TEACHING WITH GENERAL INSTRUCTION LANGUAGE

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Abstract

In this paper some experiences with General Instruction Language (GIL) implementation in classes are presented. Also, there is a special case of a student with Asperger syndrome, a disorder from autism spectrum, who has also been using GIL.

For a long time Graphical User Interface (GUI) has been a standard user interface on personal computers of any kind. For users, such interface is simplified and accelerated, but manuals accompanying different applications are rather complex. They look like a comic book with a lot of pictures and with a little bit of text, here and there. Due to the images, even for a simple sequence of actions, the manual can take up several MBs (Mega Bytes).

It is difficult to follow the instructions that occupy most of the small screen and at the same time to apply them in the application which remains in the rest of the screen or is in the background. Overlapping screens and user´s attention to instruction - application - instruction - application ... are troublesome and frustrating, especially for a user, novice, as a typical student is.

Another problem arises during the teacher's initial presentation of a task to be done during real – time teaching / learning process in a computer laboratory. Some students would like to make notes on the sequence of activities: clicking, pulling or typing that the teacher performs in a fast pace. If the teacher slows down the presentation for the sake of students' making notes, the presentation will lose its dynamics because there is not a standard procedure for writing notes. That depends on a student and, being so it is difficult to synchronize activities in the class.

GIL is developed as a tool for recording the sequence of instructions representing the user manual for an application with a graphic user interface. The physical space for its application is a screen (desktop) of a personal computer, tablet PC or a smart phone. GIL instructions do not depend on the platform (hardware or operating system) but may vary if the GUI objects have different names. Instructions written in GIL are short enough so that their column width is 20% to 30% of the active width of the screen. Due to simplicity, it is easy to learn GIL and use it in making personal notes during the teacher's presentation.

Keywords: GIL, GUI, manual, notes.

1 INTRODUCTION

In the education process, student learning is often divided between being a passive listener at ex-cathedra lectures, and hands-on active work during laboratory exercises or problem solving in the classroom. The active work is preferred as students can remember just 10% of what they see, but more than 90% of what they do [8]. Chinese philosopher Confucius said: "I hear and I forget. I see and I remember. I do and I understand". These words are motto for many educators, i.e. learning must be grounded on experience. At the professional study of electrical engineering, at the Zagreb University of Applied Sciences, great emphasis is put on practical work through laboratory exercises. Often, the laboratory exercises are conducted on computers, with graphical user interface (GUI), where students work in specialised software applications.

It is necessary to have manuals for different applications used in the teaching / learning process, which normally the teachers make. Due to the large number of images, even for a simple sequence of instructions in the application, the manual can take up several MBs. The size of a digital manual is not the major part of the problem; most of them are online and the Internet connection is accessible and fast. But it is difficult to follow the instructions that take up most of the computer screen and at the same time to apply those instructions in the application which remains in the rest of the screen or is in the background. Overlapping screens and switching user´s attention to instruction - application - instruction - application and so on, is troublesome and frustrating, especially for an inexperienced user.

It is possible to compress the manual using General Instruction Language (GIL).

The article describes the use of GIL in Personal Computer Applications course, at the Department of Electrical Engineering at the Zagreb University of Applied Sciences. Furthermore, it is described how the students with disorders from autism spectrum could benefit from learning with GIL.

2 GENERAL INSTRUCTION LANGUAGE IN ACTION

2.1 Basics of General Instruction Language

General Instruction Language – GIL is used to record the sequence of instructions which represents a user manual for the use of applications with a GUI user interface. The target areas for the GIL application are computers of moderate screen size: PC, tablet PC or a smart phone. The management of application is by selecting GUI objects with the mouse, cursor, or directly, with a finger. The desired object is activated by clicking (tapping with a finger) or entering data with a physical or virtual keyboard. The instructions do not depend on the platform (HW or OS) but may vary if the GUI objects have different names. [10]

Table 1 GIL coordinate system.

UL	UM	UR
ML	MM	MR
LL	LM	LR

Table 2 English GIL dictionary.

Object		**Activity**	
SC	ShortCut	M	Move (slider)
M	Menu	K	clicK
F	Field	W	Write
B	Button	**Outcome**	
C	Cell	>	Outcome
Sl	Slider	=	Content
Where		E	scrEen
DT	DeskTop	T	Table
UL	Upper, Left	nn	No Name
UM	Upper, Middle	NA	Not Active
UR	Upper, Right		
ML	Middle, Left		
MM	Middle, Middle		
MR	Middle, Right		
LL	Lower, Left		
LM	Lower, Middle		
LR	Lower, Right		

2.2 Application of General Instruction Language

The Personal Computer Applications (PCA) course, at the professional study of electrical engineering at the Zagreb University of Applied Sciences, is one of the courses where General Instruction Language (GIL) is introduced. The course is in the first semester, and it enrols about 200 students per year. Because of different knowledge levels of enrolled students, it includes general IT and computing concepts, possibilities, and basic work principles of parts and subsystems in a computer. Special emphasis is put on the practical work with computer applications future engineers might need – whether in their private or professional lives. A student with Asperger syndrome has enrolled this course in the academic year 2015/16.

Lectures, laboratory and construction exercises on the PCA course are the parts of blended learning environment [6] which means that the students attend lectures and exercises according to the given schedule, while all of the materials are available online in learning management system (LMS) – Moodle.

Materials – slides for the lectures are available in Moodle e-learning system. Lectures are held, face-to-face, in two relatively large groups (around 100 students in each group), where students can participate actively. Construction exercises are completely individual students' work. Students need to write a simple programming code using all of the previously gained knowledge and skills as well as using materials available and sharing experiences with their colleagues [6].

The laboratory exercises are the practical and individual work of each student and make a total of half hourly rate of the course. They are held in smaller groups (around 12 students in each group) where each student works on their own computer. It is necessary that the students attend the exercises well prepared for the current topic. This is achieved by ensuring constant access to the materials through Moodle e-learning system and by allowing the use of applications free to students, open source applications or demonstration versions of commercial software packages [7].

In the laboratory, the teacher first explains the goals, purpose and the way the exercise will be held. Then, it is presented how to work with a certain application, with the emphasis on the most important parts which the students might need in further work. After that, the students practice working with the application on their own, according to the given instructions and tasks. The teacher is there at all times, available for all possible questions – whether students need extra help or are interested in more advanced options.

The topics of the laboratory exercises are:

- Basic use of operating system (Microsoft Windows 7)
- Office Suite (text processing in Word and spreadsheets in Excel, both from Microsoft Office)
- Flowcharts (drawn in Microsoft Visio)
- Electronic Design Automation (Labcenter Proteus)
- Image processing (GIMP)

Most of these topics are already familiar to students; they have encountered some of these or similar applications in their previous schooling and/or for private use. Each of the subjects has an exercise where the students learn to work in certain application, and a week (or a couple of weeks) later they have a test on it. The topics that are usually completely new to students, e.g. flowcharts and image processing, represent the biggest problem for them. When drawing flowcharts, it is difficult to come up with the solution – to use programming logic, the use of application in which they draw (Microsoft Visio) is relatively simple. In this paper, the focus will be put on the image processing exercise where students have no problem understanding what needs to be done, but using application and finding exact options is somewhat challenging.

For image processing application GIMP (GNU Image Manipulation Program) is used. It is a freely distributed program for such tasks as photo retouching, image composition and image authoring [9]. The main aim of the exercise is introducing students to basic operations of image processing such as sizing images, selection, and rotation, use of filters and colour settings, and work with different image formats. Also, the main ideas of working with layers and masks are introduced.

The subject is new to students as they have never encountered this application. They try to follow instructions and find all the necessary options while writing down the sequence of instructions at the same time. All of this is overwhelming. To make things even worse, if they can manage all of this on the preparation exercise, most of them forget where some options are because, due to holidays, the test is 3 to 4 weeks after the preparation. It can be frustrating and result in simply giving up learning image processing, which is most certainly not the goal of the exercise. In this case General Instruction Language (GIL) is of great importance.

Some of the instructions were written down in GIL by the teacher and published online in Moodle, and students can write down other short instructions which have not been included in the published document.

The example of the manual for one operation in GIMP is given, without using GIL, just with pictures of the instruction sequence and the expected result. The original photo needs to be transformed to monochromatic image, black and white – without shades. As it is shown, the sequence in this format (figure 1, 2, and 3) takes about a page and a half. If the students used this kind of manual, they would need to switch between screens; there is not enough space on the working area to have both GIMP and manual opened at the same time on the same screen. Also, some images can be too small so the names of the options are difficult to read. The bigger picture would solve the problem of visibility, but it would take up even more space. However, the positive side here is that the students see exactly what the final result should look like.

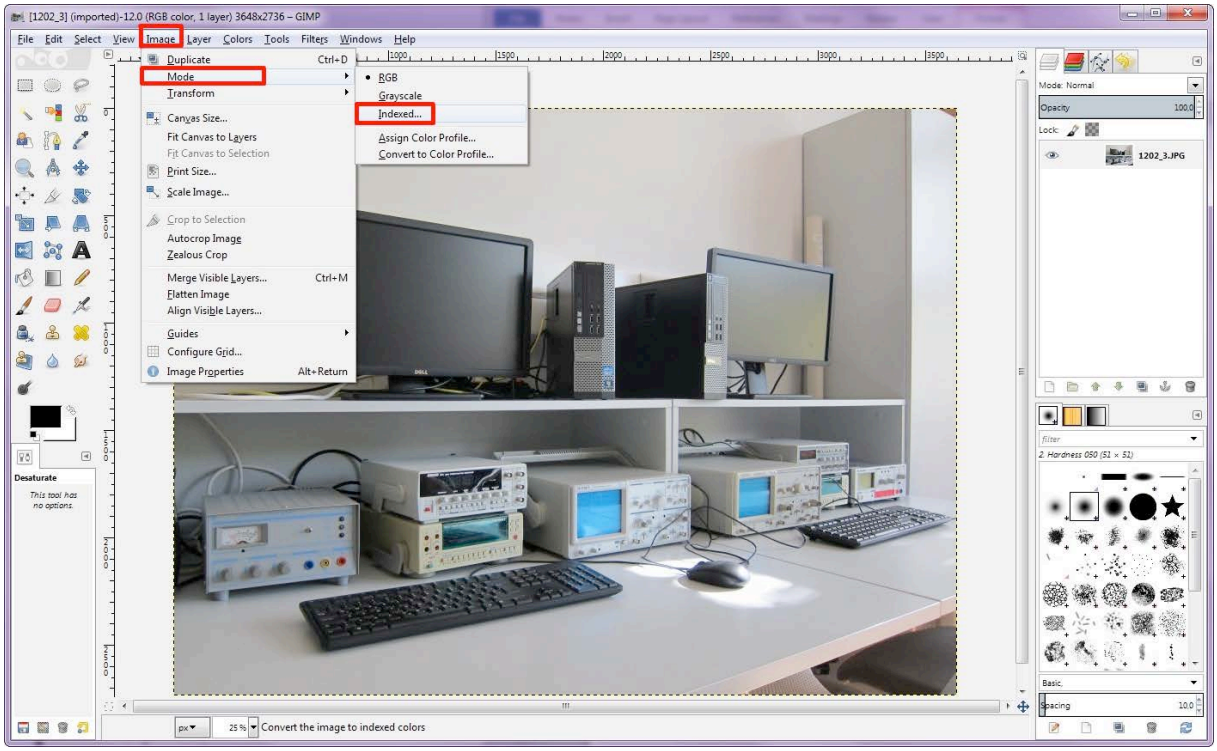

Figure 1 Original image to be transformed to monochrome image in GIMP.

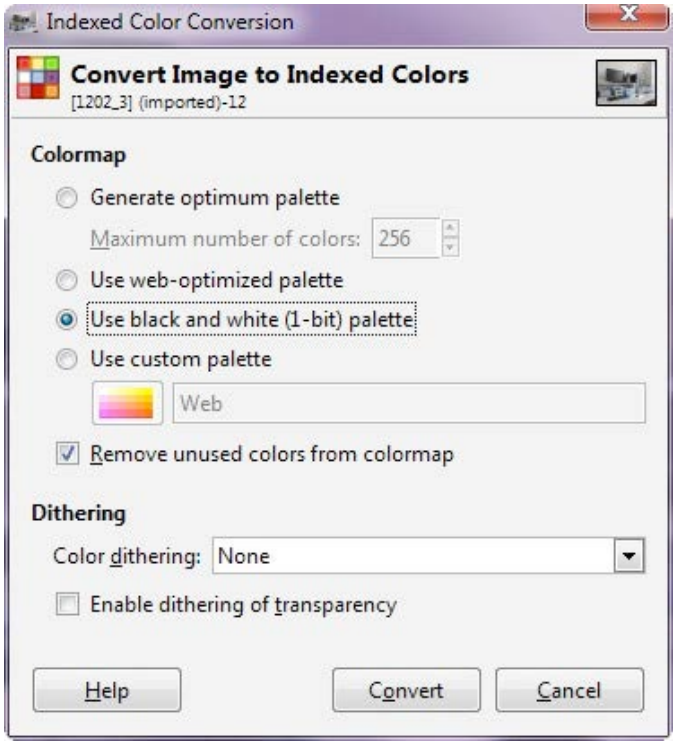

Figure 2 “Indexed Color Conversion” menu in GIMP.

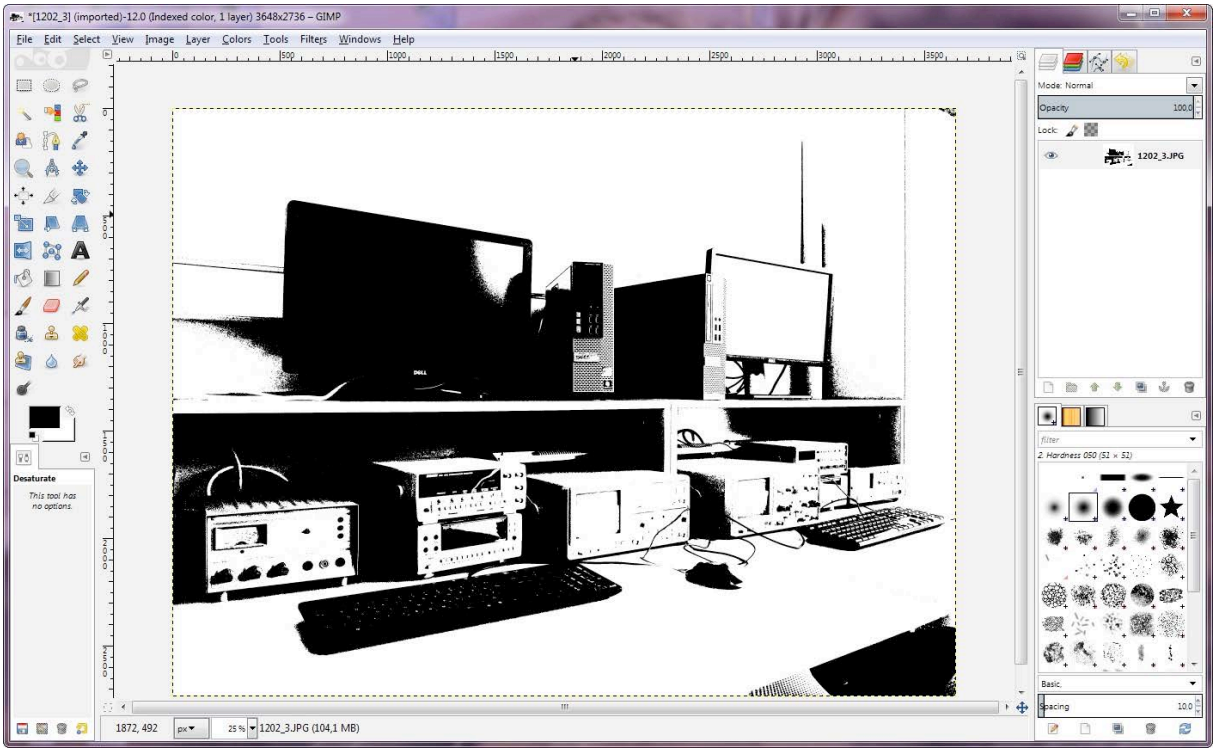

Figure 3 Result of the processing - monochrome image in GIMP.

The examples of using GIL instructions with comments are given in the Table 3. It is clear that this kind of notation takes up a lot less space. In the previous example, instructions for just one operation took up a page and a half, and the instructions written using GIL for three different operations, including comments, take up one page. There is no need for switching between screens, the instructions and the application can be on the same working space, opened at the same time.

Table 3 Examples of GIL instructions with comments.

GIL instruction	Comment
1. Image rotation	
UL, Image, K > M: nn	/ In the **U**pper **L**eft; clic**K** “Image”, **M**enu with **n**o **n**ame (nn) appears
UM, Transform, K > M: nn	/ In the **U**pper **M**iddle of the opened menu, clic**K** “Transform”, **M**enu with **n**o **n**ame appears
LM, Rotate 180°, K > Image rotated for 180°	/ In the **L**ower **M**iddle of the opened menu, clic**K** “Rotate 180°”, which results with the image rotated for 180°
2. Image resizing	
UL, Image, K > M:nn	/ In the **U**pper **L**eft; clic**K** “Image”, **M**enu with **n**o **n**ame appears
UM, Scale Image, K > M: Scale Image	/ In the **U**pper **M**iddle of the opened menu, clic**K** “Scale Image”, **M**enu “Scale Image” appears
F: Width, W:500	/ In the “Scale Image” menu, **W**rite “500” in the **F**ield “Width”
B: Scale, K > Resized image width 500px	/ In the “Scale Image” menu, clic**K** “Scale” **B**utton, which results with the resized image (with width of 500 px)
3. Turn into monochrome image	
UL, Image, K > M:nn	/ In the **U**pper **L**eft; clic**K** “Image”, **M**enu with **n**o **n**ame appears
UM, Mode, K > M:nn	/ In the **U**pper **M**iddle of the opened menu, clic**K** “Mode”, **M**enu with **n**o **n**ame appears
UM, Indexed, K > M: Indexed Color Conversion	/ In the **U**pper **M**iddle of the opened menu, clic**K** “Indexed”, **M**enu “Indexed Color Conversion” appears
F: Colormap, Use black and white (1-bit) palette, K	/ In the “Indexed Color Conversion” menu, in the **F**ield “Colormap”, clic**K** “Use black and white (1-bit) palette”
F: Dithering, None, K	/ In the **F**ield “Dithering”, clic**K** “None”
B: Convert, K > Monochrome image	/ clic**K** “Convert” **B**utton, which results in monochrome image

3 STUDYING WITH ASPERGER’S SYNDROME

3.1 Asperger’s syndrome as a part of autism spectrum disorders

Autism spectrum disorders (ASD) can be defined as neurological development brain disorders [1]. They encompass several different types: autism, non-specific pervasive developmental disorder, childhood disintegrative disorder, Rett’s disorder and Asperger’s syndrome. Although they represent different diagnostic categories, they share certain symptomatology which manifests itself in daily functioning. Specifically, people with ASD have great difficulties with social interaction and communication because they do not have empathy and ability to look things from other person’s perspective. In addition, they lack some other skills necessary to successfully relate with others: they are poor in social cognition, lack precise insight in their own and other people’s emotions and do not have key skills for maintaining conversation with people in their surroundings, e.g. active listening and waiting for their turn. Likewise, people with ASD have difficulties during speech development which can be seen by the fact that some do not even speak, while others speak, but in a peculiar way. Their

speech is frequently characterised by excessive use of nouns, unusual accent and lack of understanding of semantics, sarcasm and changes in intonation. People with ASD also have major deficits in processing complex information (especially when they are simultaneously processed while executing some instructions) because they find it hard to switch their attention from one task to another [2]. This kind of difficulties, together with the need to establish social interaction and relationships with other people, usually leads to high levels of frustration and anxiety. Additionally, people with ASD frequently behave unusually, like repeating other people's words or phrases, various mannerisms and excessive interest for letters, numbers or colours [1]. Their motor skill is also unique because they have problems coordinating and planning different fine and precise movements [3], which can lead to severe problems even in simple tasks as holding a pencil. Although only difficulties related to ASD were mentioned by now, people with disorders from this spectrum have some strengths as well. In particular, they have a well-developed visuospatial thinking and their information processing gets easier when information is presented in the form of pictures, colours and graphic symbols. In spite of having difficulties understanding and following the speech, this problem can be reduced by presenting tasks in written form [1].

Although different disorders can be categorised as ASD, they differ in their manifestations and in degree to which the person is affected. For example, people with ASD can be classified from low functioning to high functioning, depending on their intellectual ability. Good example of high functioning form of ASD is Asperger's syndrome. Although individuals with this syndrome are similar to those suffering from autism in some symptoms, e.g. social interaction and communication deficits, unusual behaviour, they are still different because of their average or above average intelligence [1]. In addition, unlike in those with low functioning forms of ASD, speech deficits are less pronounced in people with Asperger's syndrome as they frequently start to speak in early childhood and have rich vocabulary. Nevertheless, they still have difficulties with pragmatics, prosody, accent and understanding of what is said, especially if another person is speaking fast or using complex sentences.

3.2 Asperger's syndrome in academic context

Students with Asperger syndrome face numerous challenges during transition from high school to college [4]. They, like other students, have to adapt to completely different environment in which they will have to cooperate and establish relationships with many people, including their colleagues and professors. College attendance can place further challenges upon students in form of moving away from home to the city where campus is located, where they will have to learn how to be independent because their family is not around. In addition to these tasks, students must get used to completely different regime than that in high school; studying is more challenging, it consists of numerous complex tasks and it allows greater freedom in managing one's leisure time.

Most students eventually adapt to challenges mentioned above. However, students with Asperger's syndrome face some unique challenges in academic context. First of all, transition from safe and known environment of high school can be a very stressful life period for these students, because they have low tolerance for changes in usual daily routines. Frustration and stress can also be caused by the fact that for successful studying it is important to establish good relationships with colleagues, e.g. writing group seminars and projects, exchange of knowledge, and professors. Students with Asperger's syndrome want to make friends and communicate with other people but they simply lack the key skills necessary for it. Because of this, contact with others can be the source of anxiety which can ultimately lead to problems such as social isolation and loneliness.

For those suffering from Asperger's syndrome teaching methods used during classes can be the source of distinct problems because they are not adapted to students' needs and abilities. For example, lectures are usually conducted orally, some professors speak fast and can use a lot of digressions and abstract concepts are frequently mentioned. This method of presentation during classes usually overburdens students with Asperger's syndrome because they find it difficult to follow and understand speech, especially if it is fast or it contains complex information and if the topic is not interesting to them. Difficulties with deducing right conclusions, developing concepts and with concentration can cause severe anger or boredom during class, which can lead to consequences such as unusual behaviour such as finger tapping, chair spinning. Similar problems can and do occur during laboratory exercises. Students are usually required to solve complex tasks the aim of which is to test whether they understood the content of the lectures. During their work, students in parallel receive instructions to make tasks easier to understand, and it is recommended that they write them down in case they need them in the future. This kind of multitasking presents great demand for the

working memory of the students with Asperger's syndrome because they experience difficulties trying to concurrently understand what is going on, to organise sequential execution of steps necessary to complete the tasks and to switch their attention between following instructions and taking notes.

Universities of applied sciences and technical colleges are faced with these problems because students with Asperger's syndrome must learn how to use different applications which are challenging even for people with normal cognitive functioning. Namely, usually both the instructions and applications are presented on the same screen and students have to switch back and forth between them because there is not enough screen space. Additionally, during exercises in the computer laboratory, students have to write down notes quickly in order to keep up with their colleagues and the teacher does not have to slow down the pace of the presentation. Unfortunately, at the moment there is no standardized procedure for taking notes on how to use an application, which makes it challenging and, sometimes, a difficult task for students, especially if they have no previous experience in the use of that particular application. Students with Asperger's syndrome face additional difficulties; due to their lack attention, they have problems focusing on one task and switching attention between different tasks, especially if they are presented in various modalities [5]. Also, taking notes poses another problem because of already mentioned deficits in fine motor control, which can lead to faster onset of fatigue compared to other students.

3.3 General instruction language and Asperger's syndrome

Application of General instruction Language (GIL) could make it easier for students with Asperger' syndrome to follow classes and to accomplish various educational outcomes. It is hypothesised that the main mechanism for this positive effect lies in the fact that GIL adapts teaching methods to needs and abilities of students with Asperger's syndrome. First of all, GIL reduces the need for constant attention switching between instructions and application, which makes it easier for students to retain concentration and to focus at the current task. This form of presentation should be well suited to students with Asperger's syndrome, who suffer from already mentioned working memory, attention and concentration deficits. Second, GIL provides standardized syntax for taking notes during writing down the instructions and it makes it possible for students to do it relatively quick (e.g. "UL; B:File K" is much simpler and quicker to write down than "Upper left corner, then find and click on button 'File'"). This syntax also enables structured notation of steps necessary to execute some task, which should theoretically make it easier for students with Asperger's syndrome to learn their correct sequence. Third, GIL should decrease occurrence of fatigue in these students because they do not have to bother with too long writing sessions, thus avoiding excessive load on their fine motor skills.

4 CONCLUSION

General instruction language is being developed at the Communication and Computer Techniques division of the Department of Electrical Engineering, Zagreb University of Applied Sciences, Croatia. It is based on the standard Latin alphabet as the source of the symbols. Syntax of instructions is simple and well defined in order to be suitable for efficient automated translation from one language to another, if needed.

GIL reduces the need for constant attention switching between instructions and application, which makes it easier for students to retain concentration and to focus at the current task. Also, it provides standardized syntax for taking notes during writing down the instructions and it makes it possible for students to do it relatively quick.

In the first year of GIL's implementation, students' responses are positive. Further development and introducing GIL into other courses are in progress.

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