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Introduction of Modern Educational Programs into Corporate Training of Real Estate Agency Employees

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Abstract: ***This study aims to develop a comprehensive framework for implementing modern educational programs in real estate agencies' corporate training. The research employs a multidisciplinary approach, integrating theories from real estate economics, human capital theory, organizational behavior, and andragogy. Methods include systematic literature review, mathematical modeling of competencies, and application of change management theories. Key results demonstrate the effectiveness of adaptive learning systems based on machine learning algorithms and cognitive modeling, integrated with immersive technologies and microlearning. The study proposes a multi-level competency taxonomy and a strategy for program implementation, considering organizational, technological, and human factors. Conclusions emphasize the transformative nature of modern educational programs in real estate agencies, highlighting the need for continuous adaptation. This research contributes to the field by providing a novel, integrated approach to corporate learning in the real estate sector, bridging the gap between educational technology advancements and industry-specific requirements.***

Keywords: corporate training, real estate education, adaptive learning systems, competency modeling, organizational change, immersive technologies, micro-learning, andragogy, human capital development, educational technology integration.

1. Introduction

In today's rapidly evolving world, the real estate market is undergoing significant transformations driven by the digitalization of the economy, changes in consumer preferences, and global economic processes. Under these conditions, the issue of the professional competence of real estate agents becomes particularly significant, as it directly correlates with the efficiency of agency operations and client satisfaction. The paradigm of continuous education, which has become an integral part of the corporate culture of leading organizations, dictates the need for the implementation of innovative educational programs in the corporate training system for real estate agency employees.

The relevance of this topic is driven by several factors:

1) The high volatility of the real estate market, requires agents to constantly update their knowledge and skills.
2) Intensified competition in the real estate services sector, stimulating the search for new competitive advantages through staff qualification enhancement.
3) The absence of specialized training programs in higher education institutions.
4) Technological progress introducing new tools and methods into the practice of real estate agents.
5) Changing consumer behavior patterns driven by digitalization and increased client awareness.

Therefore, the aim of this article is to develop theoretical and methodological foundations and practical recommendations for integrating modern educational programs into the corporate training system for real estate agency employees.

To achieve this aim, the following objectives need to be addressed:

1) Analyze the specifics of the real estate market and current competency requirements for agents.
2) Investigate modern concepts of corporate training and the principles of andragogy in the context of professional development.
3) Conduct a critical analysis of contemporary educational technologies applicable to corporate training.
4) Develop the structure and content of an educational program for real estate agencies.
5) Formulate a strategy for implementing the educational program and mechanisms for assessing its effectiveness.

Thus, this study aims to make a significant contribution to the development of the theory and practice of corporate training within the specific context of real estate agencies, offering innovative approaches to enhancing the professional competence of agents in a dynamically changing market environment.

2. Theoretical foundations of corporate training in the real estate sector

The real estate market, characterized by a high degree of volatility and heterogeneity, imposes specific requirements on the professional competencies of agents. The uniqueness of this market is determined by several factors: information asymmetry, low asset liquidity, significant capital intensity, and a long investment cycle. In this context, corporate training in the real estate sector becomes critically important for maintaining the competitiveness of agencies.

The theoretical foundation of corporate training in real estate is based on the integration of several scientific disciplines: real estate economics, human capital theory, organizational behavior, and andragogy. Let us consider the key aspects of this synthesis.

Real estate economics provides the conceptual basis for understanding market specifics. The spatial equilibrium

theory [1] and the model of monopolistic competition in the real estate market [2] form the basis for analyzing market processes. These theories emphasize the need for agents to deeply understand the spatial and economic factors affecting real estate value.

Human capital theory [3] justifies investments in corporate training as a means of increasing labor productivity. In the context of the real estate market, this is expressed in the direct correlation between the level of agents' competencies and their ability to generate income for the agency.

Organizational behavior provides the theoretical basis for understanding training processes at the organizational level. The concept of a learning organization [4] is particularly relevant for real estate agencies, considering the market's dynamism. Senge's five disciplines form the foundation for creating a culture of continuous learning in real estate agencies:

- Systems thinking,
- Personal mastery,
- Mental models,
- Shared vision,
- Team learning.

Andragogy, as the science of adult learning, offers principles that are critically important for effective corporate training in the real estate sector. Knowles' andragogy model [5] highlights the following key aspects:

1) Self-concept of the learner,
2) Learner's experience,
3) Readiness to learn,
4) Orientation to learning,
5) Motivation to learn.

The integration of these principles into the corporate educational programs of real estate agencies can be represented in the form of a conceptual model, as illustrated in Figure 1.

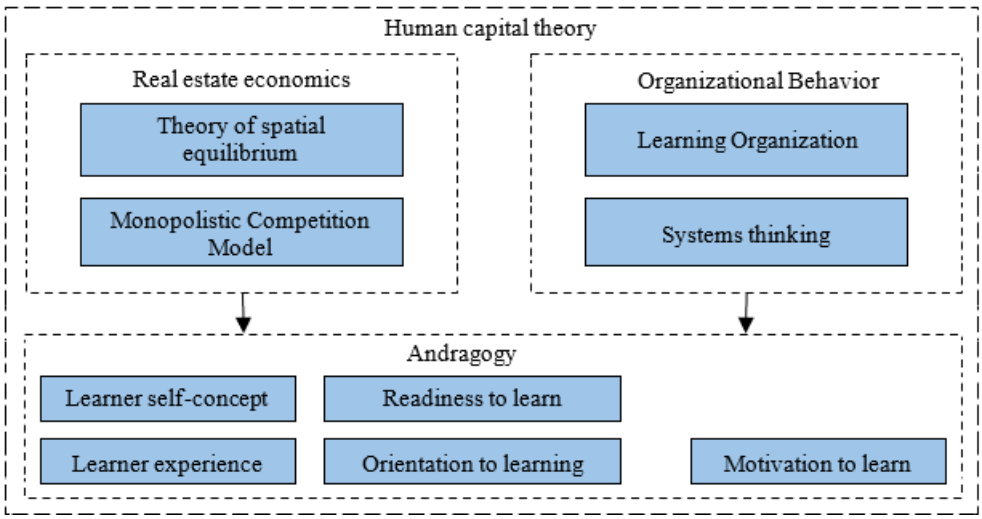

Figure 1: Integration of principles into corporate educational programs for real estate agencies

This model illustrates a comprehensive approach to corporate training in the real estate sector, integrating key theoretical concepts. Modern neuroscience research also makes a significant contribution to understanding adult learning processes. The concept of neuroplasticity [6] substantiates the brain's ability to change and adapt throughout life, which has important implications for developing educational programs for real estate agents.

Empirical studies on the effectiveness of various corporate training methods in the real estate sector demonstrate the advantages of an integrated approach. The combination of formal training, mentoring, and practical experience (corresponding to the 70-20-10 model) leads to the most sustainable results in developing real estate agents' competencies.

Table 1: Comparative analysis of the effectiveness of training methods in the real estate sector

Training Method	Short-Term Effect	Long-Term Effect	Developed Competencies
Formal Courses	High	Medium	Theoretical knowledge, analytical skills
Mentoring	Medium	High	Practical skills, professional ethics
Simulations	High	High	Negotiation skills, decision-making
Microlearning	Medium	Low	Knowledge updating, adaptability
Project-Based Learning	Low	High	Complex problem-solving, teamwork

It should be noted that the theoretical foundations of corporate training in the real estate sector represent a complex interdisciplinary construct. The synthesis of knowledge from real estate economics, human capital theory, organizational behavior, and andragogy provides a foundation for developing innovative educational programs.

3. Analysis of modern educational technologies

In the context of corporate training in the real estate sector, a key area of development for educational technologies is the creation of adaptive learning systems (ALS). ALS are comprehensive platforms integrating advanced technologies

such as artificial intelligence, data analysis, and cognitive science to optimize the educational process.

The theoretical foundation of ALS is the concept of Vygotsky's zone of proximal development [7], which, in the context of modern technologies, transforms into a dynamic competence model. This model considers not only the current level of knowledge and skills of a real estate agent but also their potential for development in the short and medium term.

A key component of ALS is the cognitive modeling system based on Bayesian networks and deep learning algorithms. This system analyzes patterns of agent interaction with educational content, professional activities, and competency assessment results to create a multidimensional cognitive model of the learner.

Mathematically, this model can be represented as:

$$M(a,t) = f(K(t), S(t), E(t), C(t))$$

where:
M(a,t) is the cognitive model of agent “a” at time “t”
K(t) is the knowledge vector
S(t) is the skills vector
E(t) is the experience vector
C(t) is the vector of contextual factors (market situation, organizational environment)

The function “f” represents a nonlinear mapping implemented using deep neural networks.

Based on this model, ALS generates an individual learning trajectory, optimizing the sequence and complexity of the provided content. A key aspect here is the balance between exploitation (using existing knowledge) and exploration (gaining new experience), which can be mathematically expressed as a contextual multi-armed bandit problem [8].

An important element of ALS is the content generation system, based on natural language processing and computer vision methods. This system can dynamically adjust the complexity and format of educational material depending on the current state of the agent's cognitive model. For example, for agents with a predominant visual learning style, the system can automatically generate infographics based on textual descriptions of market trends.

The effectiveness of ALS in training real estate agents can be evaluated through the lens of transfer of learning theory [9]. In this context, the key indicator is the agent's ability to apply acquired knowledge in new, non-standard situations in the real estate market.

However, the implementation of ALS faces several challenges. A major issue is ensuring the ethics and transparency of algorithms, especially in the context of career development decisions for agents. This requires the development of new approaches to explainable artificial intelligence (XAI) in the educational context.

Another important aspect is the integration of ALS with existing business processes in real estate agencies. Here, the development of interoperability standards and data exchange protocols between educational platforms and CRM systems plays a crucial role [25].

4. Development of a modern educational program for real estate agencies

Developing an effective educational program for real estate agencies requires a systematic approach that considers market dynamics, the cognitive characteristics of adult learners, and the technological capabilities of modern education. The foundation of this approach is the integration of competency theory, principles of andragogy, and innovative educational technologies.

A fundamental step in developing the program is the identification and structuring of key competencies. In the context of the modern real estate market, a multi-level taxonomy of competencies is proposed, based on the professional competency model by Cheetham and Chivers [10], adapted to the specifics of the real estate industry:

1) Cognitive Competencies
2) Functional Competencies
3) Social-Communicative Competencies
4) Digital Competencies
5) Meta-Competencies

Each competency category represents a set of interconnected skills and knowledge necessary for effective performance in the current real estate market. It is important to note that these categories are not isolated but form a complex, interrelated system.

For example, analytical thinking (a cognitive competency) is closely related to big data skills (a digital competency) and the ability to present analysis results to clients (a social-communicative competency). This interconnection reflects the complexity of the tasks faced by modern real estate agents.

To formalize these interconnections, it is proposed to use a competency model in the form of a weighted graph, where vertices represent individual competencies, and edges represent the strength of their interconnection. Mathematically, this can be expressed by an adjacency matrix “A”, where a_ij represents the strength of the connection between competencies “i” and “j”:

$$A = [a_{ij}], \text{ where } 0 \leq a_{ij} \leq 1$$

This approach allows not only to visualize the structure of competencies but also to apply graph theory methods for analyzing and optimizing the educational program.

Based on the developed competency model, a modular structure of the educational program is formed. Each program module should be designed following the principles of constructive alignment [11], ensuring coherence between learning objectives, educational activities, and assessment methods.

Consider an example of the module structure "Real Estate Market Analytics":

1) Learning Objectives
2) Educational Activities

3) Assessment Methods

A key aspect of module development is ensuring an optimal cognitive load for effective learning. According to cognitive load theory [12], it is necessary to balance the intrinsic cognitive load (complexity of the material), extraneous cognitive load (how information is presented), and germane cognitive load (the process of assimilating and integrating new knowledge).

In the context of training real estate agents, this means that complex analytical concepts should be presented using visualizations and practical examples, and practical tasks should gradually increase in complexity, keeping learners within their zone of proximal development [7].

Thus, a modern educational program for real estate agencies should integrate advanced educational technologies, ensuring personalization, immersion, and effective learning. Consider the key technological solutions and their role in the program:

- Adaptive Learning Systems (ALS)
- Immersive Technologies
- Microlearning
- Social Learning

It is important to note that these technologies should not be applied in isolation but should form a unified learning ecosystem. For example, data collected by ALS on learner progress can be used to personalize scenarios in VR simulations and create individual microlearning plans.

To formalize this integration, the concept of a learning graph is proposed, where vertices represent individual educational activities, and edges represent the sequence and interconnections between them. Mathematically, this can be represented as a directed graph G = (V, E), where V is the set of educational activities, and E is the set of directed edges representing transitions between activities.

This approach allows the use of graph optimization algorithms to personalize learning trajectories. For example, Dijkstra's algorithm can be adapted to find the optimal learning path, where the weight of an edge represents cognitive load or the time required to transition between educational activities.

For a comprehensive evaluation of the educational program's effectiveness, a multi-level model based on the Kirkpatrick-Phillips approach, but expanded to account for the specifics of the real estate market, is proposed:

- Reaction Level
- Learning Level
- Behavior Level
- Results Level
- ROI Level

It is important to note that each subsequent level depends on the previous ones. This dependency can be expressed through a Bayesian network, where the probability of success at each level depends on the success at previous levels:

$$P(\text{ROI} \mid \text{Results}, \text{Behavior}, \text{Learning}, \text{Reaction})$$

This approach not only allows evaluating the program's effectiveness but also identifies key factors influencing its success, which is critically important for the continuous improvement of the educational process.

5. Strategy for implementing the educational program

Implementing an innovative educational program in real estate agencies is a complex process of organizational change that requires a systematic approach and consideration of multiple factors. Based on Kotter's change management theory [13] and Rogers' diffusion of innovations concept [14], we propose the following implementation strategy.

1) Diagnosis and Preparation

At this stage, a thorough analysis of the current state of training in the agency and the organization's readiness for change is conducted. The organizational readiness model [15] is used, which evaluates:

- Collective efficacy
- Collective commitment
- Motivational readiness

Mathematically, readiness can be expressed as a function:

$$R = f(E, C, M)$$

where R is readiness, E is efficacy, C is commitment, and M is motivation.

Based on this assessment, a preparatory plan is developed, including work on overcoming resistance to change and forming a coalition to support the program.

2) Pilot Implementation

The pilot implementation is conducted on a limited group of agents selected based on Rogers' diffusion of innovations theory. The group includes:

- Innovators (2.5% of the total number of agents)
- Early adopters (13.5%)

This allows the program to be tested in real conditions and to gather valuable feedback for refinement. To assess the results of the pilot implementation, a control group method with a quasi-experimental design is used [16].

3) Scaling Up

After a successful pilot implementation and necessary adjustments, the program is scaled to the entire organization. The scaling process is modeled using percolation theory [17], where the spread of the new educational practice is viewed as a diffusion process in the agency's social network.

The probability of an agent “i” adopting the program can be expressed as

$$P(A_i) = f(T_i, S_i, N_i)$$

where T_i is the individual adoption threshold, S_i is the perceived value of the program, and N_i is the proportion of neighbors in the social network who have already adopted the program.

4) Institutionalization
At this stage, the new educational program is integrated into the organizational processes and culture of the agency. A key aspect is the creation of a continuous improvement system for the program based on the principles of Total Quality Management [18].

6. Organizational aspects of implementation

1) Structural Changes
Implementing a new educational program may require restructuring the training and development department. A matrix structure is proposed, combining functional roles (content developers, technical specialists) and project teams responsible for individual program modules. The effectiveness of such a structure can be assessed using the theory of organizational ambidexterity [19], which ensures a balance between exploiting existing competencies and exploring new opportunities.

2) Technological Infrastructure
Creating a reliable technological infrastructure is critical for the successful implementation of the program. It is proposed to use a microservice architecture, providing flexibility and scalability to the system. Key components include:

- LMS (Learning Management System)
- Adaptive Learning Engine
- Analytics Dashboard
- Integration Layer (API Gateway)

The reliability of the system can be formally expressed through the Markov reliability model:

$$R(t) = e^{(-\lambda t)}$$

where R(t) is the system's reliability at a time “t”, and λ is the failure rate.

3) Data Management
Effective management of educational data is a key success factor for the program. It is proposed to implement a data management system based on FAIR principles (Findable, Accessible, Interoperable, Reusable) [20]. To ensure confidentiality and compliance with regulatory requirements (such as GDPR), a differential privacy model is applied [21]:

$$\varepsilon\text{-differential privacy: } P(M(D) \in S) \leq \exp(\varepsilon) \times P(M(D') \in S)$$

where M is the data access mechanism, D and D' are neighboring datasets, S is a subset of possible outputs, and ε is the privacy parameter.

A critical success factor for the program is the preparation of a team of internal trainers and mentors. The training process is based on the "Train the Trainer" concept and includes the following stages:

4) Candidate Selection
The selection is conducted based on a multi-criteria decision-making (MCDM) model that considers both professional competencies and pedagogical inclinations of the candidates. The TOPSIS method (Technique for Order Preference by Similarity to Ideal Solution) is applied:

$$C_i^* = S_i^- / (S_i^+ + S_i^-)$$

where C_i^* is the relative closeness to the ideal solution, S_i^+ and S_i^- are the distances to the positive and negative ideal solutions, respectively.

5) Intensive Training
The trainer training program is based on the principles of andragogy [22] and includes modules on adult learning facilitation, application of educational technologies, and group dynamics management.

6) Supervised Practice
Novice trainers undergo practice under the guidance of experienced mentors. The supervision process is structured according to the Dreyfus model of skill acquisition [23], which involves five stages of development: from novice to expert.

7) Continuous Development
To maintain and develop trainers' competencies, a system of continuous professional development is established, including regular workshops, experience sharing, and participation in professional communities of practice.

The effectiveness of trainer preparation is evaluated using the Kirkpatrick-Phillips training program evaluation model, supplemented by elements of the theory of learning transfer [24].

Thus, the proposed strategy for implementing the educational program represents a comprehensive approach, integrating theoretical models of organizational change, innovation diffusion, and educational process management. A key success factor is the systematic consideration of all aspects of implementation—from technological infrastructure to human resource preparation.

It is important to note that the implementation process should be iterative and adaptive, with constant feedback and strategy adjustments based on the data received. This will ensure the program's flexibility and its ability to evolve alongside changes in the real estate industry and educational technologies.

7. Conclusion

This study analyzed the process of implementing modern educational programs into the corporate training of real estate agency employees. The examined aspects cover a wide range of theoretical and practical issues, from the fundamental principles of corporate training to specific strategies for implementing innovative educational programs.

The key findings of the study can be summarized as follows:

1) Theoretical Foundations: The theoretical foundations of corporate training in the real estate sector represent a complex interdisciplinary construct, integrating concepts from real estate economics, human capital theory, organizational behavior, and andragogy. The synthesis of these fields creates a foundation for developing effective

educational programs capable of adequately responding to the challenges of the modern real estate market.

2) Modern Educational Technologies: The analysis of modern educational technologies highlighted the key role of adaptive learning systems (ALS), based on machine learning algorithms and cognitive modeling. The integration of ALS with immersive technologies, microlearning, and social learning forms a comprehensive corporate learning ecosystem that can adapt to the individual needs of agents and the dynamics of the real estate market.
3) Educational Program Development: Developing a modern educational program for real estate agencies requires a systematic approach based on a multi-level taxonomy of competencies and principles of constructive alignment. A key aspect is the creation of an adaptive, personalized learning system capable of evolving with market changes and the individual needs of agents.
4) Implementation Strategy: The strategy for implementing an educational program must consider a complex array of organizational, technological, and human factors. Applying theories of change management, innovation diffusion, and organizational ambidexterity allows for the development of an effective implementation plan that ensures the successful scaling and institutionalization of the new educational program.

The conducted study demonstrates that the implementation of modern educational programs in the corporate training of real estate agencies is not just a technological update but a fundamental transformation in the approach to developing human capital in the industry. This transformation requires systemic thinking, integration of advanced technologies, and a deep understanding of the specifics of the real estate market.

It is important to note that the process of implementing and developing educational programs must be continuous and adaptive. In the context of a rapidly changing real estate market and the constant evolution of educational technologies, the ability to flexibly adjust and evolve educational programs becomes a critical factor for the competitiveness of real estate agencies.

Further research in this area may focus on developing more accurate models for evaluating the effectiveness of educational programs, studying the long-term impact of innovative educational approaches on the productivity of real estate agencies, and exploring the possibilities of integrating artificial intelligence technologies into corporate training processes.

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