DRAW-A-PROGRAMMER TEST AND FIRST RESULTS IN SLOVAKIA

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Abstract

We propose the Draw-a-Programmer Test (DAPT) that can be used to study the stereotypical perception of the professions in the ICT field. The test is administered by a survey where respondents are asked to draw a programmer (i.e., a software engineer), their colleagues, and their working environment. The survey form also contains background demographic questions and some cross-check questions.

In this work, we used the test on junior high school students with the aim to find out how they perceive the programmer's profession, and especially we focused on the gender of the perceived stereotype, in order to find out if both the boys and the girls could possibly identify with this profession.

We have collected data from 172 respondents – junior high school students aged 12–14 of which 92 were girls and 80 boys.

Our analysis showed that most respondents admit that a woman can be employed as a programmer. More than 62% of the students had this opinion. However, a more detailed analysis of the boys' vs. the girls' responses revealed that this high percentage was mainly achieved by the girls' answers. Up to 62.5% of boys see programming only as a male job, while more than 75% of female respondents consider it to be suitable for women. We consider this finding to be positive, as such a girls' opinion can direct their further education and career choices to the information technology area.

Keywords: drawing-based instrument, career prospects, ICT, gender issues.

1 INTRODUCTION

Nowadays, in most developed countries, gender is usually not an obstacle for men and women to choose a profession. However, traditional gender stereotypes may still exist in our minds more or less. We are interested in understanding the stereotypical perception of professions in the field of information and communication technology (ICT), and of the possible career prospects in this field in the population of junior high school students in the age in which they start to consider their future careers. Specifically, we are interested in understanding if this field is perceived as a suitable career prospect by boys and girls and surveying the prevalence of other common societal stereotypes associated with the ICT field.

To develop effective strategies that can encourage more female students to pursue ICT-related study programs and jobs, it is necessary to learn about the attitude of children and youth towards this field and their view of people working in the ICT area. According to Cheryan et al. [1] the stereotypes of academic fields influence who chooses to participate in these fields – whether male or female students. If the stereotype is incompatible with how women see themselves (e.g., “computer nerd” intensely focused on computers and lacking interpersonal skills), it is likely one of the most significant factors causing that women are highly underrepresented e.g. in computer science (a field studied by Cheryan et al.) but as well in other related fields.

Such stereotypes have been studied since the 1950s in the broad area of science [2]. In the 1980s Chambers developed the Draw-a-Scientist Test (DAST) [3]. The aim of DAST is to investigate a subject population’s perception of a scientist and the development of the common societal stereotypes associated with the scientist profession. Since then similar tests were used to investigate societal stereotypes associated with other professions, e.g. Draw-a-Computer-Scientist Test [4], and Draw-an-Engineer Test [5].

We propose a variant of DAST that we call Draw-a-Programmer Test (DAPT). The test is administered as a survey where respondents were asked to draw a programmer, their colleagues, and their working environment. The form also contained basic demographic questions and some cross-check questions.

In this study, we have collected data from 172 junior high school students aged 12–14 of which 92 were girls and 80 boys.

The test is evaluated by analyzing the drawings and noting common features that together form the stereotypical image of a programmer. If the typical stereotypical features are known one may focus on these, however, this was not the case in this work therefore we employed qualitative techniques to discover some of them. In our sample, the only significantly prevailing indicator of a programmer's stereotype seems to be working with a computer (99.4% incidence) in a simple office-like environment (77.9%). Of course for different research questions, one may look for different characteristics of the drawings.

Our main focus was on the gender perceived stereotype. While the greatest share of our respondents perceive programmers as male, in contrast to many similar studies involving DAST, DAET, and DACST tests surprisingly many draw programmers as female or both genders (62.4% of those where gender could be identified). This number increases to 75.3% if we only consider the girls' responses. We consider this an optimistic result, as it shows that these girls are not widely affected by societal prejudice against women's career in ICT (and in science and technology in general).

2 RELATED WORKS

2.1 Draw-a-Scientist Test

Research of the student view of scientists began five decades ago, with the work of Mead and Metraux [2] who conducted a study among 35,000 high school students. Students were asked to write an essay to describe their image of a scientist. The qualitative analysis of data from this survey brought the so-called standard image of a scientist usually depicting an elderly or middle-aged man who wears glasses and a white lab coat, and works in a laboratory surrounded by equipment such as test tubes, flasks, and bottles, bunsen burners, etc. [2]. This standard image was found to be stereotypical throughout the period of three decades [6].

Chambers conducted a study [3] with the objective to determine at what age children first develop distinctive images of a scientist. This led to the development of the Draw-a-Scientist Test (DAST) – a research instrument that can be utilized at an earlier age than instruments relying on verbal response and also enables comparison of groups using different languages without translation problems. The subjects are asked to "draw a picture of a scientist" to a blank piece of paper. Based partly on the previous studies, seven types of indicators of the standard image of a scientist were chosen, such as lab coat, eyeglasses, facial hair, symbols of research, symbols of knowledge, technology, and relevant captions. Each drawing is then analyzed and given a score indicating the extent to which the standard image was present.

The research showed that the stereotypical image of the scientist from previous studies among high school students appears already at the primary school level, with various stereotype indicators appearing more frequently in higher grades. Chambers also concluded that DAST is probably better in identifying than in attitude measurement and may, therefore, show to be more useful in hypothesis construction than in testing them.

During the next decades, a body of research on the perception of a scientist has been conducted with the people of all age categories [7], mostly using DAST as the research instrument. However, several authors [8, 9, 10] have criticised the extent to which the DAST can measure scientific literacy and demonstrated that modified wording of instructions can result in different test outcomes, e.g. more female scientists were drawn. Another criticism argued that DAST itself supported the existence of a stereotype by suggesting that there is such a thing as a typical scientist. Certain studies reported using DAST to measure the effectiveness of intervention programs designed to improve the image of a scientist and increase scientific literacy [11].

More recently, modifications of the DAST, such as Draw-an-Engineer Test (DAET) [5] and also Draw-a-Computer-Scientist Test (DACST) [4] have been developed.

2.2 Gender Issues

As mentioned above, the standard image describes the scientist as a man. This finding was confirmed not only in the first research using the DAST [3], where only 0.6% of drawings depicted a female scientist (all of them drawn by girls), but also by the outcomes of many following studies based on the

DAST which consistently report the masculine image of scientists held by students of all age categories [12, 13, 14, 15]. Two huge systematic reviews of DAST-studies [7, 16] conducted over fifty years also affirmed the persistency of these stereotypical perceptions.

Similar results can be ascertained in papers reporting the results of the research using the DAET [5, 17] as well as DACST [18, 19]. For example, in their study exploring the influence of an intervention on students' view of a computer scientist [19], Hansen et al. noticed that more girls drew a female computer scientist in the post-test than in the pre-test. A similarly oriented study has been conducted by Tsui [20] who unveiled differences in girls' perception of computer scientists before and after experiencing various computing activities in a summer day camp.

3 METHODOLOGY

For the purpose of investigation of the children's image of a programmer, we developed a research design partly inspired by Chambers's DAST [3]. As the research instrument, a test based on the Draw-an-Engineer Test [5] was proposed. The instrument is called Draw-a-Programmer Test (DAPT).

The test was performed using a survey form in which the students were first asked to fill in their basic demographic data, such as name, gender, and age, and then answer four questions, some of which were cross-check-questions (see Table 1). The questions were preceded by a written instruction that explained to the students we only were interested in their opinion, so they were expected to write and draw what they think about programming and not to worry about whether it is correct or not.

Table 1. Questions in the DAPT form.

1	In your own words, what is programming?
2	What does a programmer do at work?
3	Do you know someone who has this kind of job? Mark one of the answers: YES – NO
4	If yes, then what is their relation to you?

The opposite side of the form sheet provided an empty frame in which the students were instructed to draw a programmer, their colleagues, and their working environment. Examples of students' drawings are shown in Fig. 1.

Note that the word programmer here is to be understood in a wider context and thus e.g. Draw-a-Programmer and Draw-a-Software-Engineer tests would be just the same. We encourage researchers to choose the word most appropriate for their target respondents. (This may depend on country, age, or other factors.)

Due to some peculiarities of Slovak language (which has no gender-neutral designation of professions) we needed to be very careful in formulating all the DAPT questions in Slovak so as not to affect students' answers and drawings. The instruction for drawing a programmer has to be worded as follows: "Draw a picture of someone who is programming at work. Please also draw the work location and people who work together with this person." Also, question 2 needed to be phrased as "What does a person whose job is programming do at work?"

Testing was carried on at several junior high schools with seventh-grade students (age 12–14). The tests were administered during the classroom teaching mostly by the regular teacher of the students. Some of them were conducted by pre-service teachers during their training in junior high schools. The time reserved for testing was 20 minutes.

To analyze the drawings, qualitative and quantitative techniques were employed. As there was no standard image of a programmer before, we have not used a scoring system for a beforehand prepared list of stereotypical indicators, such as in the original Chambers's research [3]. Instead, the drawings were first explored and coded with the aim to identify frequently represented elements that could serve as possible indicators. Subsequently, three researchers examined the drawings for the presence of particular indicators and characteristics. Each individual result was taken into account only if all three researchers reached an agreement.

Figure 1. Two examples of students' drawings; the captions: "muž" means man and "žena" means woman

4 RESULTS

We collected drawings from 172 junior high school students, with the mean age 13.13 and a standard deviation of 0.6. The sample comprised 53.5% of girls and 46.5% of boys.

4.1 Gender of the Programmer

In the data analysis, we focused mainly on the gender issue and explored the number of drawings depicting female programmers. The gender analysis has been performed from several points of view.

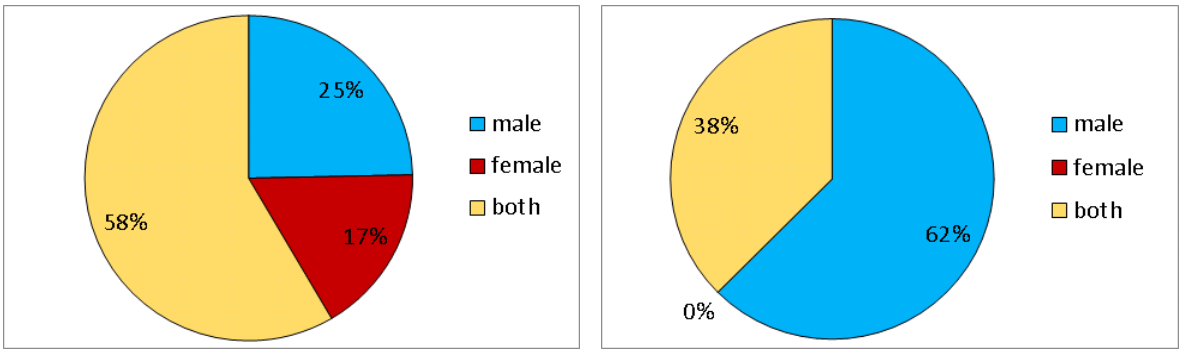
First, 8 drawings (4.7%) were excluded from this part of the examination because they did not contain any person, only the workplace was depicted. Subsequently, other 47 drawings (28.7%) were eliminated, since they portrayed people as stick figures and so they could not be coded for gender. This way, 40 boys' and 15 girls' drawings were excluded.

Out of the remaining 117 drawings, 44 (37.6%) depicted exclusively male programmers, while 13 drawings (11.1%) represented only female programmers. The drawings of the remaining 51.3% of students contained both male and female programmers. Thus, a total of 62.4% of students admitted of the female gender of a programmer.

When comparing the corpora of girls' and boys' drawings we came to the following results: 62.5% of boys depicted only male programmers, 37.5% of them drew programmers of both genders and no one pictured exclusively female programmers (see Fig. 2(b)). On the other hand, girls drew only a little more male than female programmers: 19 male and 13 female. However, these constitute only 24.7% and 16.9% of their drawings, as the remaining 58.4% of girls drew both male and female programmers (see Fig. 2(a)). So only 37.5% of boys admitted that women can also work as programmers, while among girls, as many as 75.3% did so.

Based on the background questions we also analyzed the view of different subgroups of the sample. We compared those who could have some possible prior knowledge of programmers with the students

who did not know any programmer; the students whose close relative was a programmer with the others; particular age categories, etc. None of these comparisons showed any significant differences or trends in displaying the gender of the programmer.



(a) (b)

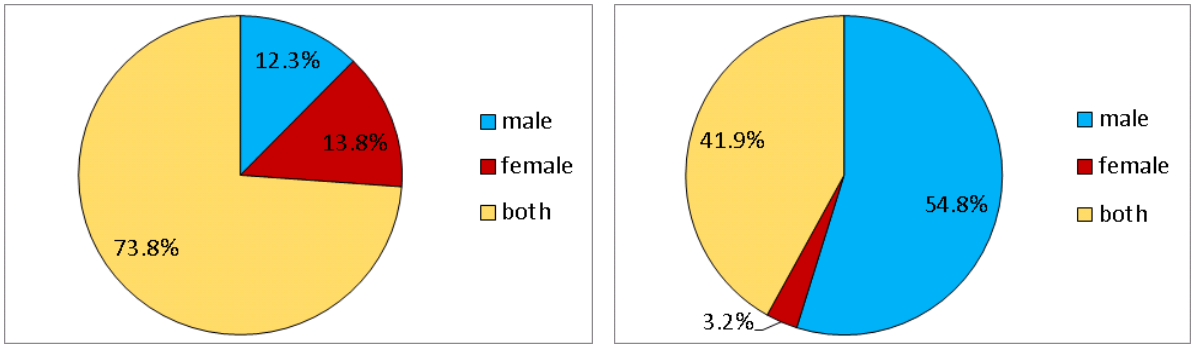
Figure 2. Programmer's gender (a) by girls and (b) by boys

4.2 Colleagues of the Programmer

When conducting the DAPT, children were instructed to draw not only the programmer but also their colleagues. Despite this instruction, 20.1% of all students did not draw any colleagues, which we interpret as thinking that the programmer is working alone. This is what 24% of boys and only 16.9% of girls think.

After cleaning the data set from 41 drawings not containing colleagues or even any people at all and 35 drawings with colleagues pictured as stick figures, we found out that 25 out of remaining 96 drawings (26%) contained entirely male colleagues, only 10 drawings (10.4%) depicted merely female colleagues, and the colleagues in the highest share of drawings – 63.5% – represented both male and female gender.

When analyzing the gender of the programmer's colleagues from girls' vs. boys' point of view the following outcomes were revealed: according to 54.8% of boys the programmer's colleagues are exclusively men, just 1 boy (3.2%) drew only female colleagues and 41.9% of boys think the programmer's colleagues can be as men so women (see Fig. 3(b)). Regarding the girls' drawings, we found only 12.3% of them that depicted only male colleagues, 13.8% of them depicting only female colleagues, and no fewer than 73.8% of them, where the colleagues were both male and female (see Fig. 3(a)).



(a) (b)

Figure 3. Gender of programmer's colleagues (a) by girls and (b) by boys

Altogether, up to 74% of all students assume that women can work as programmer's colleagues. However, this rather high percentage was attained thanks to the girls' drawings, because nearly 87.7% of them thought that a programmer's colleague can also be a woman, while only 45.2% of boys admitted this eventuality.

According to 86.3% of students, the programmer's colleagues are programmers as well, while a little more girls than boys think so (87.8% vs. 84.2%). Other clearly evident types of colleagues the

students drew, such as a boss, secretary, graphics or sound designer, engineer, and salesperson were represented only infrequently, always in one or two drawings. About 11.5% of drawings containing pictures of colleagues depicted an undistinguishable type of colleagues' job.

4.3 Indicators of the Programmers Image

Naturally, we were also interested in finding out what are the typical indicators of the standard image of a programmer. Apart from the indicators usually presented in the standard image of a scientist, we looked for features specific to programmers and their environment.

Nearly 78% of students think the programmer's workplace is just plain and only a little more than 22% of them have drawn certain elements of a comfortable environment such as a sofa, an indoor plant, a cat, etc. The opinion that the working environment is just simple prevails more in boys (83.8%), while 27.2% of girls drew a cozy space. In the group of students whose close relative is a programmer, even more drawings contained elements of a comfortable environment – their share was as high as 45.5%. However, this group constituted only 22 students.

In addition, 14.5% of students (16.3% of girls and 12.5% of boys) imagine the programmer's workplace as organized. Their drawings contained such elements as notice boards, charts, schedules, etc.

In several drawings, such components as coffee, energy drinks, tired red eyes, or the presence of the boss occurred. These attributes were interpreted as signs of a demanding job. At least one of these elements was present in up to 17.4% of all drawings, while more frequently in the boys' ones (22.5%).

When examining the tools that a programmer uses at work, nothing surprising was found. Desktop computers dominated other tools – they were displayed on 91.3% of drawings. Laptops were present in 17.4% of drawings. Altogether 99.4% of all drawings featured some type of computer. Other tools that students have drawn included high-tech gear (7%), remote controls (1.7%), and headsets (1.7%). These results did not vary significantly across different groups (girls vs. boys; those who know a programmer vs. who do not know any; particular age groups, etc.), except that the group of students whose close relative is a programmer featured a slightly increased incidence of high-tech gear (13.6%).

While more than half of the students did not include the results of the programmer's work in the picture, the rest of them (47.7%) did so. Several drawings even contained more than one type of outcome. However, in 16.3% of drawings, it was not possible to clearly identify the type of programmer's product. The remaining 31.4% of students included in their drawings the following outcomes: a program code (61.1%), robots (20.4%), applications (14.8%), graphics (14.8%), games (3.7%), and animations (1.9%).

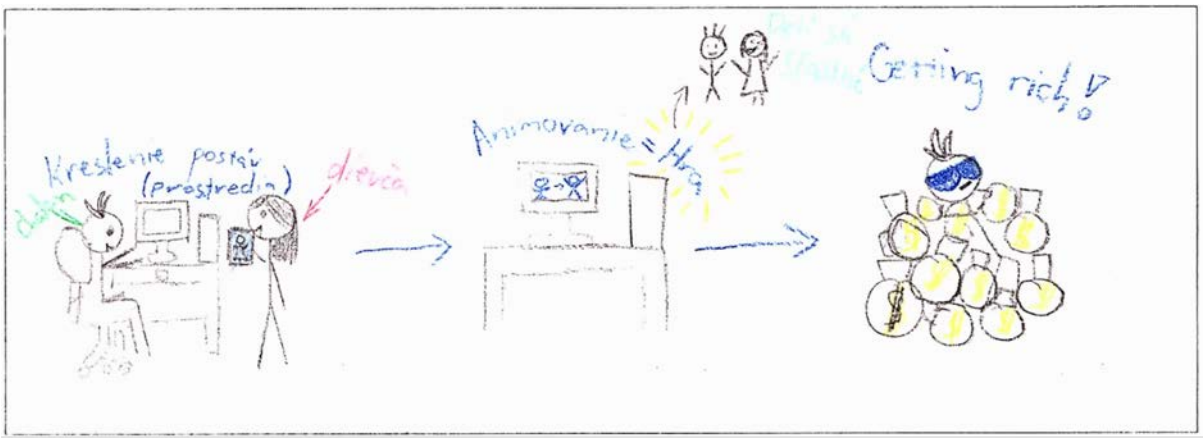


Figure 4. One of the drawings indicating a successful career

Among the students' drawings, there were also two indicating that the programmer's job can imply a successful career, one of them quite funny (see Fig. 4). However, we stress that in the overall sample this was an exception.

5 CONCLUSIONS

We have proposed the Draw-a-Programmer Test (DAPT) that is intended to be used in order to determine the stereotypical impression of a programmer and of the programmer/software engineer profession in populations. Similarly to Draw-a-Scientist, Draw-an-Engineer, and other previous variants of this test that we build on, the test does not require verbalized answers and hence it can be administered even to pre-school populations (apart from the background and cross-check questions, which can be omitted or administered in form of an interview).

As the main task in the test, respondents are asked to draw a programmer, together with their colleagues and their environment. From the collected drawings, one may assess the perceived stereotype of a programmer in the surveyed population and study various properties thereof.

In our preliminary research, we have applied the test in the group of 172 junior high school students aged approx. 13 years. Our main goals were to find out what is the perceived stereotype and we predominantly focused on gender. We found that while the majority of respondents perceive programmers as male, surprisingly many draw programmers as female or both genders (62.4% of those where gender could be identified). This number increases to 75.3% if we only consider the girls' responses. This finding is in sharp contrast to many similar studies involving DAPT, DAET, and DACST tests.

In addition, we were also curious to find out whether programmers are stereotypically assumed to be working alone or with other colleagues, what is the stereotypical perception of their working environment, and what are the other typical indicators of a programmer's job in our tested population. In our sample, the only significantly prevailing indicator of a programmer's stereotype seems to be working with a computer (99.4% incidence) in a simple office-like environment (77.9%). Other hypothesised indicators such as signs of organized work (e.g. various charts) and demanding job (such as coffee and energy drinks) were also present but with much lesser incidence. In a sense, these results are similar to those obtained by Hansen et al. [4] who revealed that four-to-six-grade students most frequently drew an image of a computer scientist as a man working alone and programming websites, games, and animations. This poses the question of whether and to what extent children at this age actually distinguish between a programmer/software engineer, and computer scientist professions.

Together with science and other technical disciplines, ICT may provide equal opportunity and may lead to a successful and rewarding career for many young people. Hence no one should be discouraged to pursue a career in ICT based on societal prejudice e.g. against their gender. Therefore it is important to study the stereotype of a programmer in young people who are on the verge of choices that will influence their future life and career, and whose choices may be significantly influenced by this stereotype [1]. We believe that the proposed DAPT test will be useful to other researchers who are working on these issues.

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