior Knowledge	Epistemological belief	Problem difficulty
1. LearnLike	.83			
2. LearnWill	.76			
3. CourseWill	.66			
4. PriorKnow		.99		
5. PriorExp		.66		
6. DifIncAsk				.85
7. DifIncSearch				.46
8. SelfLearnPerc			.52	
9. SelfLearnLike			.82	
10. ClassLearnDis			.49	
Reliability Coefficient (α)	.78	.79	.61	.61

Note. Overall α= .69, total variance explained=56.25%.
LearnLike: Interests in course content; LearnWill: Willingness to master course content; CourseWill: Willingness to take such an elective course; PriorKnow: Prior knowledge; PriorExp: Prior learning experience; DifIncAsk: Willingness to ask for help online when difficulty increases; DifIncSearch: Willingness to search online when difficulty increases; SelfLearnPerc: Perception of self-learning; SelfLearnLike: Preference of self-learning; ClassLearnDis: Dislike of classroom learning

5. Results

5.1. How do computer science students seek help online?

Data from 207 participants were used for analysis. Descriptive summaries of how students seek help online are presented in Table 2.

Table 2
Descriptive analysis of online help seeking

	Novice students		Expert students		Total	
	Mean	SD	Mean	SD	Mean	SD
Online searching	2.88	0.82	3.46	0.78	3.00	0.84
Asking teachers online for help	2.02	0.80	2.29	0.81	2.07	0.81
Asking peers online for help	2.53	0.91	2.90	0.77	2.60	0.89

A t-test was applied to explore the difference in online help seeking between the novice students and the expert students. The result indicated that a significant difference existed in online searching [t (205) = -4.11, p < .01] and asking peers online for help [t (205) = -2.42, p < .05]. No statistically significant difference was found in asking teachers online for help between the novice students and the expert students.

Permutation tests were used to examine the differences among three online help-seeking behaviors of all students. The result indicated that students searched online [Mean (total) = 3.00] more frequently than asked peers online for help [Mean (total) = 2.60] (Difference between Means = .39, p < .01), and asked peers online for help significantly more frequently than asked teachers for help online [Mean (total) = 2.07] (Difference between Means = .53, p < .01).

5.2. How is computer science students' academic performance related to their online help seeking?

A Kendall rank correlation analysis was applied to explore the relationship between academic performance and online help-seeking behavior. Students' grades were transformed into Z-scores to represent their academic performance because the measurements, such as assignments and exams, were different for two groups of students. The result suggested that students with better academic performance tended to seek help more frequently by online searching (τ = .22, p < .01), asking peers online for help (τ = .13, p < .05) and asking teachers online for help (τ = .12, p < .05).

5.3. To what extent can the proposed factors predict computer science students' three types of online help seeking?

Multiple regression was conducted to explore the predictive power of the proposed factors, such as epistemological belief, interest, learning proficiency level, prior knowledge of the learning subject, and problem difficulty, on three types of online help-

seeking behaviors respectively. Factor scores generated in explorative factor analysis were used as the independent variables for the factors as epistemological belief, interest, prior knowledge of the learning subject, and problem difficulty.

Three prediction models were constructed on online searching, asking teachers online for help and asking peers online for help. Multicollinearity diagnostics and cross validation were conducted on each model. The Variance Inflation Factor of all the predictors was smaller than 2.5 in each model.

In the model of online searching, 26.9% of variance ($R^2 = .269$, $p < .00$) of the dependent variables were accounted for in total. Learning proficiency level ($t = 3.97$, $p < .00$), epistemological belief ($t = 5.93$, $p < .00$) and problem difficulty ($t = 3.84$, $p < .00$) were significant predictors (Table 3).

Table 3
Multiple regression analysis on online searching

	R^2	R^2_{adj}	ΔF	β	t
Online searching	.269	.251	14.82		
Learning proficiency level				.25***	3.97
Interest				-.04	-0.70
Prior knowledge of the learning subject				-.01	-0.10
Epistemological belief				.36***	5.93
Problem difficulty				.23***	3.84

*Note. * p < .05; ** p < 0.01; *** p < .001*

In the model of asking teachers online for help, 6.3% of variance ($R^2 = .063$, $p < .05$) of the dependent variables were accounted for in total. The only significant predictor was problem difficulty ($t = 2.64$, $p < .05$) (Table 4).

Table 4
Multiple regression analysis on asking teachers online for help

	R^2	R^2_{adj}	ΔF	β	t
Asking teachers for help online	.063	.04	2.72		
Learning proficiency level				.13	1.91
Interest				-.01	-0.15
Prior knowledge of the learning subject				.06	0.87
Epistemological belief				-.10	-1.52
Problem difficulty				.18*	2.64

*Note. * p < .05; ** p < 0.01; *** p < .001*

In the model of asking peers online for help, 21.9% of variance ($R^2 = .219$, $p < .00$) of the dependent variables were accounted for in total. Interest ($t = -3.99$, $p < .00$) and problem difficulty ($t = 5.28$, $p < .00$) were significant predictors (Table 5).

Table 5
Multiple regression analysis on asking peers online for help

	R^2	R^2_{adj}	ΔF	β	t
Asking peers online for help	.219	.20	11.30		
Learning proficiency level				.12*	1.86
Interest				-.25***	-3.99
Prior knowledge of the learning subject				.09	1.38
Epistemological belief				.10	1.56
Problem difficulty				.33***	5.28

*Note. * $p < .05$; ** $p < 0.01$; *** $p < .001$*

6. Discussion

6.1. How do computer science students seek help online?

This study contributes to the literature of help seeking by a) demonstrating that online searching should be considered as an integrated part of online help seeking, and b) discovering the difference of online help-seeking behaviors between novice and expert students.

Help seeking was defined narrowly in most prior studies. In particular, only seeking social assistance was counted as help seeking, while online searching was deemed as a topic that should be addressed by other academic fields (Zimmerman & Pons, 1986). Although Puustinen and Rouet (2009) and Cheng and Tsai (2011) called for the emergence of seeking social assistance and information, they did not provide evidence supporting such a claim. The findings of this study showed that students tended to search online more frequently than asking people for help online, which provides fine-grained evidence supporting that online searching should be considered as an integrated part of online help seeking.

This study also found that expert students tended to search online significantly more frequently than their novice counterparts. One possibility is that some novice learners were not fully aware of the potential benefits of online searching and asking people online for help. The other possibility is that novice learners had difficulties in forming the right questions or search terms that needed to be applied when using these two help-seeking approaches. This finding indicated that developing novice learners' awareness of different help-seeking approaches or deliberate training on their question phrasing might be necessary.

6.2. How is computer science students' academic performance related to their online help seeking?

The findings of this study expanded the discussion regarding the relationship between students' academic performance and help seeking. Students' academic performance was found to be positively correlated with all types of all online help seeking. Although this

finding was congruent with the findings of Kumrow (2007) and Mäkitalo-Siegl and Fischer's (2011), their studies did not consider online searching as a help-seeking approach. Online searching had the strongest correlation with academic performance, which indicated that online searching, as a help-seeking approach, might need more attention from educators. Skills to solicit relevant information from search engines can provide students with more opportunities for just-in-time learning, but also may require additional training.

6.3. To what extent can the proposed factors predict computer science students' three types of online help seeking?

To encourage students to fully take advantage of online help seeking is becoming increasingly urgent, as student-teacher ratio keeps growing. The findings on predictors of online help seeking of this study shed light on this question by providing guidelines for practice and future studies.

Firstly, deliberate instruction is necessary to develop students' awareness of using online searching for help seeking. Epistemological belief was found one of the most powerful predictors for online searching, which indicated that the acceptance of independent learning as a knowledge source is important for students to take advantage of online searching in problem solving.

Secondly, asking teachers online for help may not be well aligned with online searching and asking peers online for help. The proposed factors, including epistemological belief, interest, learning proficiency level, prior knowledge of the learning subject, and problem difficulty, have strong predictive power on online searching and asking peers online for help, but relatively weak predictive power on asking teachers online for help. This finding indicated that online searching and asking peers online for help shared some similarities, but they differed considerably from asking teachers online for help. Given that students also reported that they searched online and asked peers for help online more frequently, future research may give more focus to online searching and asking peers online for help.

Lastly, more fine-grained evidences regarding differences between novice and expert learners on online help-seeking behaviors are critical in answering the question how to encourage students to seek help online. Learning proficiency level was found a significant predictor for all three types of online help seeking. Expert learners tended to use all different types of online help-seeking approaches, especially online searching, more frequently than novice learners when encountering difficulties. A possible reason for the difference may be rooted in differences in their problem solving process. Novice learners might have difficulties in breaking down problems into smaller pieces, and therefore are less able to express the problem as a question for peers or a query for search engines. Future studies can focus on the more fine-grained difference in online help seeking between novice and expert learners.

7. Limitations

All participants of this study came from the same university due to resource limits. Therefore, whether the findings of this study can be generalized needs further examination in future studies. Stratified sampling on a larger sample could be adopted in future studies.

Survey was the only tool used in this study to explore students' online help-seeking behaviors, so the realism level might be negatively affected because participants were not studied in the context where they sought help online in their learning. Future studies may consider measuring students' online help seeking using other options, such as tracking students' online interaction in authentic learning environments.

8. Concluding remarks

Online help-seeking skills are essential in order for students to take full advantage of online resources in the learning process. Accordingly, it is crucial to gain a better understanding about how students can be supported in developing the skills and competences to engage in online help seeking most effectively. This research sought to respond to this issue by shedding light on the factors that affect online help-seeking behaviors among college students studying computer science.

The findings reinforce the notion that online searching should be considered as an integrated part of online help seeking and also identified a relationship among online help seeking, learning proficiency and academic performance. In particular, the research found that students with higher learning proficiency or better academic performance were more inclined to search online, and asked peers online for help more frequently than lower performing students.

In addition, the five proposed factors, including learners' interest, prior knowledge, epistemological belief, learning proficiency and problem difficulty, influenced online help seeking to various extents. The implications of these findings are significant and can be used as guidance for the design and implementation of strategies to facilitate online help seeking among students. In particular, based on our research, we wish to note that deliberate instruction is required to better support novice learners in engaging in independent learning through using open education resources, devising relevant questions and forming queries in online searches.

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Appendix I

Survey: What factors influencing online help seeking

Section 1

1. When you find difficulties in solving problems (e.g., algorithmic problems - find the mode from an array of integers) in assignments, how often do you search online to learn about it?

A. Never   B. Seldom   C. Sometimes   D. Often

2. When you find difficulties in solving problems (e.g., algorithmic problems - find the mode from an array of integers) in assignments, how often do you email the teacher or teaching assistant for help?

A. Never   B. Seldom   C. Sometimes   D. Often

3. When you find difficulties in solving problems (e.g., algorithmic problems - find the mode from an array of integers) in assignments, how often do you ask your peers or some unknown experts online for help?

A. Never   B. Seldom   C. Sometimes   D. Often

Section 2

1. I am interested in the learning content of the class.

A. Strongly disagree   B. Disagree   C. Agree   D. Strongly agree

2. I would like to master the learning content of the course I am taking.

A. Strongly disagree   B. Disagree   C. Agree   D. Strongly agree

3. I would still like to take the course if it is elective.

A. Strongly disagree   B. Disagree   C. Agree   D. Strongly agree

4. I have prior knowledge of the learning content of the course.

A. Strongly disagree   B. Disagree   C. Agree   D. Strongly agree

5. I have related learning experience before taking the course.

A. Strongly disagree   B. Disagree   C. Agree   D. Strongly agree

6. I will become more willingly to seek help from others online if the learning task I have problems with is very complex.

A. Strongly disagree   B. Disagree   C. Agree   D. Strongly agree

7. I will become less willingly to search online if the learning task I have problems with is very complex.

A. Strongly disagree   B. Disagree   C. Agree   D. Strongly agree

8. I believe that one can master knowledge and skills of certain subjects (e.g., coding) by learning independently with the open online resources and search engines.

A. Strongly disagree   B. Disagree   C. Agree   D. Strongly agree

9. I think self-paced learning with search engines, online open resources, and helps from others online is a very important way to learn.

A. Strongly disagree   B. Disagree   C. Agree   D. Strongly agree

10. I think learning with an expert (physically present) through lecture or class is the best way to learn.

A. Strongly disagree   B. Disagree   C. Agree   D. Strongly agree