

# Determining the Difficulty Level of Tasks in Online Courses

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Received: September 8, 2020

Accepted: October 28, 2020

Online Published: October 31, 2020

doi:10.5430/ijhe.v9n8p40

URL: <https://doi.org/10.5430/ijhe.v9n8p40>

## Abstract

Online courses on different platforms provide thousands of students with the knowledge and skills they need. This paper presents the results of a survey of students, during which they expressed their opinion on the use of electronic resources in teaching. The survey showed that students are more motivated to study when they understand how their knowledge will be used in their professional activities. The survey results also showed that the objectivity of knowledge control is essential. Students are usually familiar with the criteria for assessing the performance of the task. Knowing the criteria for evaluating the task itself, understanding why it is possible to get this particular number of points for completing the task will help students to approach their studies more responsibly. We analyzed the tasks that will be offered to students in the course of learning the MAXScript language. These tasks are assessed according to factors that affect their complexity and the maximum number of points that students can receive for their correct performance. The resulting complexity value can be adjusted after analyzing the scripts written and the trainees' time. This approach to assessing tasks can be applied in the study of information technology and other disciplines.

**Keywords:** learning tasks, online courses, interactive tasks, e-learning, knowledge control, difficulty level

## 1. Introduction

Lately, e-learning is employed in educational institutions and organizations to improve the competence of employees. New technologies and devices are being developed for the improvement and successful implementation of e-learning systems. Utilizing cloud applications is becoming relevant to developing electronic educational resources and online courses (Hussein & Hilmi, 2020). Videoconferencing is broadly adopted; they grant ample opportunities for participants in the educational process and lead to the intensification of learning (Alshahrani et al., 2019). When using online courses, the presentation of theoretical material, students' independent work, and control of knowledge are essential. Experts consider different approaches to explain a new topic. A virtual classroom is a valuable educational institution method in studying theoretical material (Theelen et al., 2020). Virtual laboratories and computer simulations are increasingly applied to process skills (Gubsky et al., 2019). Experts consider the features of independent work in e-learning. For example, studies comparing online and traditional formats of homework (independent) tasks were systematized.

In most cases, online homework has been determined to increase student achievement and learning engagement (Magalhães et al., 2020). Educators and creators of online courses pay special attention to the issues of the overburdening of students. After evaluating students' time to complete tasks during the passage of five courses, it was found that a load of students may exceed the planned (Northrup-Snyder et al., 2020). Thus, the study of the structure, content of online courses, and learning outcomes remain relevant.

## 2. Methods

A survey of students was conducted; the answers received were analyzed, and the complexity of the proposed educational tasks for writing scripts was estimated.

### 3. Results and Discussion

A survey of students learning at the Institute of Computational Mathematics and Information Technologies of the Kazan Federal University was conducted using the focus group method to study the issues of using information and communication technologies (ICT) and electronic educational resources (EER) in the learning process. The surveyed group consisted of first to fourth-year students trained according to undergraduate programs, as well as students enrolled in master's programs. The total number of respondents was 100 people. All respondents indicated that they use a personal computer (PC) and a smartphone in education and in everyday life. It should be borne in mind that modern smartphones' software is in no way inferior to the software of some PCs and sometimes even surpasses them.

As part of the survey, the following questions were asked:

1. Did you use e-learning resources in your studies at the university (before learning through Microsoft Teams)?

Eighty-seven percent of the respondents answered affirmatively to this question, which shows students' readiness to study using EER. Students indicated courses posted on the distance education website (<https://edu.kpfu.ru/>) and other resources recommended by teachers.

2. Have you used e-learning resources outside of your university studies? What electronic educational resources would you recommend for use in the educational process?

Ninety per cents of the respondents answered positively. The frequently encountered resources in the answers were:

- a. skillbox.ru, which is an online university teaching professions in the field of project management, design, marketing, and programming;
- b. stepik.org, which is a platform for free online courses;
- c. metanit.com which is an information and educational site aimed at learning programming languages;
- d. coursera.org, which is an online education platform;
- e. openedu.ru, which is free courses from leading Russian universities.

During a series of clarifying interviews, it was revealed that all modern technologies are used on these services; there are laconic inserts of audio and video materials here; the materials presented are relevant, and the students understand the ultimate goal of studying the subject in which profession the acquired knowledge will be useful.

According to students, understanding how the acquired knowledge will be used in practice is a strong stimulus to learning. Therefore, we analyzed practical tasks for students in the course "Computer graphics and design". The majority of students choose this course; the students clearly understand how their skills and abilities can be applied in future professional activities (Minnegalieva et al., 2020).

The knowledge control unit is a mandatory part of online courses. Various aspects of knowledge control are currently being considered, including such as completing the base of learning tasks (Ratnayake et al., 2020). Assessment of completed tasks has been sufficiently studied for tasks with a specific answer. But, for example, evaluating compositions or essays is a very difficult process. The need for objective and quick evaluations increases the need for a system that could automatically evaluate essay questions (Hussein et al., 2019). Note that students' interest grows when they understand why a given number of points evaluates the task (Goff et al., 2020).

Usually, the "weight" of the completed task, that is, how many points a student will receive for each completed task during testing, is determined by the teacher. In doing so, he/she relies on his/her experience and takes into account the results of previous tasks by students. The conducted surveys among students show that they still have questions on the evaluation of tasks; students do not always understand why the completed task is evaluated with more or fewer points.

The completion of most educational tasks consists of the main stages:

The first is the process of understanding the content of the task, and the process of identification of an informational or mathematical model;

The second is the development of a solution plan;

The third is the practical implementation of the developed plan for solving or implementing the requirements of the information structure of the task itself;

And besides, we can consider the fourth stage, i.e., control of the work performed and return from the information structure level to the level of the original task's text content.

In (Starygina & Nuriyev, 2016), a fundamental law is considered, the essence of which is that a person solves any problem in three operations. The first operation is to formalize the problem. That is, a student transforms the problem to be solved into an analog of the problem known to him/her. The second operation is the construction of a plan for solving the problem. The third operation is the execution of these plans in a real or virtual environment. The authors consider a model where the problem of complexity  $S$  is transformed into a result under the control of formalization, constructive, and performance abilities. The result of completing any task depends on its complexity.

When solving mathematics problems, one can distinguish between the concepts of "difficulty" and "complexity", meaning the difficulty and complexity of an educational task's informational structure. These concepts are closely interrelated and have a similar meaning in ordinary life. In (Gilmanov, 1994; Halupa, 2019), the main source of difficulty is the choice of inferences and the development of a plan for solving a problem in mathematics. The difficulty of completing a learning task is determined through the solution process and the implementation of individual actions. For some mathematics problems, we can preliminary estimate the complexity of the problems using the computer algebra system Wolfram Mathematica. For example, the LeafCount function determines the number of indivisible subexpressions in a given expression. We can visually estimate the complexity of the expression and the task's complexity using the TreeForm command.

If we consider learning tasks in the general case, the factors influencing the complexity of learning tasks are:

- 1) The proximity of the desired result (answer) to the content of the educational material;
- 2) The completeness and nature of the presentation in the setting of information for the task necessary to solve it (can be presented in the form of recommendations, instructions, links, leading questions, etc.);
- 3) The amount of information that must be involved to complete the learning task, its distribution over the course content, the complexity of its reproduction from memory;
- 4) The complexity of the solution method (the number of its stages, the nature of transitions between them, the number of exceptions to the rules, etc.);
- 5) The composition and nature of the relations linking the verified provisions of the educational material, which must be taken into account when performing the task;
- 6) The form of presentation of the task set and the result (from the point of view of their clarity) (Bashmakov & Bashmakov, 2003).

Let's consider the estimation of the complexity level of tasks for creating scripts using MAXScript in Autodesk 3ds Max. We estimated the influence of each factor on the complexity with the maximum number of 1. That is, 0 is easy, 1 is the most difficult. Due to the specifics of the tasks, we do not evaluate factor 5.

Task 1. Write a script that demonstrates the movement of a sphere along a sinusoid.

The commands for creating a sphere and assigning parameters are necessary; their examples are presented in theory studying unit. That is, the task is close enough to the content of the educational material. Therefore, we estimate the first factor as 0.2 with a maximum value of 1. An example of working with animation is given in the supplementary material. For complete information, the student must study it; the completeness is estimated at 0.8 out of 1. The amount of information is small. Therefore it is equal to 0.3. The complexity of the solution method is 0.4. There are no additional requirements for visibility in this example, but the students need to scale them to represent the result, so we estimate it as 0.3. The solution is shown in Figure 1.

```

s=sphere()
s.radius=5
animate on
(for i=1 to 100 do(
at time i (s.pos=[i,1,sin (i/180)])
)
)

```

Figure 1. A script that demonstrates the movement of a sphere along a sinusoid

Task 2. Write a script that demonstrates the movement of molecules in a gaseous state of matter.

When completing this task, it is necessary to study more additional material; the required amount of information is more; the solution is performed in several stages; there are specific requirements for visibility. The values are shown in Table 1; an approximate result of execution with a script fragment is shown in Figure 2.

```

for i=1 to 15 do (
a=random -50 50
    b=random -50 50
    c=random 1 100
    d=random -90 90
s=sphere()
s.radius=5
s.wirecolor=(color 0 0 255)
    s.pos=[a,b,c]
s1=sphere()
s1.wirecolor=(color 133 133 250)
s1.radius=3

```

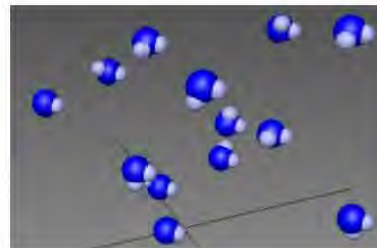


Figure 2. The code fragment and an example of the result for the task 2

Task 3. Write a script that creates a rollout that can be used to create a table.

In this case, the amount of information being checked is greater; there are requirements for visibility; the number of stages in the solution is less than that of 2<sup>nd</sup> task. The values of the parameters affecting the complexity are given in Table 1.

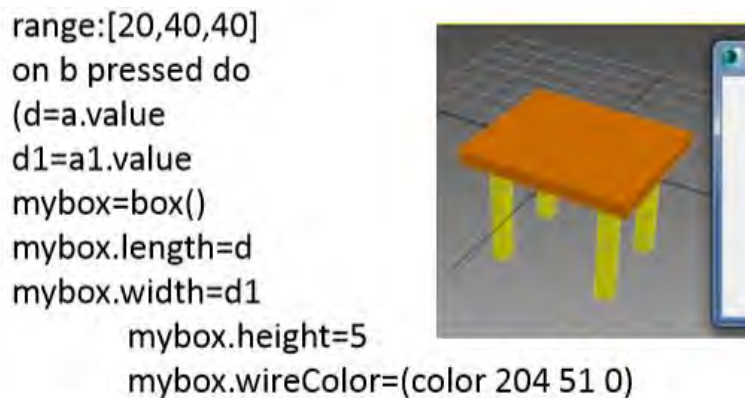


Figure 3. Code snippet and example of the result of performing the task 3

Table 1. parameters affecting the complexity

Task number	max	1	2	3
Relevance to the content of educational material	1	0,2	0,4	0,4
Completeness of information	1	0,8	0,8	0,8
Amount of information	1	0,3	0,8	0,9
Complexity of the solution method	1	0,4	1	0,8
Result presentation	1	0,3	1	1
Total	5	2,0	4,0	3,9

#### 4. Summary

When using both traditional and distance learning forms, the objectivity of knowledge control is important. Students are more interested when they know all the criteria. In particular, if they are familiar with how the maximum points for the task are determined. As shown in Table 1, the influence of the teacher or methodologist's subjective opinion will remain in determining the points. Nevertheless, in this case, the factors that affect the level of difficulty are named; students will understand why they can earn more or fewer points, respectively, the control of knowledge will be carried out more objectively, which will affect the learning outcomes.

#### 5. Conclusions

The survey has shown that students are more motivated to learn when they understand the need for specific skills for a successful career. Also, students want to know the criteria for evaluating the tasks themselves and their implementation results. Scripting tasks were analyzed while studying Autodesk 3 ds Max application. The factors that influence the complexity of the tasks are evaluated. This approach to assessing the "weight" of tasks can be applied in the study of different disciplines.

#### Acknowledgements

The work is performed according to the Russian Government Program of Competitive Growth of Kazan Federal University.

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