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**THE RATIO OF THEORY, TECHNOLOGY AND
PRACTICES IN PEDAGOGICAL EDUCATION**

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Abstract

The urgency of the investigated issue is determined due to the fact that pedagogical education should the teacher with knowledge in the ways and means of efficient transferring of theoretical knowledge, techniques and practical experience gained by the previous generations to the younger generations.

This article seeks to determine to what extent the mentioned ways and means were represented in specific pedagogical activities of a teacher who must master the pedagogical science and must know the fundamentals of specific subject knowledge areas including mathematical, physical or informational ones.

The leading research methods consisted in considering the peculiarities of scientific areas which are differentiated by the operating logic of their development, as well as the specific differences in the logic of the development of theories, technologies and practices, that can also be seen in the history of certain countries.

As a result, the difference in the activities of a special subject teacher shows the difference in the dynamics and logical development of physical, mathematical and informational knowledge of different authors. In this article, the authors traced logical system of abovementioned fields of knowledge and their reflection in pedagogical education in Russian Federation and Iran.

Materials of this article can be useful, firstly, in noting the dynamics of development of mathematical and physical knowledge, and in considering the content of information-oriented disciplines.

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Keywords: Teacher education, logic of scientific development, improvement of technology, practical application, training of special subject teachers.

1. Introduction

Teacher education molds a teacher who creates ways and means of efficient transfer of theoretical knowledge, techniques and practical experience obtained by older generations to younger generations, for the purposes of active development. This assumes that pragmatic, theoretical and practical knowledge should be combined to solve the educational problems faced by students (B. R. Robin, 2008).

It is also intended to lay the foundations for specific pedagogical activities of subject teachers who must master pedagogical science and understand the fundamentals of specific subject knowledge areas. The main relevance of the study is linked to these facts.

Literature describes general issues of technological pedagogical content development (Edginton, 2010), which are mainly related to the known theoretical knowledge and pedagogical practices occurring in practical training. There is also a description of the international experience analysis (Montgomery, 2005) associated with the proliferation of different network technologies and their adaptation and sharing.

In this article, with the help of statistical methods (Mandel, 2012; Carver, 2003) we traced the systematic logic of theories, technologies and practices development, and the Russia and Iran experiences that influence pedagogical educations in these countries.

A determined order of mastery of knowledge can be observed in different countries (Nikitina, Kislinskaya, 2004; Leslie, Kargon, 2006) including Russia and Iran.

Scientific scope varies by established logic of development that is reflected in pedagogical processes (Koehler, Mishra, 2009; 2005).

Normally, in exact sciences we talk about deductive and inductive reasoning in the course of their mastering. Accordingly, physics (Redish, 1994; Koschmann, 1996) is being mastered through a series of ongoing experiments that allows us to discover the truth, since we are repeating well-known methods of geniuses. Mastering of mathematics (Kelly, Lesh & Baek, 2004; Ivanova, 2010) is carried out in conjunction with the methods of induction and deduction, in alternative deductive direct constructions and refutations.

2. Problem Statement

The problem statement consists of the specifics of pedagogical activities of a teacher, who must master the pedagogical science and must know the fundamentals of specific subject knowledge areas including mathematical, physical and informational areas.

The prevailing logic of the development of these sciences is reflected in mastering their logics.

3. Research Questions

The article draws attention to different issues.

- How should a transformation from the use of theories and technologies to their focused development and implementation be organized?
- What is the dynamics of the transition from practice to theory that is useful for studying physics and mathematics?

- Which way of obtaining IT experience in Russia and Iran is more useful in pedagogical education?

4. Purpose of the Study

In this article, specified differences will be reviewed by the example of the dynamics and logic of physical, mathematical and informational knowledge development. Specific differences in the logic of development theories, technologies and practices can be seen in the experience of two countries in various learning areas.

5. Research Methods

Materials and methods in this research were built based on the clear understanding that a particular theory or technology can simply be used, studied, or designed. The possibility of a deeper understanding of the technology and its role depends on prior educational experience in a secondary school. Depending on the goal priority stages implemented: a new theory is created (the essence of knowledge), a new technology is designed (the essence of algorithms) or new items are produced (the essence of consumer products). In this idealized scheme passage phases of mastering a particular professional activity through theories, technologies and practices become visible. This path is logical for mathematics and physics and accordingly for majority of natural and mathematical sciences and their technical and technological applications.

In both countries represented in this study, a fundamental knowledge of physics is built on the basis of the experience which allows for generating a theoretical position that is proved experimentally by tests. These approaches are fairly frequently used in mathematics - the transition from theory to practice and from practice to theory.

You can find plenty of examples to prove its inherent dynamics and the presence of a forward or reverse moving from practice to theory characteristic for certain sections of physics or mathematics. Established order of mastering which follows the development of each of the sciences is typical for secondary schools as well as for classical university education. This order can be observed in different countries including Russia and Iran.

The stage order of mathematical and physical knowledge mastering can be significantly transformed at technical, technological and humanitarian institutions. This transformation is represented in the fact that the relevance of theorems evidence is slightly reduced giving way to the practical application of consequences formulated on their basis.

As a result, certain sets of instructions emerge that gradually develop in technological knowledge (Skinner, 2016).

This range and the degree of scientific development of technological and practical knowledge and experience can vary significantly in the following aspects:

- a) a difference in the ratio of historical development, stages of theory, technology development and implementation in the two countries,

b) experimentally organized training of teachers in different countries who must implement information and distance learning technologies,

c) pedagogical and subject preparation of students receiving a different specialization within the framework of pedagogic education branch.

The ratio of historical stages of development of theoretical, technological development and implementation in different countries, the knowledge and experience of information and distance education were carried out on the basis of the definition of historical borders of most active treatment to named stages. Such stages were identified during the analysis of scientific and educational literature and normative documentation.

Mastering on the level of theory, technology and practice of contemporary teachers of the two countries was studied in the process of shaping experiment conducted in Kazan Federal University (Russia) and State University of Esfahan (Iran), was attended by 30 people in equal proportions of both Russian and Iranian teachers. As a result, data of the system using the appropriate means of distance educational technology before and after teacher training is analyzed.

During a pilot study to assess the level of systematization of considering scientific, technological and practical areas of activity, the following criteria and indicators were suggested to teachers: the criterion of scientific character - this dimension was measured on the basis of the implementation of the proposed typical tools to prepare their own blogs for scientific purposes, the criterion of effectiveness - its measurement was based on the application of the proposed typical means of podcasts in technological purposes, and the criterion of usability - the measurement of which was proceeded on the basis of application of the proposed typical means of social networking tools in order to represent the progress and results of their activities.

A comparative analysis of the mastering and substantive preparation of students was conducted in the study after performing their professional functions by specially trained teachers. In experimental work the ratio of theoretical, technological and applied knowledge in pedagogical and disciplinary training of students was investigated. 156 students –future teachers specializing in areas such as mathematics, physics and information technology (respectively 52 students in each field) were engaged in this part of the experiment. The students were asked to find and examine a relevant literature for coursework in their field, separate it by category (educational or disciplinary literature), and make a quantitative analysis. The final conclusions were made on the basis of two characteristics: the amount of literature related to a specific category, and the quality of its mastering by students of each subject area.

6. Findings

The historical experience of science and education of countries such as the conceptualization, technological completeness and pilot implementation of information technologies were not addressed fully, causing a number of problems to be acknowledged. The inability to solve these problems will result in difficulty in expecting progress and development in various fields of the information society.

It is notable that in Russia for most fields of knowledge, education focused on the formation of theories, meanwhile in Iran, the education is focused on the use of technology. The analysis of the information sphere has shown that the Russian educational practice relies on scientific provisions,

revealing the didactic bases of information educational technologies. It is not infrequent to come across a system vision on a specific set of theoretical knowledge and practical implementation that ignores the transition into the technological level. The use of adapted foreign experience application of information technologies prevails in the Iranian practice. This usage does not imply further perfection and refinement of used technologies.

Dynamics of theories, technologies and practices, as stages of development of information and distance education are presented in table 1.

Table 01. Chronology of input into the active circulation projects and publications in information and distance learning in Russia and Iran.

Years	Country	The focus and content of projects and publications
1965-1975	Russia	A theoretical stage. Development of bases of algorithmization in learning and theory of programmed learning
1985 - 1997	Iran	A practical stage. Start of widespread information on education, participation of eighteen state and non-state universities in distance education development project
2001	Iran	A technological stage. Adaptation of distance educational technologies in Iranian universities
2003	Iran	A practical stage. Virtual departments and institutes at major universities throughout the country and some non-profit universities started
2004	Russia	A technological stage. The emergence and dramatic increase in number of publications explaining key terms such as "information educational technology" and "distance learning technologies"
2006	Iran	A theoretical stage. Theoretical studies and projects in the field of educational information and communication technologies developed

The theoretical phase in Russia is associated with the formation of own scientific basis in the named field, which started already from 1965 to 1975. For example, the visible manifestations of this phase are publications of Russia scholars, who made notable strides in scientific substantiation of certain positions important for information and distance learning technologies (Landa, 1975; Talízina, 1969). As a result, there are programed learning theories and substantiation of algorithmization of learning.

Practical phase of information educational technologies dissemination can be associated with the launch of the ubiquitous education informational support that dates back to 1985, and practices for dissemination of distance education technologies that have considerably increased in connection with the involvement of eighteen public and non-public HEIs into distance education development project, holding in Moscow. Congress of UNESCO in 1996.

Recent developments are linked with technological stages relating to the period after the year 2004. This period was revealed by content analysis identified in Russian scientific electronic library publications that include keywords like "distance learning technology" and "information technologies in education". The found content was associated with the metadata of similar studies that relate to the theoretical and practical phases of development of information and distance learning tools. In accordance with the results of the analysis of the development of each chronological mentioned stages, an opportunity to identify and confirm the current scheme of development theory, technologies and practices was created.

Figure 01 shows the current sequence of stages of the implementation of distance learning technologies in Russia, which is compared with similar dynamics, detected in Iran.

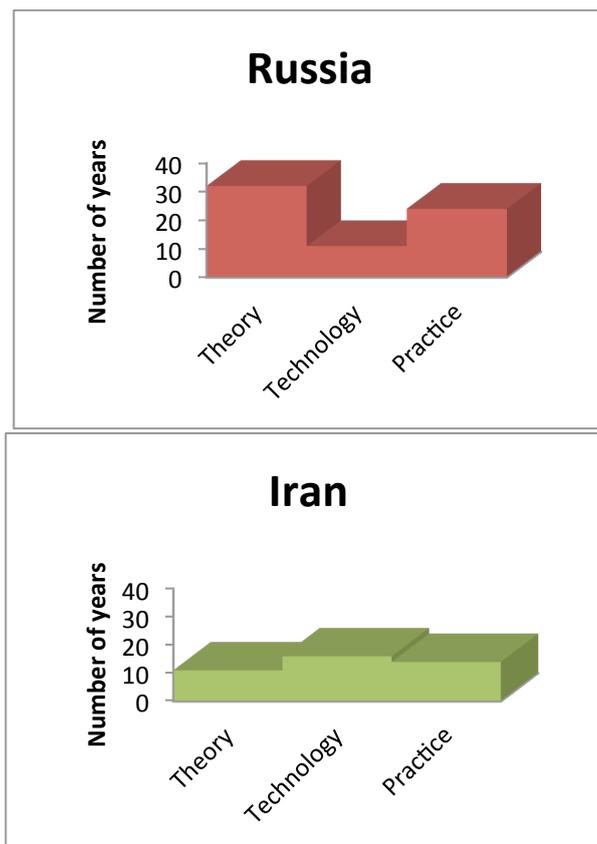


Figure 01. The dynamics of the circulation of information and distance education in Russia and Iran during the implementation of theoretical, technological and practical steps.

Technological stage in Iran is linked to the commencement of the adaptation of distance educational technologies in Iranian universities in 2001 (programme “Takfa”). It should be noted that during the period of implementation, technologies were not accompanied by sufficient adaptation activities and had a piecemeal nature (Zarei, 2013).

Practical implementation of distance education technologies in Iran was clearly distinguished in 2003, by the wider application of distance learning technologies. At that time, virtual departments and institutes at major universities throughout the country and some non-profit universities were launched. In the initial stages of this phase, a comprehensive program that determined a nationwide strategy designed for schools and universities using distance education technologies had not yet been developed.

Stage of theory development in Iran began from 2005 to 2006, while various studies and projects in the field of educational ICT receive active development. For example, there were project to develop and implement the standard software systems for virtual universities, to develop hardware architecture for virtual universities and start a University pilot Web portal. Significant differences were associated with the choice of priority in scientific, technological and operational areas of the work of teachers from different countries.

Improvement of the teachers’ educational activities were associated with a transmission of theoretical, technological and practical experience for future teachers. Statistical processing of the data of the shaping experiment (Table 02) showed significant positive changes in the systemic understanding of the scientific, technological and practical activities

Table 02. The use of educational technology tools by teachers, participants in the formative experiment

Theory, technology and practice tools	Before or after	Not used	Scantly used	Vastly used
RUSSIA				
The use of blogs for scientific purposes	Before	4	8	3
	After	2	1	12
The use podcasts for technological purposes	Before	14	1	0
	After	3	7	5
Application of tools for representing the progress and outcome of practical activities	Before	2	10	3
	After	0	8	7
IRAN				
The use of blogs for scientific purposes	Before	6	4	5
	After	2	2	10
The use podcasts for technological purposes	Before	14	1	0
	After	0	4	11
Application of tools for representing the progress and outcome of practical activities	Before	12	3	0
	After	0	1	14

A high correlation of registered Students' outcomes with their professors' data was received (Table 03)

Table 03. Correlation of the learning outcomes of students and their teachers

Comparing of experiences of regular use of scientific, technological and practical activities		Students outcomes
Teachers outcomes	Pearson correlation Value (double-aspect)	,380 ,162

At the final stage, the behaviour of students specializing in physics, mathematics and computer sciences were experimentally explored. Analysis of the pedagogical and special literature produced by students showed differences associated with particular specialization (Table 04).

Table 04. Choice of pedagogical and special literature made by students of different specializations

Source category	Specialization of teacher		
	Physics	Mathematics	Informatics
Pedagogical	27 (18%)	21 (14%)	75 (50%)
Pedagogical and special	18 (12%)	99 (66%)	9 (6%)
Special	105 (70%)	30 (20%)	66 (44%)

It is noteworthy that physics teachers, had a preference to use sources of taught discipline, and mathematicians – a desire to use equally both source categories. For future informatics teachers, a unified strategy is less characteristic because a part of the students is characterized by a preference for pedagogical literature and for the other part - specialized literature. The results can be explained by the different logic of the development of scientific, technological and practical foundations in the basic disciplines of specialization. Undoubtedly, these differences should be taken into account in the preparation of future teachers.

7. Conclusion

Authors have published earlier a research work close to this one, on collating Russian and Iranian experience in the field of distance learning technologies quality, as well as on streams of information in education in integrative content designing at a federal university (Kirilova, Vlasova, 2016). In that article, the logic of system adherence to scientific, technological and practical phases of training lecturers and future teachers was revealed for a first time and its specificity in distance learning environment was shown.

In the literature, there is an analysis of the experiences of different countries, including Russia and Iran (Zarei, 2013; Kirilova, Soleimani Vlasova, 2017). In this paper a step forward was made and results of the shaping experiment, including training of both teachers and students were shown.

There are a number of works dealing with the peculiarities of teachers' training specialized in physics, mathematics and informatics (Redish, 1994, Kelly, 2014).

In this study a comparative observation associated with the different logic of development in different countries and different areas of activity of the future teacher-special was carried out for the first time.

In this study, the content structure of informational education is revealed. Let us show you a content structure of informational education that allows moving from the focus of application of theories and technologies to their development and implementation.

1. Preparation in the field of scientific knowledge: a) gnostic component b) innovative component.
2. Training in technology: a) design component b) constructive component) communicative component.
3. Practical activities: a) group and individual work planning; b) creative and problem-search tasks solving; c) selection of appropriate information resource; d) implementation of electronic documents circulation and statistical processing of training outcomes.

In conclusion, the following requirements are formulated:

- The current chronological scheme ought to be fundamentally transformed, and we need to observe the following system functional sequence phases of conceptualization, technological detail and pilot implementation of information technologies;
- Each phase must be entirely implemented without missing any details; movement to the next phase occurs only when the preceding stage is completed;
- Society should focus on and achieve the goals of establishing and introducing more effective theories and technologies and their practical implementation to ensure the innovation framework of the information.

The proposed content structure of informational education is based on educational skills formed in the process of learning mathematics and physics, and develops the technological component of educational content for Russia and theoretical - for Iran. The result will be a transformation from the use of theories and technologies to their development and implementation.

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References

- Carver J. (2003). Issues in using students in empirical studies in software engineering education //Software Metrics Symposium, 2003. Proceedings. Ninth International. IEEE, 239-249.
- Edginton C. R. (2010). A Dynamic Pedagogy of Physical Education Teacher Preparation: Linking Practice with Theory. *Asian Journal of Physical Education & Recreation*, 16, № 2.
- Ivanova T. A. (2010). *Sovremennyy urok matematiki: teoriya, tekhnologiya, praktika: Kniga dlya uchitelya* //N. Novgorod: NGPU.
- Kelly A. (2004). Design research in education: Yes, but is it methodological? *The journal of the learning sciences*. T. 13, № 1, 115-128.
- Kelly A. E., Lesh R. A., Baek J. Y. (2014). *Handbook of design research methods in education: Innovations in science, technology, engineering, and mathematics learning and teaching*. Routledge.
- Kirilova G.I., Soleimani N., Vlasova V.K. (2017). A study model of collating russian and iranian experience in the field of distance learning technologies quality. *Modern Journal of Language Teaching Methods*. Vol. 7, Issue 3, 582-591.
- Kirilova G.I., Vlasova V.K. (2016). Information streams of education content integrative designing at a federal university. *IEJME: Mathematics Education*.,T. 11, № 4, 767-778.
- Koehler M. J., Mishra P. (2005). What happens when teachers design educational technology? The development of technological pedagogical content knowledge. *Journal of educational computing research*. 32. – № 2, 131-152.
- Koehler M. J., Mishra P. (2009). What is technological pedagogical content knowledge //Contemporary issues in technology and teacher education, T. 9, № 1, 60-70.
- Koschmann T. D. (1996). *CSCL, theory and practice of an emerging paradigm*. Routledge, 1996.
- Landa L. N. (1975). Some problems in algorithmization and heuristics in instruction. *Instructional Science*. T. 4, № 2, 99-112.
- Leslie S. W., Kargon R. (2006). Exporting MIT: Science, technology, and nation-building in India and Iran .*Osiris*. T. 21,№ 1, 110-130.
- Mandel J. (2012). *The statistical analysis of experimental data*. Courier Corporation.
- Montgomery A. H. (2005). 3 Proliferation networks in theory and practice. *International Security*. T. 30, № 2, 153-187.
- Nikitina N. N., Kislinskaya N. V. (2004). *Vvedeniye v pedagogicheskuyu deyatel'nost': teoriya i praktika* Moscow: Akademiya, 20.
- Redish E. F. (1994). Implications of cognitive studies for teaching physics. *American Journal of Physics*. T. 62, № 9. 796-803.
- Robin B. R. (2008). Digital storytelling: A powerful technology tool for the 21st century classroom // *Theory into practice*, T. 47, № 3, 220-228.
- Skinner B. F. (2016). *The technology of teaching*. BF Skinner Foundation.
- Talizina N. F. (1969). *Theoretical problems of programmed learning*. Publishing House of Moscow University, 132.
- Zarei Z. (2013). Assessment and evaluation of e-learning. *Journal of Higher Education*, №3, 16-28.