STUDENT INTEREST AND CHOICE IN PROGRAMMING ASSIGNMENTS

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ABSTRACT

This paper describes a study, conducted in an introductory programming course, on the factors that make students interested in programming assignments. These factors include whether the assignment is perceived as easy or difficult, and the paper analyzes these in detail. There are also significant factors involving the end product of the assignment. The study also looks at the impact of these interest factors on choice, when students must actually choose a program to write. The same factors are involved, but some become more important while others become correspondingly less important. These observations may be useful for instructors considering the design of assignments or the role of student choice in introductory programming courses.

INTRODUCTION

Introductory programming courses typically see a wide range of student aptitude. Faced with this diversity, computer science educators may struggle to design programming exercises. Easier assignments are trivial for high-aptitude students, but harder assignments may not be effective learning experiences for low-aptitude students.

Ideally, each student would perform exercises at an individually appropriate level, working up to more challenging levels over time. It is interesting to note that this is exactly what modern video games get players to do. Education researcher James Gee suggests that these games encourage learning because they "operate at the outer edge of a player's growing competence" [4].

Perhaps we could create a similar learning environment by designing exercises with a range of difficulty and encouraging students to choose the ones that interest them. If challenges just at the edge of our comfort zone are the most interesting, this framework could be very effective. However, it is worth asking whether student interest in programs really would follow this pattern.

I have conducted a small study on this topic at my undergraduate liberal arts institution. This paper presents the results of that study, and attempts to answer the following questions:

- Are my introductory programming students truly most interested in mild challenges?
- Other than the level of challenge, what other factors affect my students' interest in programs?
- If I did give my students a choice of programs, what factors would most affect their choice?

BACKGROUND

The impact of interest on learning is well established in psychological research. Studies in this area most frequently focus on reading comprehension as the learning task, but their findings may apply more generally. In one early example, Hidi [6] found that interest in subject matter is correlated with motivation, and leads to higher attention, persistence, and memory. Ainley et al. [1] suggest an explanation: interest increases the emotional value of the reading, which encourages persistence. Edelson and Joseph [3] also found that interest leads to increased effort and a higher mastery of skills.

One study on mathematical word problems may be more directly applicable to the programming setting. Renninger et al. [7] found that interest in problem topics leads to higher focus and tolerance for frustration. However, they also had a cautionary finding: familiarity with a topic can lead to overconfidence in a problem solution.

Some educational research has also addressed the factors that promote student interest in learning activities. Tobias [8] argues that prior knowledge about the topic of a learning task is an important factor. Edelson and Joseph [3] suggest that the perceived usefulness of an activity is also relevant.

There are a few studies on student interest specifically in the programming setting. Hansen and Eddy [5] had CS2 students rank assignments by level of engagement and frustration, and found that the two were correlated. They proposed a measure that they call *niftiness*, which increases with engagement and decreases with frustration.

Cliburn and Miller [2] allowed their students to choose between three types of assignments: traditional, game-based, and story-based. A large majority chose the game assignments because they found games interesting. Story assignments were the least popular, but only because students found them to be too open-ended.

DATA COLLECTION

To answer the questions posed above, I conducted survey activities with students in my introductory programming course. Participation was voluntary and earned students a small amount of extra credit in the course. I conducted three different surveys, spread evenly throughout the semester, to increase the opportunities for participation.

I was able to collect data from 14 students, exactly half of my class of 28. Of these, 8 participated once, 3 participated twice, and 3 participated all three times. Based on their final grades, these students represented a good cross-section of the course: one ranked first in the class, one ranked 22nd, and the rest fell in between.

The surveys each presented a list of 7 program descriptions. Each description specified a program to be written in Python, using concepts recently covered in the course. Table 1 shows some examples. All of the programs were somewhat short, to keep the activity brief, since it was being conducted outside of class on a volunteer basis. None of the programs were games, since preferences for those are already known [2], but some did involve graphical displays. Graphics programs used a course library, a simple wrapper for Tkinter that allowed drawing, animation, and mouse interaction.

Given this list of programs, each survey asked students to do the following:

- Give each program an interest rating: *boring*, *neutral*, or *interesting*.
- Give each program a difficulty rating: *easy*, *moderate*, or *hard*.
- Choose one program to write.

The surveys asked students to provide written explanations for their ratings and their program choice. These questions were entirely open-ended, so that students were free to mention any relevant factor.

Table 1: A few examples of program descriptions from surveys.

Write a program that inputs people's weights and prints whether the total weight entered is safe for a 1000-pound capacity elevator.
Write a program that inputs a number and prints whether it is a power of two. A power of two can be divided by two repeatedly, and the result is always an even number, until it hits 1.
Write a program that draws animated circles moving randomly across the screen.

DATA ANALYSIS

Student responses explaining their interest ratings contained several strong themes. I extracted these six factors from their responses:

- The program involves graphics.
- The program has a useful practical application.
- The program is entertaining to use.
- The program connects to my major or hobby.
- The program looks challenging to write.
- The program looks easy to write.

Several of these factors focus on the end product of the assignment. Many students found programs that involved graphical displays to be more interesting than console programs. Others appreciated when they could see "a point" to a program, by which they meant either practical use or entertainment value. Connections to a major or hobby were important for some students.

The other factors focus on the perceived difficulty of the program. Two distinct preferences appeared here. Some students were more interested in programs that looked challenging, while others favored programs that looked easy.

Table 2 shows how many students mentioned each of these factors at some point during one of their surveys. Overall, end-product factors had substantially more impact on student interest than challenge factors did. Those who did mention challenge factors were approximately evenly split on whether they preferred easiness or difficulty.

When actually choosing a program to write, students explained their choices with the same factors. However, they cited some factors more frequently than before, and others less. Table 3 shows how many students mentioned each factor to explain a choice.

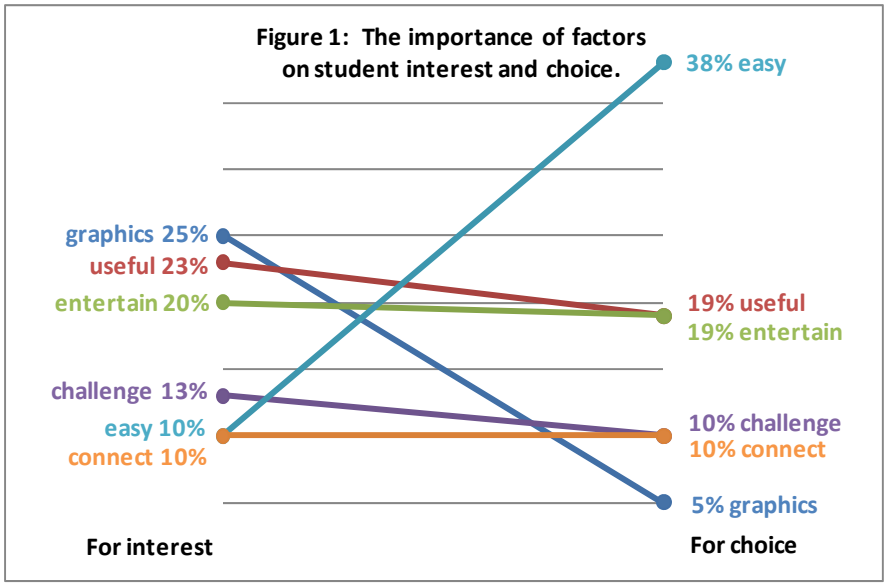
Table 2: How many of the 14 students mentioned each factor to explain an *interest*.

Interest factor	Number of students
Graphics	10
Useful	9
Entertaining	8
Challenging	5
Easy	4
Connects	4

Table 3: How many of the 14 students mentioned each factor to explain a *choice*.

Choice factor	Number of students
Easy	8
Useful	4
Entertaining	4
Challenging	2
Connects	2
Graphics	1

Figure 1 illustrates how factors influenced choice differently than interest. I estimated the *importance* of a factor as its percentage of the total weight in Table 2 or 3. In the shift from interest to choice, easiness went from being one of the least important factors to one of the most, and graphics went from being one of the most important to one of the least. The other factors remained relatively stable.



Tables 4 and 5 summarize the difficulty and interest ratings that students gave to programs. Overall, across all the programs, the most common difficulty rating was *moderate* and the most common interest rating was *interesting*. However, the programs students actually chose to write were most commonly rated *easy* for difficulty level and *interesting* for interest level.

Table 4: How many times students assigned each *difficulty* rating to a program.

Difficulty rating	All programs	Chosen programs
Easy	29	11
Moderate	40	10
Hard	20	2

Table 5: How many times students assigned each *interest* rating to a program.

Interest rating	All programs	Chosen programs
Interesting	37	15
Neutral	32	6
Boring	20	2

It is more informative to look at difficulty and interest ratings jointly. Table 6 summarizes the rating pairs that students gave to programs. Easy programs were most likely to be labeled boring, moderate programs neutral, and hard programs interesting. Table 7 shows the rating pairs only on programs that students chose to write. Programs labeled *moderate-interesting* were plentiful overall, so it is not surprising that students chose them frequently. However, *easy-interesting* programs were less frequent, and students appear to have chosen them disproportionately.

Table 6: How many times students assigned each rating pair to a program.

	Easy	Moderate	Hard
Interesting	7	18	12
Neutral	7	19	6
Boring	15	3	2

Table 7: How many times students assigned each rating pair to a *chosen* program.

	Easy	Moderate	Hard
Interesting	6	7	2
Neutral	4	2	0
Boring	1	1	0

DISCUSSION

Some of the interest factors my students cited resonate with previous studies. Edelson and Johnson found that usefulness is important in learning activities [3], and one of the top interest factors for my students was the usefulness of a program. Tobias claims that prior knowledge about a topic enhances interest [8], and some of my students were interested in programs because of connections with their majors or hobbies. Cliburn and Miller noted student preferences for games [2], and while none of the programs in this study were games, my students cited two interest factors – graphics and entertainment value – that are surely related.

The graphics factor had somewhat surprising effects: a strong impact on student interest, but a weak impact on student choice. The easiness factor made the opposite shift. This may indicate that students perceived graphics programs to be difficult, or that graphics were a surface attraction that they were willing to forego in exchange for expedience. Note that they were less willing to forego other factors, such as usefulness and entertainment value.

Overall, my students rated harder programs more interesting than easier ones. This lends some support to my conjecture that challenges just at the edge of our comfort zone are the most interesting. However, when offered a choice, my students disproportionately chose to write less challenging programs than their interest patterns had suggested. They did not typically choose boring programs – just ones that were interesting for reasons other than their challenge level. Note that these programs would score highly on Hansen and Eddy's *niftiness* scale [5].

At the beginning of this study, I was imagining a learning environment in which students chose among exercises of varying difficulty. Unfortunately, the study has negative implications for this type of learning environment. Rather than choosing programs at the optimal level of challenge, many students would choose easy programs that happen to contain other interest factors.

Instead, I plan to ensure that my homework assignments focus on the three most important interest factors for my students: graphics, usefulness, and entertainment value. Every program can include at least one of these factors, and most can contain more than one. It may always be challenging to cope with a wide range of student aptitude, but by focusing on these factors, I hope to increase motivation and persistence in all of my students.

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