



 Research Article

A Model for Institutional Engagement of University Students in Land Accounting and State Registration of Real Estate Rights Based on Geo-Information Intelligence

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ABSTRACT

This study proposes and evaluates an institutional model for engaging university students in land accounting and the state registration of real estate rights based on geo-information intelligence technologies. The research is conducted within the framework of the Law of the Republic of Uzbekistan No. 937 (August 5, 2024), which regulates the recognition of rights to unauthorized land plots and related constructions. The model integrates academic training with practical cadastral activities by involving students in field-based geospatial data collection and processing. The experimental implementation was carried out in seven mahalla territories according to an approved schedule proposed by local government authorities. A total of 31 second- and third-year students from the Geodesy and Geoinformatics program of Kokand State University participated in the study. Field measurements were conducted using electronic laser distance meters, GPS receivers, and modern geodetic instruments, and the collected data were integrated into the UZKAD automated cadastral information system. The results indicate improvements in GIS competency (38%), geodetic accuracy (25%), and digital data processing speed (58%) ($p < 0.001$). The proposed model supports digital cadastral transformation and strengthens practical geospatial competencies.

KEYWORDS

Land accounting; State registration; Real estate; Geo-information intelligence; GIS; UZKAD; Digital cadastre; Institutional integration.

INTRODUCTION

In modern public administration, land accounting and the state registration of real estate rights represent fundamental components of sustainable economic development, effective land governance, and the protection of property rights. Reliable and well-structured cadastral information systems provide an institutional foundation for spatial planning, taxation, infrastructure development, and investment activities. The availability of accurate land and property data enables governments to ensure transparency in land administration and create favorable conditions for economic growth and territorial development [1]. In this context, efficient cadastral systems play a critical role in strengthening legal guarantees of property ownership and improving the investment climate [2].

In recent decades, the rapid development of digital technologies has significantly transformed land administration systems worldwide. The integration of geographic information systems (GIS), global navigation satellite systems (GNSS), remote sensing technologies, and digital geospatial databases has improved the efficiency and accuracy of cadastral data collection, processing, and management [3]. These technologies facilitate the precise delineation of land parcel boundaries, identification of real estate objects, and creation of integrated digital cadastral databases that support spatial decision-making processes [4]. Moreover, digital cadastral platforms contribute to improving the accessibility and speed of public services related

to land registration and property rights management [5].

In Uzbekistan, substantial reforms have been implemented in recent years to modernize land administration and cadastral management systems. One of the key legislative developments in this area is the Law of the Republic of Uzbekistan No. 937, adopted on August 5, 2024, “On the Recognition of Rights to Unauthorized Land Plots and Buildings and Structures Constructed on Them.” This law establishes a legal framework for recognizing property rights to land plots that were previously occupied without formal authorization, as well as buildings and structures constructed on such land parcels. The adoption of this law aims to improve the formalization of property rights, enhance the transparency of land administration, and expand the national cadastral database [6]. As a result, large-scale inventory and cadastral registration activities are currently being conducted throughout the country in order to identify and legally register previously undocumented land parcels and real estate objects [7].

These activities are carried out by district and municipal cadastral authorities in accordance with approved implementation schedules developed on the basis of proposals submitted by local government bodies. During the inventory process, land parcel boundaries are determined through geodetic measurements, and information about existing buildings and structures is collected and verified. The collected spatial and attribute data are subsequently processed and

integrated into national cadastral information systems [8]. In Uzbekistan, digital cadastral data management is primarily supported by the automated cadastral information system “UZKAD,” which provides a unified platform for storing, processing, and managing cadastral data across different administrative levels [9].

However, the large scale of cadastral inventory activities creates a growing demand for qualified specialists in geodesy, geoinformatics, and spatial data analysis. In this regard, the involvement of university students specializing in geodesy and geoinformation technologies in practical cadastral activities can provide a mutually beneficial solution. On the one hand, such involvement supports the implementation of large-scale cadastral tasks, while on the other hand, it provides students with valuable practical experience and enhances their professional competencies. Previous studies emphasize that the integration of higher education with practical governmental and institutional activities significantly improves the effectiveness of professional training and contributes to the development of highly qualified specialists in geospatial sciences [10].

Therefore, the present study proposes an institutional model for involving university students in land accounting and state registration processes of real estate rights using geoinformation intelligence technologies. The research evaluates the effectiveness of integrating academic training with practical cadastral activities and assesses the potential of this approach for supporting the digital transformation of land administration systems while simultaneously strengthening the professional competencies of future geospatial specialists.

METHODS

The methodological framework of this study is based on the integration of theoretical approaches in education, geospatial technologies, and digital land administration. The research combines elements of educational theory, geoinformation analysis, and practical cadastral implementation in order to evaluate the effectiveness of involving university students in land accounting and real estate registration processes. Particular attention is given to the relationship between academic training and practical professional activities within the context of modern digital cadastral systems.

From a theoretical perspective, the study relies on the concept of practice-oriented education and workplace-based learning. According to the theory of work-based learning, students develop professional competencies more effectively when they participate directly in real professional environments rather than learning exclusively through classroom instruction. Participation in real projects allows students to apply theoretical knowledge in practice, develop problem-solving skills, and gain experience in handling real spatial data and field measurements. In the context of geodesy and geoinformatics education, such approaches are particularly important because the profession requires strong practical skills in spatial measurements, data processing, and geospatial analysis.

Another important conceptual basis of the research is the notion of geo-information intelligence. Geo-information intelligence refers to the use of advanced geospatial technologies for collecting, processing, analyzing, and interpreting spatial data in order to support informed decision-making. In modern land administration

systems, geo-information intelligence integrates geographic information systems (GIS), satellite navigation technologies, digital mapping tools, and spatial databases. These technologies enable the efficient identification of land parcels, accurate determination of boundaries, and integration of spatial data into national cadastral information systems. As a result, geo-information intelligence plays an increasingly important role in improving the transparency and efficiency of land governance processes.

The research also considers the ongoing transformation of cadastral systems toward digital platforms. Digital cadastral transformation involves the integration of spatial, legal, and administrative information into unified digital databases that allow government institutions to manage land and property records more efficiently. Digital cadastral systems enable faster data processing, improved accuracy of spatial information, and better coordination between different governmental agencies involved in land administration. Despite the growing body of literature on digital cadastral systems and geospatial technologies, the issue of institutional involvement of university students in official land accounting and state registration processes, particularly within the framework of national legislation, remains insufficiently studied. This research therefore aims to address this gap by proposing and testing a practical model of institutional student engagement.

The empirical part of the study was conducted using a pre-test and post-test experimental design. This approach allowed the researchers to evaluate changes in students' professional competencies before and after their participation in practical cadastral activities. The experimental design made it possible to assess improvements

in GIS skills, geodetic measurement accuracy, and the speed of digital spatial data processing.

The participants in the study were 31 second- and third-year students enrolled in the "Geodesy and Geoinformatics" program at Kokand State University. These students already possessed basic theoretical knowledge in geodesy, cartography, and geographic information systems, which allowed them to participate effectively in field inventory activities. Before the beginning of the fieldwork, students received methodological instructions regarding measurement procedures, data collection standards, and safety requirements.

The field component of the research was carried out in seven mahalla citizens' assemblies located within the study area. These territories were selected in accordance with the official implementation schedule approved by local government authorities for conducting cadastral inventory activities. The field inventory process followed a full-coverage approach, meaning that each land parcel and real estate object within the selected territories was examined individually. This method ensured the completeness and reliability of the collected spatial and attribute data.

During the fieldwork, students used modern geodetic and geospatial equipment. The primary instruments included electronic laser distance meters for measuring building dimensions, GPS receivers for determining geographic coordinates, and electronic total stations for precise geodetic measurements. In addition, mobile GIS platforms were used for recording spatial data directly in the field and synchronizing it with digital mapping systems. The use of these technologies allowed the research team to obtain

accurate spatial information and minimize potential measurement errors.

After completing the field measurements, the collected data were processed and integrated into the automated cadastral information system UZKAD. At this stage, cadastral data layers were created within the system, spatial boundaries of land parcels were vectorized, and attribute information about buildings and structures was added to the database. Based on the processed data, official documentation required for the state registration of real estate rights was prepared in accordance with the established cadastral procedures.

To evaluate the effectiveness of the proposed educational and institutional model, statistical analysis was conducted using paired sample t-tests. The results demonstrated statistically significant improvements in students'

competencies after participating in the practical cadastral activities. The paired t-test results showed a value of $t(30) = 11.62$ with a significance level of $p < 0.001$, indicating a strong effect of the practical training intervention. In addition, correlation analysis revealed a positive relationship between participation in field inventory activities and improvements in geospatial competencies, with a correlation coefficient of $r = 0.72$.

Overall, the methodological approach adopted in this research allowed for a comprehensive evaluation of both educational outcomes and operational effectiveness of student participation in cadastral activities. The integration of theoretical foundations, practical fieldwork, and statistical analysis provides a reliable basis for assessing the proposed model of institutional engagement in digital land administration processes.

Table 1. Statistical analysis of competency improvement

Indicator	Initial value	Final value	Growth
GIS competency	44%	82%	+38%
Geodetic accuracy	72%	97%	+25%
Digital data processing speed	1.00	1.58	+58%
Completeness of registry data	77%	98%	+21%

RESULTS AND DISCUSSION

The study tested an institutional model for engaging university students in land accounting and state registration processes of real estate rights. The experimental implementation was conducted in seven mahalla citizens' assemblies

located in Kokand city, where 31 second- and third-year students from the "Geodesy and Geoinformatics" program participated in field cadastral activities.

The fieldwork was carried out using modern geodetic and geospatial technologies, including

electronic laser distance meters, GPS receivers, electronic total stations, and mobile GIS platforms. These tools enabled the collection of both spatial and attribute data related to land parcels and real estate objects within the study area. The collected data were subsequently processed and integrated into the automated cadastral information system UZKAD, where cadastral layers were created, parcel boundaries were vectorized, and the necessary documentation for state registration procedures was prepared.

The application of the full-coverage inventory method across seven mahalla territories contributed significantly to the clarification and updating of land accounting data. Each land parcel and property object was examined individually, which improved the completeness and reliability of the cadastral database. The use of electronic laser measurement devices and GPS technologies increased the accuracy of geodetic measurements and reduced potential technical errors during field data collection.

The obtained results demonstrate that the participation of university students significantly improved the efficiency of cadastral data collection and processing activities. According to the empirical results, students' competency in using GIS technologies increased by 38%, the accuracy of geodetic measurements improved by 25%, and the speed of digital data processing increased by 58%. Statistical analysis confirmed that the differences between the pre-test and post-test indicators were highly significant. The paired t-test showed $t(30) = 11.62$ with $p < 0.001$, indicating a strong positive effect of practical participation in real cadastral activities on the development of students' professional skills.

In addition to educational outcomes, the field inventory activities also contributed to improving the quality of cadastral information within the study area. During the fieldwork, several land parcels were identified where existing cadastral data required clarification. In some cases, parcel boundaries were re-vectorized based on precise geodetic measurements, and additional attribute information about buildings and structures was recorded. As a result, the accuracy and reliability of land accounting data in the studied territories were significantly improved.

Another important outcome of the research is the identification of an effective institutional cooperation mechanism between different stakeholders involved in land administration. The implementation of the proposed model followed a structured institutional chain: local government authorities → approved implementation plan → cadastral agencies → UZKAD digital system → university participation. This coordinated mechanism ensured efficient organization of field activities and facilitated the integration of collected data into the national cadastral system. The results indicate that such institutional cooperation can play a key role in supporting the digital transformation of cadastral systems.

The practical significance of the proposed model is reflected in several aspects. First, the involvement of students contributes to improving the quality and completeness of land accounting data. Second, it accelerates the processes of state registration of real estate rights by expanding the workforce available for cadastral inventory activities. Third, it supports the development of highly qualified geo-information specialists with practical experience in modern geospatial technologies. Finally, the model contributes to the

further development and modernization of the digital cadastral system.

From a scientific perspective, the research presents several important contributions. A GIS-integrated institutional model for involving university students in cadastral processes has been developed and tested in practice. Empirical results obtained from fieldwork conducted in seven mahalla territories provide evidence of the effectiveness of the proposed approach. Furthermore, the study demonstrates measurable growth in geospatial competencies through participation in practical activities integrated with the UZKAD cadastral information system.

Overall, the results confirm that institutional collaboration between universities, local government bodies, and cadastral authorities can serve as an effective mechanism for both strengthening the digital cadastral infrastructure and improving the practical training of future geospatial professionals.

CONCLUSION

The results of this study demonstrate that the institutional engagement of university students in land accounting and the state registration of real estate rights represents an effective and practical model for integrating education with public administration processes. The empirical findings confirm that the participation of students in real cadastral activities significantly enhances their professional competencies in geodesy, geographic information systems (GIS), and digital cadastral technologies.

During the research, the application of modern geodetic instruments and geospatial technologies

accelerated the processes of collecting and processing spatial data related to land parcels and real estate objects. At the same time, the accuracy and reliability of cadastral information were improved. These results highlight the potential for more efficient use of human resources in the context of the ongoing digital transformation of land administration systems. In addition, the collaboration established between the university, local government authorities, and cadastral agencies contributed to improving the effectiveness of territorial land management processes. The integration of spatial data collected and processed by students into the UZKAD cadastral information system also supported the improvement of the completeness and accuracy of the national digital cadastral database.

The proposed institutional model can therefore be considered an effective mechanism for integrating academic education with practical professional activities. On the one hand, the model strengthens the professional training of students by providing them with real-world experience in geospatial data collection and cadastral processes. On the other hand, it contributes to the development of additional qualified human resources for the national cadastral system.

In the future, the implementation of this model could be expanded to other regions of the country. Further integration of advanced geoinformation technologies, including artificial intelligence and automated spatial data analysis, may also enhance the efficiency and accuracy of land accounting and real estate registration processes. Such developments would contribute to strengthening the digital land administration

infrastructure and supporting sustainable territorial management.

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