ПЛОВДИВСКИ УНИВЕРСИТЕТ "ПАИСИЙ ХИЛЕНДАРСКИ", БЪЛГАРИЯ
НАУЧНИ ТРУДОВЕ, ТОМ 39, КН. 3, 2012 – МАТЕМАТИКА
PLOVDIV UNIVERSITY "PAISSII HILENDARSKI", BULGARIA
SCIENTIFIC WORKS, VOL. 39, BOOK 3, 2012 – MATHEMATICS

MODEL AND METHODOLOGICAL TOOLS FOR TEACHING EVENT-DRIVEN PROGRAMMING IN SECONDARY SCHOOLS

Kosta Garov, Stefka Aneva, Gencho Stoitsov

Abstract. The present paper consists of a didactic model and methodology of teaching for the organization and carrying out of specialized training in Informatics on high school level in secondary schools teaching the module "Event-driven programming in graphical user interface environment (IDE)". Step-by-step methodological tools for teaching the Informatics curriculum have been developed considering the module.

Key words: event-driven programming, graphical user interface, Informatics, teaching methodology.
Mathematics Subject Classification 2000: 97D20, 97D40, 97C30, 97C90.

1. Introduction

Bulgaria has great traditions in teaching Informatics and Information technology. The subject of Informatics has been introduced as a compulsory subject in Bulgarian schools since 1986, and Information Technology (IT) – since 1994. Today these school disciplines have their own place in the preparation of the students in Bulgaria. The methodology of teaching Informatics and Information technology is also developing 0.

The vast development of new technologies and the usage of computers and Information Technology in all aspects of life inevitably necessities the corresponding requirements to the educational system – the system has to react

adequately to the need for trained personnel, who are able to use and develop the new technologies.

The training of good programmers and quality workers in the sphere of Informatics and Information Technology is a complicated and continuous process, because the sphere of Informatics and Information Technology is constantly changing. It is of a vital necessity that the Informatics and Information Technology curriculum is constantly improved and enriched, the training process modernized by the use of innovative methods and tools. Those factors, on their own, contribute to forming complete competitive professional computer specialists with developed professional skills, who are able to deal with the challenges of the IT community and dynamics of today's world.

There is a great need for professionally competent qualified programmers with an in-depth knowledge in the sphere of Informatics and IT nowadays. In order to satisfy this need, the training must begin while the students are still in the secondary school. On the current curriculum those school disciplines are taught in the compulsory and specialized training.

The material for the Informatics curriculum for 11-12th grade 0 is based on the modern and widely used technology for visual programming, the so-called "event-driven programming" in the environment of graphical user interface. The basic principles and abilities with this kind of programming are to be expressed in concrete form and presented through specific environment and technology for automating computer programming.

Today visual programming is a specific area of the software industry and it is a basic tool for the software product development. With the on-going development and improvement of technologies and tools for building the Graphical user interface (GUI), the process of creating application products turns up to be more and more of a designer's activity. This activity is necessary for creating effective and user-friendly graphical user interface with maximum usability of the application forms.

In the last few years when teaching the module "Event-driven programming in graphical user interface environment" in secondary schools Visual Basic 6.0. environment (IDE) has been used. The availability of licensed software for visual development of applications with window-based graphical user interface and the degree of professional training and qualification of Informatics teachers in secondary schools are premises for successful usage of other environments for creating programs, controlled by events for the need of the specialized training in Informatics. In teaching practice the free versions of Express Edition of the environments of Visual Basic and Visual C# of Visual Studio packet are becoming more and more used.

2. Constructing a didactic model for specialized training in Informatics on secondary school level

The base components of the constructed model are:

- ✓ Aims and expected results from the training;
- ✓ Curriculum and common themes;
- ✓ System of terms and skills;
- ✓ Methodology of teaching;
- ✓ Didactic tools.

An important condition while the training 0 is going on is that the curriculum, the aims and the expected results are clearly stated.

Aims and expected results from the training in the model of specialized training in Informatics

Aims

- Learning the main principles, terms, tools and technologies for creating software programs in the environment of event-driven programming and graphical user interface;
- Acquiring beginner skills for applying the tools of visual programming in integrated development environment and, as a result, broadening student's knowledge and abilities for the IT community;
- Developing students algorithmic thinking skills, that consecutively are built up with skills for creating basic object-oriented software applications with simplified graphical interface;
- Encouraging the students into research and applying creativity from the acquired knowledge skills for making projects and creating desktop applications with window-based GUI when solving real practical problems;
- Formation of knowledge and skills for analyzing and comparing of different viewpoints and solving problems in different variants;
- Developing team work skills and collaboration in the development of group projects.

Expected results from the training considering the level of the curriculum

In result of the training in Informatics for 11th and 12th grade, on second (higher) level, considering the module „Event-driven programming in graphical user interface environment" the student must be able to:

- List and explain the basic principles, terms, tools and technologies for creating software in particular environment for visual programming and GUI;

- Work in particular integrated environment for visual development with GUI;
- List and apply the basic algorithmic constructions and operators in the language of programming;
- Create basic data structures and implement basic operations for work with the structures in event-driven programming environment;
- Configure and use objects and create software products in the environment of event-driven programming with GUI;
- Program default and other events of GUI elements;
- Create, modify, test and execute program applications with GUI;
- List, configure and use objects from the programming environment for data processing of given Database management system (DBMS).

Main topics in the curriculum

In the learning process of the module "Event-driven programming in graphical user interface environment" the following five topics must be discussed (0, 0):

1. Main terms in event-driven programming and GUI.
2. Main elements of the programming language (Visual Basic or C#).
3. GUI Objects.
4. Interaction with OS.
5. Database connection.

Exemplary curriculum for teaching the module "Event-driven programming in GUI environment" as a specialized training in Informatics

In 00 a detailed curriculum is presented about the module "Event-driven programming in GUI environment" along with classes program. In this program 50/87 classes are considered for exercises. This is why we think that the question of the role and place of the problems in the module is of great importance for the teacher. At the end of the module 10 classes are thought for developing and presenting students' own projects.

System of terms and skills for the discussed module for specialized training in Informatics on secondary school level

The tendency of the technologies and new programming languages to develop and evolve requires the teaching of the terms and concepts to be on the maxim level no matter of which language or integrated environment of the visual programming.

Main skills, considering the specialized training in Informatics under the suggested model:

- Forming and developing of skills for developing Graphical user interface with visual tools when creating applications with GUI on a given template;

- Forming and developing of skills for modeling and developing of Graphical user interface with visual tools in creating applications with GUI on given functionality;
- Forming and developing of skills for creating application with suitable design and presentation of GUI through application of a suitable selection for suitable GUI elements in accordance with the necessary functionality of the graphic interface of the application;
- Forming and developing of skills for programming of implied and other events for the basic GUI elements;
- Forming and developing of skills for implementing graphics and animation in applications with GUI;
- Forming and developing of skills for implementing of applications with GUI for connecting the database.

3. Methodological tools of teaching the module "Event-driven programming in graphical user interface environment"

Teaching of event-driven programming in specialized training of Informatics in secondary schools through suitable system of problems with different difficulty levels gives an opportunity to the student to get familiar basic principles and opportunities of visual programming and to master the basic technologies and mechanisms for implementing event-driven programs with user-friendly Graphical user interface. In-depth training and mastering of the basic principles of the event-driven programming will bring a better quality of the preparation of the future generation of specialist in the area of software. The tendency of the technologies and new programming languages to develop and evolve necessitates the teaching of the concepts to be on the maxim level no matter of the specific language or integrated environment of the visual programming.

Main types of problems for the module "Event-driven programming in Graphical user interface environment"

In the course of training on the model "Event-driven programming in Graphical user interface environment" the following five types of problems must be discussed 0:

1. The first type of problems includes a group of exercises for the assimilation of Graphical user interface (GUI) and work with its basic elements (basic problems).
2. The second type of problems is about getting the knowledge and skills to create graphics and animations.

3. The third type of problems is about working with arrays of GUI elements and creating collections of objects.
4. The fourth type of problems realized user applications for database connection.
5. The fifth type of problems includes creating standard Windows applications, consisting of menus.

Main steps in the execution of a problem for implementation of GUI applications

In order to build an application with GUI, the following three steps must be consecutively followed:

- Creating the GUI of the application;
- Setting the properties of GUI elements in design time mode of the application;
- Adding programming code to the application.

System of problems for teaching on the module "Event-driven programming in GUI environment"

The system of problems on Informatics module "Event-driven programming in GUI environment" is categorized and systemized in six main groups and ensures:

- Getting familiar with basic principles and concepts of the event-driven programming and systematization of the new knowledge;
- Mastering of the techniques and mechanisms of work along with the most used Graphical user interface elements when creating window-based GUI applications;
- Developing and improving the knowledge and skills of the students when practicing extra activities, that are needed for new knowledge and skills;
- Summarizing the knowledge and its practical application when solving real life problems in everyday life.

I. Basic problems for learning Graphical user interface and work with its base elements.

In the **main problems** in teaching the event-driven programming 0, categorized problems must be included, and thus to stress on the purpose and abilities on the following common elements (objects) of GUI, that are most often used when Graphical user interface is built:

- **Label** – to display the text (caption) on the form;
- **Command button** – to trigger the actions (commands);
- **Text box** – input for any kinds of text data in run time mode. Additionally, the input data entered in the text box can be validated.

- **Image** – Visualization of graphic images;
- **ListBox** – for displaying a list of strings, which can be selected;
- **ComboBox** – editing a text with the option to choose from a drop-down list;
- **CheckBox** (control boxes) – can choose from options independently one from another from the type Yes/No;
- **RadioButton** (choice button) – for alternative choice of only one of a few self-excluding options.

At this stage of the learning process the student must:

- Know how to model and develop Graphical user interface with visual tools;
- Be able to select suitable GUI elements in accordance with the necessary functionality of the graphic interface of GUI;
- Know to modify the settings on GUI elements in design time mode and run time mode;
- Know how to program implied and other events for basic GUI elements;
- Know the mechanism for declaring variables and know how to declare and use local and global variables;
- Know the mechanism for calling one event procedure from another.

II. Second part of the step-by-step methodological tools for teaching on the topic "Event-driven programming in GUI environment"

Using the idea of step-by-step methodological tools 0, the next step in the teaching of event-driven programming is the solving **problems, which are based on already developed and combined problems of the past**. The main point is on the systematization and focusing on the main practical principle, processes and technologies, playing a vital role in creating effective Graphical user interface. What is being discussed are the possibilities that Visual Basic and Visual C# environments can offer and the correct selection when using the basic GUI elements to implement a dialog with the user at the run time of the given application 0.

At this stage of the learning process the student must be able to:

- Create applications with a suitable GUI Layout and Design.
- Develop and perfect one's skills in choosing suitable GUI elements in accordance with the necessary functionality of GUI's application.
- Master one's knowledge and skills when declaring variables and their usage, and understanding of the necessity of converting the data in certain cases.
- Understand the necessity of using a GUI element when grouping in forms of application that has radio buttons with different functionality.

- Understand the necessity of the usage of GUI element arrays.
- Get familiar with the technology for adding a form in application or creating an application that consisted of more than a single form.

At this stage of the learning process on event-driven programming specific didactic aims are implemented, that are connected to:

- Strengthening of the acquired knowledge and perfecting the practical skills for creating event-driven programs in given programming environment;
- Application of different algorithms, tools and technologies for solving real practical problems in GUI environment;
- Creative application of the acquired knowledge and skills for effectively solving computer problems.

III. Problems for forming knowledge and skills for implementing graphics and animation

At this stage of the training the problems are about some tools and technologies for implementation of graphics and animations. Main tools and technologies are discussed about the implementation of the graphics and animation in Visual Basic and Visual C# 0.

As a result of the training on stage three the student must:

- Deepen and develop one's skills for a selection of suitable GUI elements in accordance with the necessary functionality of the graphic interface of the application;
- Know the basics mechanism and technologies for implementing animation;
- Know the purpose of the timer element and is able to use it for implementing animation on given GUI element or already drawn graphic object in the form of the application;
- Be familiar with basic functions of GDI+ on Windows, accessible through System.Drawing and is able to use basic methods for drawing of graphic objects – line, ellipse, rectangle, polygon, curve and others; also work with images, texts and fonts;
- Able to declare and use object variables;
- Understand the necessity for the use of GUI elements-containers;
- Be able to create and call out common procedures in application on C# or Visual Basic.

IV. Problems, connected to work with arrays of GUI elements and creating collections.

Arrays of GUI elements provide convenient ways to work with groups of GUI elements that share common functionality. Groups of elements might be used to display related data, or provide related behavior when clicked.

Some of the more useful aspects of GUI element arrays include the following:

- Accessing a set of controls with the same name by index, allowing to retrieve and set properties by number and iterate through all the controls in an array;
- Handling events for multiple events with a single event handler (event procedure), and retrieving and using the index in those events;
- Dynamically adding or removing controls at run time.

Although Visual Basic .NET and Visual C# have no inherent support for creating GUI element arrays, it is possible to duplicate all of the functionality of element arrays programmatically.

Delegates can be used to bind events from multiple elements to a single event handler. However, it might be more convenient to incorporate that functionality into a single dynamic component that uses the following:

- A collection to index and sort the elements;
- An event handler to handle the event;
- Code to allow referencing the control and its members by index:
- Code to dynamically add and remove a GUI element from the application form.

In result of the training in stage four the student must:

- Know the mechanism of adding and removing a class to applications with GUI in particular integrated environment for visual development;
- Master the technology of class constructor;
- Develop skills for implementing methods of dynamic adding and removing of an element from a form in run time mode;
- Form beginner skills of working with collections when implementing an array of GUI elements.

V. Problems for implementing applications in connection to database.

Windows Forms has many GUI objects for visualization and data modification – texts, lists, tables. To save developers' time a concept called **data binding** is created that allows automatic connection of the data and the elements for their visualization. The connection of data ensures the automatic transfer of data

from the GUI elements and the data sources, but it is a one-way data connection – from the GUI object to the data source!

Windows Forms has two types of data binding:

- **Simple Binding** – binding of a GUI element with a single object or single (current) list item. This type of binding is used typically with GUI elements such as a TextBox and CheckBox, which typically displays a single value.
- **Complex Binding** – binding of a GUI element for implementing a list with list. This type of binding is used typically with GUI elements such as ListBox, ComboBox и DataGrid. A currently selected (active) element of a list is available.

As a result of the training on stage five the student must:

- Understand the purpose and get familiar with some of the main characteristics of GUI elements, implementing connection with the database;
- Form basic knowledge and skills to create database connected applications;
- Master the technology for simple and complex binding in visualization of database in the form of an application.

VI. Problems for forming knowledge and skills for implementing standard Windows applications, including menus in Visual Basic or Visual C# environment.

At this stage of teaching the theme "Event-driven programming in Graphical user interface environment" the tools and the technologies of implementing standard Windows applications, including menus in Visual Basic and Visual C# environment are discussed. An important moment in implementing this kind of type of problems is examining and using the technology of creating applications with Multiple Document Interface.

As a result of the training on this stage the student must:

- Know the purpose of the components for implementing a system of menus and has the ability to use them in creating applications with suitable design and presentation of GUI;
- Improve and develop one's skills for a proper selection of suitable GUI elements in accordance with the necessary functionality of the application;
- Know the purpose of the components for implementing of standard dialogs when choosing a file, font and colour;
- Be familiar with the technology of creating applications with Multiple Document Interface and understand the work principle of forms in MDI mode.

At this stage of the training on event-driven programming a number of problems can be discussed, giving the students an opportunity to practice their creativity, acquired knowledge and skills for effectively solving of real practical problems and tasks. Systems of menus find application in creating information systems and specialized software.

4. Conclusion

The suggested model for specialized training in Informatics on secondary school level and the developed methodology for teaching and constructing of knowledge through system of problems contribute to the improvement of the teaching quality in the Informatics discipline training in secondary schools and the permanent and in-depth mastery of the main terms and principles of the event-driven programming and fulfilling the schooling aims.

References

[1] ANDREEV, M., *The process of learning. Didactics, University Publishing House "St. Kliment Ohridski"*, Sofia, 1996 (In Bulgarian).

[2] ANEVA, S., System of basic problems in learning of event-driven programming with Visual C# Environment in high school, *Proceedings of the scientific Conference "Education in the Information Society"*, Plovdiv, 2010, p. 239-251 (In Bulgarian).

[3] ANEVA, S., The role of basic problems in learning of event-driven programming with Visual C# Environment in high school, *Proceedings of the Anniversary International Conference "Synergetics and reflection in Mathematics education"*, Bachinovo, Bulgaria, 2010, p. 353–363 (In Bulgarian).

[4] ANEVA, S., Using problems to introduce some tools and technologies for implementation of graphics and animation in C#, *Proceedings of the Anniversary International Conference „Research and Education in Mathematics, Informatics and their Applications"*, Plovdiv, Bulgaria, 2010, p. 395-402.

[5] DUREVA, D., *Problems of the methodology of training in Informatics and Information Technology*, Publishing House "N. Rilski", Blagoevgrad, 2003 (In Bulgarian).

[6] GAROV, K., AND S. ANEVA, The role of the problems in learning of event-rriven programming with Visual Basic in high schools, *Proceedings of the Thirty Third Spring Conference of the Union of Bulgarian Mathematicians,*

Mathematics and Mathematical Education, Sofia, 2004, p. 322-328. (In Bulgarian)

[7] GROZDEV, S., AND P. KENDEROV, Instrumentarium for identification and support of gifted students in Mathematics, *Proceedings of the Thirty Fourth Spring Conference of the Union of Bulgarian Mathematicians, Mathematics and Mathematical Education*, Sofia, 2005, p. 53-64 (In Bulgarian).

[8] MOMN, *Directorate "Politics in general education". Syllabus part III for basic and specialized training – IX, X, XI and XII class*, Sofia, 2003.

[9] SHKURTOV, V., K. GAROV, AND S. ANEVA, Learning of event-driven programming in secondary schools, *Proceedings of the Thirty Second Spring Conference of the Union of Bulgarian Mathematicians, Mathematics and Mathematical Education*, Sofia, 2003, p. 401-406 (In Bulgarian).

Faculty of Mathematics and Informatics
University of Plovdiv
236 Bulgaria Blvd.,
4003 Plovdiv, Bulgaria
e-mail: **kosgar@uni-plovdiv.bg**
stfaneva@uni-plovdiv.bg
stoitzov@uni-plovdiv.bg

Received 28 November 2012

МОДЕЛ И МЕТОДИЧЕСКИ ИНСТРУМЕНТАРИУМ ЗА ИЗУЧАВАНЕ НА СЪБИТИЙНО ПРОГРАМИРАНЕ В СРЕДНОТО УЧИЛИЩЕ

Коста Гъров, Стефка Анева, Генчо Стоицов

Резюме. В настоящата разработка е представен дидактически модел и методика на преподаване за организиране и провеждане на профилирано обучение по информатика в гимназиален етап на обучение в средното училище при изучаване на модула „Събитийно програмиране в среда на графичен потребителски интерфейс". Разработен е стъпаловиден методически инструментариум за преподаване на учебното съдържание по информатика за разглеждания модул в профилираната подготовка в средното училище.