

AGROINFORMATIX: THE DIGITAL TRANSFORMATION OF THE FARM. DEVELOPMENT AND OPERATION OF AN APPLICATION THROUGH NO-CODE PROGRAMMING IN VOCATIONAL EDUCATION

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Abstract: This paper presents the innovative educational good practice “AGROINFORMATIX”, which was designed, developed and tested within the framework of the European Erasmus+ KA220-VET project, reference number 2023-1-RS01-KA220-VET-000154237. The main focus of this practice was the use of modern digital technologies to support agricultural and livestock production, while simultaneously developing the digital, vocational and collaborative skills of students in Vocational Education and Training (VET).

AGROINFORMATIX was designed as an enterprise-grade mobile application capable of operating in different environments and supporting real-world use cases in the agricultural and livestock sectors. It was developed by teachers and students from three European educational institutions: the Laboratory Centre of Serres in Greece, the Sonja Marinković agricultural school in Serbia, and the GRM Novo Mesto Biotechnology Centre in Slovenia.

Keywords: AGROINFORMATIX, No-Code Programming, Digital Transformation, Digital Agriculture, Vocational Education, Transnational Cooperation.

1. INTRODUCTION

The digital transformation of the primary sector is one of the most significant challenges facing the modern European economy. Agriculture and livestock farming must simultaneously respond to increasing demands for productivity, quality, food safety, environmental protection and the rational management of available resources. In this context, digital technologies can make a substantial contribution to systematic data collection, production monitoring and evidence-based decision-making.

Despite the rapid development of digital technologies, many everyday activities in small and medium-sized agricultural and livestock businesses still rely on handwritten records, notes, paper forms and unorganised files. This practice creates several problems, including data loss, difficulties in retrieving previous entries, errors when transferring information and an inability to use data immediately for decision-making.

The AGROINFORMATIX good practice was developed in response to this real-world need. The main idea was to create a user-friendly digital tool that could be used directly at the producer’s workplace, whether in the field, in the barn or at an agricultural facility.

However, the practice was not approached solely as a software development project. It constitutes a comprehensive educational initiative in which VET students from all three participating schools actively took part in the main stages of the digital product development lifecycle: needs analysis, design, prototyping, implementation, testing, evaluation and revision.

The choice of No-Code programming was a decisive pedagogical decision. Rather than initially facing the difficulties of writing and debugging code, students engaged with computational thinking through visual elements, logical nodes, data connections and interface design.

Technology therefore served not only as a means of producing software but also as a means of learning, creativity, collaboration and professional development.

The purpose of this paper is to present the AGROINFORMATIX educational practice in detail, describing its educational and technological context, the application development methodology, the pedagogical approaches employed, the evaluation process, the results and the potential for transferring the practice to other educational environments.

2. EDUCATIONAL CONTEXT OF IMPLEMENTATION

The purpose of the teaching intervention was to actively engage students in investigating a contemporary social issue through collaborative activities, the use of digital resources and the production of a multimodal final product.

A key feature of this good practice was the use of the No-Code programming philosophy through the AppGyver platform. This enabled students to participate actively in software design and development without requiring extensive knowledge of traditional programming languages or code syntax.

Using a visual development environment, students created user interfaces, business logic, data-entry forms and information management processes.

The application includes livestock management functions for pigs, sheep and cattle, as well as functions related to agricultural crops and fruit-bearing plants. These include recording medical histories, reproductive activities, milk production, cultivation operations, plant protection treatments and harvesting.

Particular emphasis was placed on using mobile device cameras as barcode scanners, enabling the rapid and reliable identification of animals and related records.

Development followed an iterative Agile approach, involving five successive versions of the application. Each version was tested, reviewed and improved, while the final evaluation took place under real-world conditions in fields, barns and agricultural facilities.

A total of 160 end users from the three participating countries took part in the testing process.

An especially important requirement was the ability to operate in areas with limited or no Internet access. Offline functionality was therefore a critical factor in the application's practical usefulness, allowing users to record data directly in the field and synchronise it when connectivity was restored.

The results demonstrate that No-Code technologies can serve as a powerful pedagogical tool in Vocational Education and Training, connecting education with real labour market needs. At the same time, the initiative strengthened the European dimension of education, transnational cooperation and the development of digital skills.

The practice was presented at educational and institutional events and disseminated through the European EPALE platform as an example of open educational innovation.

2.1 Expected Learning Outcomes

Upon completion of the practice, students were able to:

1. Analyse a real-world professional problem and translate it into digital requirements.
2. Design basic data structures and organise information systematically.
3. Create functional user interfaces using visual tools.
4. Develop logical workflows and automated processes without extensive coding.
5. Integrate mobile device features, such as cameras and barcode scanning.
6. Design applications that meet the requirements of real working environments.
7. Conduct usability testing and identify technical or functional problems.
8. Collect and use feedback from real users.
9. Collaborate in international teams and manage distributed tasks.
10. Understand the lifecycle of a digital product, from the initial idea to final evaluation.

2.2 Description of the Good Practice

The application development process did not begin with a predetermined technological solution but with the identification of a real need.

Questionnaires, discussions and targeted information gathering were used to understand how producers managed their everyday records. It was found that a significant proportion of information was recorded manually. This included both livestock data and information relating to crops, production, medical history, reproduction and plant protection.

The needs analysis identified several key requirements:

- The application had to be user-friendly.
- Data entry had to require as little time as possible.
- Animals had to be identified quickly.
- Data had to be organised within a unified environment.
- The application had to function under real field conditions.
- Its operation could not depend entirely on an Internet connection.
- Users in different countries had to be able to use the same digital tool in their own language.

This process represents an important pedagogical element because students were not simply asked to “build an application”. They first had to understand why the application was needed and what problem it was expected to solve.

2.3 Application Development Process

Development was organised according to an iterative Agile approach. This allowed the team to avoid designing a supposedly final product from the outset and instead progress gradually, using the results of each cycle.

The process was organised into five main stages.

Stage 1 – Kick-off and Initial Design

During the first phase, the following were defined:

- The main user needs.
- The main data categories.
- The application architecture.
- The principal screens.
- The core functions.
- The roles of the participants.

Students were also introduced to the fundamental principles of No-Code programming.

Stage 2 – First Version

During the second phase, the initial functional prototype was created. Students became familiar with:

- Creating screens.
- Placing user interface (UI) elements.
- Creating forms.
- Managing data.
- Establishing logical connections.

The first version served as the basis for evaluating the application's functionality.

Stage 3 – Improvements and Expansion

Based on the feedback received, corrections were made and new functions were added. Particular emphasis was placed on improving usability and reducing the number of steps required to enter a record.

Stage 4 – Testing with Real Users

The application was moved from the laboratory into its actual operating environment. Students tested it in fields and livestock facilities.

This stage was particularly important because it revealed problems that could not easily have been identified in a school or laboratory environment.

Stage 5 – Final Version

Following the integration of users' observations, the final version of the application was produced. The process concluded with final functionality checks and user evaluation.

2.4 Structure and Functions of the AGROINFORMATIX Application

The final application was organised around a central navigation interface containing six main categories:

- Pigs
- Sheep
- Cows

- Agriculture
- Fruits
- Reports

This structure enables users to navigate quickly to the section they need.

Livestock Management

A digital profile is created for each animal. Identification can be performed using a barcode scanner that utilises the mobile device's camera. This reduces the need to manually enter long or complex codes.

Medical – Medical History

The Medical section allows users to record information relating to:

- Diagnosis.
- Date.
- Medication.
- Observations.
- Withdrawal period.

Recording the withdrawal period is particularly important because it is associated with the safety of animal-derived products and determines how long must pass before milk or meat can be marketed.

Reproduction

The reproduction section includes information such as:

- Insemination date.
- Male animal identifier.
- Number of offspring.
- Related reproductive information.

Maintaining organised reproductive records enables more systematic monitoring of livestock.

Milk Production

For cattle, a specialised function was incorporated to monitor milk production.

Recorded information includes:

- Milk quantity.
- Protein percentage.
- Fat percentage.
- Somatic cell count.

In this way, the application goes beyond simple data storage and supports the monitoring of both qualitative and quantitative production indicators.

2.5 Agricultural Production Management

In addition to livestock, the application supports crop production management. A central element is the identification of each plot through its Field Number.

For each plot, information relating to the crop lifecycle can be recorded, including:

- Sowing.
- Fertilisation.
- Plant protection.
- Pesticide use.
- Cultivation operations.
- Harvesting.

This creates a digital history of agricultural production activities.

This approach has particular educational value because it enables Informatics students to understand a professional field outside their immediate subject area, while students specialising in agriculture can see how their professional knowledge can be translated into digital requirements.

2.6 Teaching Methodology and Pedagogical Approach

The AGROINFORMATIX pedagogical approach was based on combining learning by doing with real-world problem-solving.

Students were placed in the role of technology creators rather than passive users. The application was the final product of a process in which they had to:

- Identify problems.
- Discuss possible solutions.
- Design interfaces.
- Organise data.
- Create logical workflows.
- Test functionality.
- Receive criticism.
- Correct errors.
- Repeat the process.

The choice of No-Code programming reduced the initial learning barrier associated with mastering a traditional programming language.

Computational thinking was not eliminated; instead, it shifted from code syntax to the logical organisation of a process. For example, a function could be described as the following sequence:

User action → Data validation → Logical decision → Data storage → Screen update.

In this way, students understood fundamental computing concepts, such as variables, conditions, workflows, data, events and interactions, without having to focus initially on syntactic complexity.

2.7 The Role of Interdisciplinary Learning

One of the most important aspects of the practice was the connection between Informatics, Agriculture and Animal Production.

Developing an application for real farmers required Informatics students to understand the professional environment in which the software would be used. Similarly, students from agricultural disciplines had the opportunity to transform their professional knowledge into digital requirements.

Interdisciplinary learning therefore went beyond the simple coexistence of two subjects. A shared problem-solving environment was created in which students from different specialisations collaborated to produce a common outcome.

2.8 Materials, Resources and Tools

The following resources were used to implement the practice:

- The AppGyver/SAP platform for application development.
- Computers for design and development.
- Smartphones for field testing.
- Mobile device cameras for barcode scanning.
- Digital and printed instructions.
- Questionnaires for needs assessment and feedback collection.
- An application user manual.
- Real-world data and usage scenarios.

The *Application Presentation Manual* was particularly important, serving as both educational and support material. It included instructions on registration and email verification, livestock management, medical history recording, reproduction, milk production, agricultural activities and report generation.

2.9 Multilingualism and the European Dimension

The transnational nature of the practice created the need to support different languages. The application was designed to support four languages:

- Greek.
- English.
- Serbian.
- Slovenian.

Multilingualism is not merely a technical feature. It reflects the need for a European digital tool to be accessible to different user groups without language barriers restricting access.

At the same time, cooperation between students and teachers from three countries strengthened communication in an international environment and created opportunities for authentic European collaboration.

3. EVALUATION OF THE LEARNING PROCESS

Evaluation took place throughout the development process rather than exclusively at the end of the practice.

Formative assessment was integrated into the five-version development cycle. Each version served as an intermediate product that underwent testing and evaluation.

The process followed this cycle:

Design → Development → Testing → Feedback → Improvement.

This approach helped students understand that software development is not a linear process. A product may require multiple iterations before it meets users' actual needs.

The transition from laboratory testing to real-world testing was particularly important. Students used the application in actual workplaces, where they encountered conditions that cannot be fully reproduced in a classroom.

3.1 Real-World Testing

The final testing phase involved a total of 160 users from Greece, Serbia and Slovenia.

Table 1. Application testing involving participants from all three schools

User group	Number	Country/Region
Students at the Novo Mesto Agricultural School	50	Novo Mesto, Slovenia
Students at the Požarevac Agricultural School	40	Požarevac, Serbia
Farmers	40	Požarevac, Serbia
Livestock farmers	30	Serres, Greece
Total	160	

The testing process made it possible to evaluate not only technical characteristics but also usability, data-entry speed and suitability for real-world conditions.

One particularly representative scenario involved using the application inside a livestock facility. A user could identify an animal using a barcode, access its corresponding digital profile and enter relevant information without having to return to a computer.

4. RESULTS AND BENEFITS

4.1 Benefits for Students

Students gained experience in the complete software development lifecycle. They were not limited to learning technological concepts theoretically but participated in a real project involving specific users and requirements.

The main benefits included:

- Development of digital skills.
- Improvement of problem-solving abilities.
- Development of collaborative skills.
- Experience in software testing.
- Interaction with real professionals.
- Understanding of labour market needs.
- Increased confidence in their ability to create digital solutions.

4.2 Benefits for Teachers

Teachers gained experience in managing an international digital project and using modern software development methods. The practice also established a framework for cooperation between different specialisations and countries.

4.3 Benefits for Farmers and Livestock Producers

For professionals in the primary sector, the application provided the opportunity to consolidate data within a unified digital environment.

The barcode scanner could reduce data-entry time and limit errors caused by manual input. Report-generation capabilities enabled users to exploit collected data for production monitoring and more informed decision-making.

4.4 Reports and Decision Support

The Reports section was one of the features that transformed the application from a simple recording tool into a decision-support tool.

Using time filters, users can retrieve data from specific periods and obtain an overview of their activities.

This approach is particularly important in modern agriculture, where value lies not only in collecting data but also in the ability to use it effectively.

5. CHALLENGES, LIMITATIONS AND MITIGATION MEASURES

The most significant technical challenge was limited or unavailable Internet access in rural areas. This requirement directly influenced the application's design and led to the need for offline functionality. As a result, users could enter the necessary information in the field and synchronise it when the Internet connection was restored.

6. INNOVATION AND ADDED VALUE OF THE PRACTICE

The innovation of AGROINFORMATIX lies primarily in its combination of Vocational Education and Training, No-Code development, digital agriculture and European cooperation.

In a traditional educational environment, developing a complex application would require considerable time to learn programming languages, libraries and development techniques.

The use of No-Code tools significantly changed this relationship.

Students could focus more on:

- Application logic.
- User needs.
- Data structures.
- User experience design.
- Testing.
- Problem-solving.

Furthermore, the application was not merely an educational prototype. It was designed for use under real-world conditions and tested by actual professionals.

The European added value is reinforced by:

- The participation of three countries.
- Multilingual functionality.
- Knowledge exchange.
- The involvement of different educational specialisations.
- Testing by real users.
- Dissemination of the results at European level.

7. POTENTIAL FOR APPLICATION IN OTHER EDUCATIONAL CONTEXTS

One of the main advantages of this practice is that its methodology can be transferred to other subject areas.

The same educational approach can be used to develop applications relating to:

- Tourism.
- Catering and food services.
- Retail.
- Supply chain management.
- Healthcare.
- The environment.
- Civil protection.
- Cultural heritage.
- Small businesses.
- School or municipal service management.

The core educational model remains the same:

Real-world problem → Needs analysis → Design → No-Code development → Testing → Feedback → Improvement → Final digital product.

This flexibility makes the practice particularly suitable for Vocational Upper Secondary Schools (EPAL), Laboratory Centres and other VET environments.

More specifically, it can serve as a model for interdisciplinary projects in which students from different specialisations collaborate to address a common problem.

8. CONCLUSION

Disseminating the results is an important element in ensuring the sustainability of the AGROINFORMATIX educational innovation.

The practice was presented at institutional and educational events, including the two-day event organised by the State Scholarships Foundation (IKY) in Serres, while further presentation was planned as part of a summer series of presentations.

At the European level, the results were disseminated through the EPALE platform, expanding the opportunities for their use by educators and professionals.

AGROINFORMATIX highlights the role of Vocational Education and Training in developing digital solutions to real labour market needs.

Starting from problems encountered in agriculture and livestock farming, students actively participated in every stage of application development, from requirements analysis to testing under real-world conditions.

The use of No-Code technologies reduced initial technical barriers and enabled students to focus on computational thinking, information systems design and problem-solving.

Cooperation between the Informatics, Agriculture and Animal Production specialisations was crucial, bringing different subject areas together to achieve a common practical outcome.

At the same time, the participation of 160 users from Greece, Serbia and Slovenia contributed to the evaluation of the application and strengthened transnational cooperation and intercultural learning.

Support for operation without a continuous Internet connection was also a significant design decision, adapted to the requirements of agricultural environments.

Beyond the development of the specific application, the practice offers a methodology that can be transferred to different professional fields.

Needs identification, collaborative development, testing and continuous improvement of a digital product can provide the foundation for similar interdisciplinary projects in vocational upper secondary schools and Laboratory Centres.

Continued dissemination of the results and their use in future Erasmus+ collaborations can further strengthen AGROINFORMATIX's contribution to the digital transformation of Vocational Education and Training and the primary sector.

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