# The impact of psychological and learning training on educational motives and reflective skills of future IT specialists

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# The impact of psychological and learning training on educational motives and reflective skills of future IT specialists

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**Abstract.** Nowadays, there are a lot of psychological and pedagogical research aimed to explore students' individual characteristics and how to take them into account in educational process, as well as to develop new teaching techniques. In this study, we focus on future IT specialists' internal motivation to continue education and training, internal motivation for professional activity as a software engineer, and reflective skills. We consider the impact of psychological and learning training on educational motivation and reflective skills of university students. We present pedagogical technique which involves motivational training, training exercises, and learning training. In particular, we give a brief description of author's learning training on "NoSQL databases: MongoDB and ASP.NET MVC". The results of pedagogical experiment conducted to evaluate efficiency of this technique are presented. In experimental work 405 higher education students majoring in 121 Software Engineering, 122 Computer Science, 123 Computer Engineering took part. Based on statistical processing of empirical data, we made a conclusion about potency of our technique.

## 1. Introduction

The development of the information society, the formation of open knowledge societies, the globalization processes cause the growing need for highly qualified IT specialists who can produce effective means of access to information, its accumulation and processing. There are high requirements for these workers: from having thorough professional knowledge in computer science and software engineering to a range of practical skills in software development as well as communication, management, reflective skills, responsibility, independence, professional mobility, readiness for permanent and advanced training.

Universities as centres of high-quality fundamental education, which is based on the principles of competence and student-oriented approaches, play the leading role in meeting the demand for such specialists. The semantic centre of this activity is now a student. That is because, in the context of increasing the importance of the ideas of a society of sustainable development and lifelong learning, human is the main social value. At the same time, universities are designed to meet the needs of other stakeholders, including the labour market and academia. Among such urgent requests is the need to implement educational programs of a shortened cycle of professional training of future IT specialists. Their purpose is to provide specialists with the

opportunity to obtain a bachelor degree based on a junior specialist or a junior bachelor degree. The social significance of this task is related to the need of IT companies in the rapid training of highly qualified workers, as well as the person's need to improve skills or master a new speciality, to determine his/her own educational and professional path.

There are some contradictions that hinder the efficient professional training of future IT specialist, in particular future software engineers, namely:

- between the requirements for the professional level of IT specialities graduates and insufficient motivation of higher education students to study and improve their skills;
- between the educational needs of students and the limited ability to build individual educational trajectories with a combination of different forms of education, including non-formal one, at universities;
- between the availability of students with professional competences formed during the previous level of education, and the IT bachelor's curricula content at universities;
- between the need to comply with the standards of Ukrainian higher education at the bachelor's level and the limited period of study.

To overcome these contradictions, we have developed teaching technique to improve professional competencies and to enhance the learning outcomes of future IT specialists. This technique contains means for development of motivational, cognitive, operational, communicative, and reflective individual spheres. In this article, we focus on forming of students' academic motivation and reflective skills by the means of psychological and learning training.

The article aims to present authors' approach to use psychological and learning training in IT education and the results of an experimental examination of its impact on students' educational motives and reflective skills.

## 2. Literature review

To develop our technique and ways to implement it in the process of future IT specialists education, we reviewed the scientific publications [1–11] and psychological and pedagogical books [12–17] on the problems of human *motivation*. Let's focus on some aspects of this phenomenon.

According to Rean, the motive is "the inner motivation of the individual to a particular type of activity (activity, communication, behavior), associated with the satisfaction of a particular need" [16, p. 89], and "a set of stable motives that have a certain hierarchy and express the orientation of the individual" forms the motivational sphere of the individual [16, p. 90].

As Bakshaeva and Verbitskiy noted, any human activity is polymotivated, i.e. guided by many motives, it is impossible to identify individual motives, especially in educational activities, so the problem of forming cognitive, professional and other motives is extremely difficult [12, p. 93]. The phenomenon of polymotivation is manifested when within one physical behavior of a person several activities are psychologically carried out, each of which corresponds to its motive [3, p. 106].

Extremely interesting is Klymchuk's opinion that according to modern post-classical scientific views "the motivation of the individual ceases to be a set of biological or social needs, a hierarchy of values" [14, p. 7], it turns into "a permanent process of constructing motivation, explaining to oneself the reasons and goals, meanings and values (motivational narrative)" [14, p. 7].

There are two main types of motivation: extrinsic and intrinsic. Ryan and Deci in [8] notes:

- "Intrinsic motivation is defined as the doing of an activity for its inherent satisfactions rather than for some separable consequence." [8, p. 56];
- "Extrinsic motivation is a construct that pertains whenever an activity is done in order to attain some separable outcome." [8, p. 60].

According to Ilin, intrinsic motivation is "the process of forming a motive with reliance on internal factors (needs, urges, desires)" [13, p. 344].

The main theme of Ryan and Deci article [9] is self-determination theory (SDT). They consider SDT as a framework for understanding factors that facilitate or undermine intrinsic motivation, autonomous extrinsic motivation, and psychological wellness. The authors make a conclusion that both intrinsic motivation and well-internalized forms of extrinsic motivation has a positive impact on educational levels. Moreover, there is a dynamic link between teaching style and student motivation.

Keller in his work [17] presents the ARCS (Attention, Relevance, Confidence, Satisfaction) model of motivational design which is aimed to improve "students' motivation to learn, employees' motivation to work, people's motivation to pursue a chosen career path." [17, p. 22]. Also, the author describes in details the main stages of motivational design: (i) identifying motivational problems; (ii) identifying motivational goals and tactics; (iii) integrating motivational and instructional strategies. Tools to support motivational design (worksheets, surveys, checklists) are very useful and should be applied in educational process.

Scholars discuss the impact of academic motivation on different processes, such as: on higher education students' intention to drop out [7]; on students social integration during the first year of higher education [5]; on students perceive their learning environment [2], etc.

Based on these and other research, in our study we focus on the formation and development of students' intrinsic motivation. We consider two its aspects: internal motivation to continue education and training, as well as internal motivation for professional activity as a software engineer.

The other difficult phenomenon for our research is *reflection*. Psychological and pedagogical issues of *reflection*, *reflexivity*, and *reflective skills* are considered in scientific publications [18–28].

In [29, p. 278] reflection is defined as "a person's awareness of their own actions, their root causes and consequences, self-knowledge, which reveals the specifics of the spiritual world of man, introspection."

Marshall proposes the next definition: "Reflection is a careful examination and bringing together of ideas to create new insight through ongoing cycles of expression and re/evaluation." [27, p. 411].

D'Cruz, Gillingham, and Melendez in their work [21] considers three different meanings of the concept of reflexivity. The first variation is interesting for us because it is focused on "reflexivity as an individual's considered response to an immediate context and making choices for further direction" [21, p. 75]. This meaning involves that individuals are able to process information and create knowledge to guide course of their own lives, and responsible for their choices, self-development and self-actualization.

Karpov in [25] designates such types of refection:

- *Situational reflection* provides direct self-control of human behavior in the current situation, comprehension of its elements, analysis of what is happening, an individual's ability to correlate his/her actions with the situation and coordinate them in accordance with changing conditions and his/her own state.
- *Retrospective reflection* is manifested in a tendency to analyze past events and activities performed in the past. The subjects of this reflection are the prerequisites, motives, and causes of what happened; the content of past behavior, as well as its performance parameters and mistakes made.
- *Perspective reflection* correlates: with the analysis upcoming activities or behavior; planning; predicting probable outcomes, etc.

Gray in his article [22] gives a description of tools and processes for promoting critical management reflection, such as: storytelling, reflective and reflexive conversations, reflective dialogue, reflective metaphors, reflective journals, reflecting on critical incidents, repertory grids, concept mapping. We think that these means can be implemented for formation reflection skills, especially critical reflection and reflective thinking, of future IT specialists at universities. However, it is necessary to take into account some restrictions, eg. conversational tools are not widely used in IT education.

Engelbertink et al. in [23] present and discuss results of empirical research aimed to determine how university students reflect on five components of professional identity and at what reflection level (descriptive writing, descriptive reflection, reflection, critical reflection). These components are defined by Kelchtermans in [30], namely: self-image, self-esteem, task perception, job motivation and future perspective. We think that formation of professional identity in future IT specialists is extremally significant for their career and psychological wellness and is connected with academic motivation. So, it is expedient to use the proposed approach in next research.

Thus, we consider the reflective skills of future IT specialist as an ability to self-understand, analyze and evaluate yourself as an individual, a specialist, as a member of software developers team, as well as your own actions in the current situation, past and future.

## 3. Research results

We offer to use some methods of formation and development of students' internal motivation for obtaining higher education, professional development, professional activities, namely: training, motivation techniques, training exercises, meetings with IT professionals and others. Among them, training is the most difficult because it requires thorough preparation. In order to form professional competencies of future IT specialists, their educational motivation, and reflective skills we use the motivational, as well as learning training. It should be borne in mind that appropriate activities should be carried out systematically, both in the process of teaching certain disciplines and in extracurricular activities.

Training is "an organizational form of educational work, which, based on the experience and knowledge of its participants, provides effective use of various pedagogical methods, in particular interactive, by creating a positive atmosphere in the group, and aims to acquire skills and life competencies." [31, p. 15]. According to Fedorchuk, training is the most effective model of inclusion of the individual in interpersonal communication and activities aimed at self-knowledge, development, self-improvement of the individual [32, p. 12].

There are different approaches to definition of learning training. Thus, the researcher Bondareva considers it as an educational activity, during which "future specialists perform training exercises adapted to future professional activities, under the guidance of a teacher-trainer on the basis of specially prepared instructional materials meeting modern requirements for professional activity" [33, p. 90].

Conducting training involves the use of active and interactive technologies, organization of interpersonal and group communications. It should be focused "on the acquisition of social and professional experience, the development of professionally significant and personal qualities and abilities of students, the formation of general (universal, key) and professional competencies." [29, p. 278].

Our technique involves such elements: motivational training; training exercises; learning training. *Motivational training for future IT specialists.* Conducting this sort of training, we relied on Afanasieva's and Perelyhina's works "Training of professional motivation and self-awareness" and "Training of achievement motivation" [34], Klymchuk's and Horbunova's "Program for the Development of Internal Motivation of Youth Educational Activity" [15], elements of Fedorchuk's "Personal Growth Training" Program [32].

"Training for the development of professional motivation and self-awareness" by Afanasieva and Perelyhina [34] is designed for 4 days. During the first day, exercises are performed aimed at creating friendly relationships in the group and ensuring interaction, analysis of the past, analysis of goals and meaning of life. During the second day there is a study of the life and psychological time of group members. During the third day, students study themselves and their resources, analyze the personal value-semantic sphere, begin to prepare an essay of self-characteristics. Depending on the individual experience of the group members and the goals of the training, there are two options: self-characterization in the professional IT activity or self-characterization in educational activity. The last day of the training is devoted to the analysis of one's own social-role positions and the positions of other people. To this end, participants are invited to create an outline of fixed roles for other group members. The result of the training is the formation of abilities and focus on rethinking values. As part of the experimental work, this training was conducted over two weeks: two classes per week. The training methodology is not tied to a specific professional activity, so it is quite easy to adapt for a group of future IT specialists.

"The program of development of internal motivation of educational activity of youth" of Klymchuk and Horbunova consists of 8 stages and its' duration is 4 weeks [15, p. 80]. The program provides not only to create essays of fixed roles, but also to play them in life during the week.

*Training exercises.* In order to strengthen the internal motivation of future IT specialists, we use training exercises in classes that do not require much time, but allow to motivate students to activity, interaction and more.

For example, *the exercise "Ask - I answer"* [31, p. 37] can be used in the study of any discipline, especially during lectures. The content of the exercise is that each student or part of them, depending on the size of the group receives a card with a number and a question on the topic of the lesson. The teacher warns that in the course of the lesson it will be necessary to provide an answer. When a certain moment comes, the teacher asks: "Who has the card number N?" A student who has a card with this number voices the question and provides an answer. The exercise promotes concentration of the discussed material, accustoms students to fast and concise formulation of answers, motivates to educational activity during employment.

In order to create micro-groups to perform projects in laboratory classes, we use *the exercise "Puzzles"* [31, p. 42]. Students form a circle. The teacher then calls the number and they have to form groups with so many participants at random. The first two or three attempts are training, so that the participants move a little.

*Learning training. Interactive technique "Snowball".* This is the author's modification of the method given in [35, p. 82-86]. Its essence: to make a common definition, decision or goal, participants gradually combine their original atomic ideas. The technique allows to involve all students in the discussion, connect the group, but requires just a lot of time.

For example, the "Snowbal" technique can be implemented in the process of learning the concept of "inheritance" in object-oriented programming course. The main stages of the lesson:

(i) *introduction* - the lecturer explains the purpose, finds out whether any of the participants has experience in programming using inheritance (10 minutes);

(ii) *individual work* - participants write on sheets of paper 3 signs of the concept of inheritance based on their life, educational or professional experience (5 minutes);

(iii) *work in teams* - the lecturer divides the group into teams of 3 students each; teams formulate joint definitions from the participants initial ideas (10 minutes);

(iv) *work in small groups* - the teacher unites teams into mini-groups (2-3 teams); mini-groups formulate their definitions of inheritance (10 minutes);

(v) *final discussion* - mini-groups present their definitions, discuss them, the lecturer formulates the final definition (15 minutes).

Such work is quite long, but it contributes to the formation of students positive motivation, as it emphasizes the role of each participant in obtaining the final result.

The program of author's learning training on "NoSQL databases: MongoDB and ASP.NET MVC" was developed. The key problem of this training is the use of document-oriented databases. Its purpose is to form students' competence to develop such databases. This material is not included in the normative content of the discipline "Databases and Information Systems." Thus, the training is aimed at raising the professional awareness and educational motivation of higher education students, as well as it facilitates to develop their reflective skills. Training tasks are to acquaint students with the basics of document-oriented databases, to form skills to create and modify MongoDB databases, to show pros and cons of document-oriented databases. The duration of the work in auditory is 5 hours, 30 minutes are given for three breaks. Prior to the training, students should learn the basics of NoSQL databases and MongoDB.

The structure of "NoSQL databases: MongoDB and ASP.NET MVC" training is presented in the Table 1.

Based on the experience of implementation of motivational and learning training, we consider the following aspects should be taken into account to develop effective training for IT students:

(i) students already have some educational and professional experience, so the provisions of the andragogical approach should be taken into account;

(ii) training requires a significant amount of time for both the teacher-trainer and students, so this method should be used within the certification educational programs, in extracurricular time or if it is possible to take several classes in a row;

(iii) the content and activity of the training should be focused on the formation of clearly defined professional competencies and reflect the specifics of professional activity in the IT field;

(iv) programmers from enterprises should be invited to participate in training, who can reveal non-standard aspects of the problem.

## 4. Experimental data

### *4.1. Experimental design*

The impact of psychological and learning training on educational motivation and reflective skills of future IT specialists was examined within the framework of pedagogical experiment. It was conducted during 2016-2019 at Ukrainian universities, in particular, Bogdan Khmelnitsky Melitopol State Pedagogical University. The experimental work was aimed to check the effectiveness of organizational and pedagogical conditions of the formation of future software engineers professional competences which were studying by the shortened cycle of training at universities.

The pedagogical experiment included ascertaining and formative stages. At the ascertaining stage, the initial level of educational motivation and reflective skills was examined. At the formative stage, developed technique was implemented in the experimental group. The empirical data were processed to determine the presence or absence of statistically significant differences between the control and experimental groups using the statistical methods, namely: Kolmogorov–Smirnov test (KS-test) and Fisher test (F-test).

We examined students' internal motivation to continue education and training, internal motivation for professional activity as a software engineer, as well as reflective skills. We considered that each of individual characteristics had 5 levels of forming, namely: low, critical, medium, sufficient, and high. To estimate students' internal motivation to continue education and training we used Ilina's "Motivation of study at higher educational institution" technique [13, p. 433-434]. To estimate students' internal motivation for professional activity as a software

**Table 1.** The structure of "NoSQL databases: MongoDB and ASP.NET MVC" authors' training

| Duration (min.) | Tasks | Results | Methods |
|---|---|---|---|
| | | Intro stage | |
| 5 | Acquaintance | Acquaintance with the training schedule | Trainer's speech |
| 15 | Formulation of expectations | Setting up for work. Awareness of goals | Exercise "Interesting participant" [31, p. 35] |
| 10 | Establishing the group's rules | Forming a safety atmosphere in the group | Brainstorming |
| | | Main stage | |
| 15 | Mini-lecture "Database types" | Generalization of knowledge about database types | Mini-lecture |
| 10 | Warm-up | Removing fatigue | Exercise "Kapitoshka said" [36, p. 84] |
| 15 | Mini-lecture "MongoDB Opportunities" | Introducing students to the main features of MongoDB | Mini-lecture |
| 10 | Break | – | – |
| 5 | Setting up for group work | Unite groups to perform a practical task | Exercise "Puzzles" [31, p. 42] |
| 60 | Workshop "Creating a database" | Skills to develop a database using MongoDB | Workshop |
| 10 | Warm-up | Removing fatigue | Exercise "Bim-Bom" [36, p. 82] |
| 10 | Break | – | – |
| 10 | Activation of participants' activities | Setting for further work in groups | Exercise "Find a half" [36, p. 82] |
| 15 | Mini-lecture "How to choose a database to solve the problem" | Introducing students to approaches to choosing a database | Mini-lecture |
| 20 | Workshop "Choosing a database for the site" | Skills to choose the best methods of data storage taking into account the specifics of the task | Business game "Battle of the database" |
| 10 | Warm-up | Removing fatigue | Exercise "Who am I" [36, p. 84] |
| 10 | Break | – | – |
| | | Final stage | |
| 30 | Reflection "Training results" | Analysis of acquired knowledge and skills | Exercises "Knowledge Network" [31, p. 45], "Complete the sentence" [31, p. 46] |
| 15 | Reflection "Participants about training and trainer" | Analysis of the results of training and personality of the trainer | Questionnaire of participants |
| 10 | Reflection "Trainer about the teams" | The most successful moments of training, evaluation of student work | Trainer's speech |

engineer we used Gerbachevskiy's "The level of claims of the individual" technique [37, p. 303-308]. To estimate students' we used Karpov's and Ponomaryova technique of reflexivity diagnostics [25].

The general population was formed by higher education students of the first (bachelor's) level of specialties in the field of information technology. The sample was selected from the general population taking into account the following criteria: comparability of curricula in structure and content; similarity of content and educational results of selected disciplines of the cycle of professional training and modules; similarity of principles of admission of students to study (term of study, previous education, entrance examinations). Thus, 405 higher education students were selected to participate in the pedagogical experiment, majoring in 121 Software Engineering, 122 Computer Science, 123 Computer Engineering. This exceeds the minimum sample size defined above and ensures that the sample is representative. The number of control group (CG) was 207 persons. The number of the experimental group (EG) was 198 persons.

*4.2. The ascertaining stage*

An examination of students' internal motivation to continue education and training revealed the following: 46.38% of participants in CG (96 persons) and 42.93% participants in EG (85 persons) had low or critical level; 53.62% of participants in CG (111 persons) and 57.07% of participants in EG (113 persons) had medium, sufficient or high level (see Table 2). Thus, students generally understood the need to continue their education, to obtain a bachelor's degree and to learn further, and were sufficiently motivated to study.

**Table 2.** Students' internal motivation to continue education and training at the ascertaining stage

| Level | Control group | | Experimental group | |
|---|---|---|---|---|
| | persons | % | persons | % |
| low | 29 | 14.01% | 22 | 11.11% |
| critical | 67 | 32.37% | 63 | 31.82% |
| medium | 72 | 34.78% | 74 | 37.37% |
| sufficient | 30 | 14.49% | 28 | 14.14% |
| high | 9 | 4.35% | 11 | 5.56% |
| Total | 207 | 100% | 198 | 100% |

An examination of students' internal motivation for professional activity as a software engineer revealed the following: 35.26% of participants in CG (73 persons) and 36.36% in EG (72 persons) had low or critical level; 64.73% of participants in CG (134 persons) and 63.64% in EG (126 persons) had medium, sufficient or high level (see Table 3). Thus, students were slightly more motivated to professional activity than to continue education.

An examination students' reflective skills revealed the following: 61.83% of participants in CG (128 persons) and 57.57% in EG (114 persons) had a low or critical level; 38.16% of participants in CG (79 persons) and 42.43% in EG (84 persons) had medium, sufficient or high level (see Table 4). Thus, students demonstrated the lack of ability to reflect on educational and professional activities.

*Valuation of the empirical data.* Checking the hypothesis about the absence of statistically significant differences between control and experimental groups was performed using KS-test and F-test:

**Table 3.** Students' internal motivation for professional activity as a software engineer at the ascertaining stage

| Level | Control group | | Experimental group | |
|---|---|---|---|---|
| | persons | % | persons | % |
| low | 21 | 10.14% | 18 | 9.09% |
| critical | 52 | 25.12% | 54 | 27.27% |
| medium | 87 | 42.03% | 75 | 37.88% |
| sufficient | 33 | 15.94% | 36 | 18.18% |
| high | 14 | 6.76% | 15 | 7.58% |
| Total | 207 | 100% | 198 | 100% |

**Table 4.** Students' reflective skills at the ascertaining stage

| Level | Control group | | Experimental group | |
|---|---|---|---|---|
| | persons | % | persons | % |
| low | 52 | 25.12% | 42 | 21.21% |
| critical | 76 | 36.71% | 72 | 36.36% |
| medium | 51 | 24.64% | 53 | 26.77% |
| sufficient | 21 | 10.14% | 25 | 12.63% |
| high | 7 | 3.38% | 6 | 3.03% |
| Total | 207 | 100% | 198 | 100% |

- null hypothesis $H_0$: there is no statistically significant difference between the samples;
- alternative hypothesis $H_1$: there is a statistically significant difference between the samples.

Critical value of KS-test is $\lambda_{cr} = 1.36$ for the level of significance $\alpha = 0.05$. Critical value of F-test is $\phi^*_{cr} = 1.64$ for the level of significance $\alpha = 0.05$. The results of testing these statistical hypotheses are given in Table 5.

Thus, the empirical data showed that students found mostly low and critical level of reflective skills and medium level of educational motivation. In this regard, we thought it was necessary to direct the educational process to strengthen the internal motivation of higher education students to professional activities as a software engineer, continuing education and training; formation of abilities to reflect on educational and production activities (reflective skills). In addition, statistical test shown that there were no statistically significant difference between control and experimental groups.

*4.3. The results of the formative stage of the pedagogical experiment*

An examination of students' internal motivation to continue education and training revealed the following: 72.47% of participants in CG (150 persons) and 81.81% of participants in EG (162 persons) had a medium, sufficient or high level; 27.54% of participants in CG (57 persons) and 18.18% of participants in EG (36 persons) had low or critical level (see Table 6). The most

**Table 5.** Results of valuation of the empirical data (ascertaining stage of the experiment)

| Criterion | KS-test | F-test | Conclusion |
|---|---|---|---|
| Internal motivation to continue education and training | $\lambda_{emp} = 0.347$ ; $\lambda_{emp} < \lambda_{cr}$ | $\phi^*_{emp} = 0.714$ ; $\phi^*_{emp} < \phi^*_{cr}$ | Hypothesis $H_0$ is accepted. |
| Internal motivation for professional activity as a software engineer | $\lambda_{emp} = 0.307$ ; $\lambda_{emp} < \lambda_{cr}$ | $\phi^*_{emp} = 0.724$ ; $\phi^*_{emp} < \phi^*_{cr}$ | Hypothesis $H_0$ is accepted. |
| Reflective skills | $\lambda_{emp} = 0.429$ ; $\lambda_{emp} < \lambda_{cr}$ | $\phi^*_{emp} = 0.865$ ; $\phi^*_{emp} < \phi^*_{cr}$ | Hypothesis $H_0$ is accepted. |

significant difference between CG and EG (-10.67%) was recorded at a sufficient level, i.e. the percentage of students with a sufficient level of educational motivation in EG exceeds a such percentage in CG.

**Table 6.** Students' internal motivation to continue education and training at the formative stage

| Level | Control group | | Experimental group | |
|---|---|---|---|---|
| | persons | % | persons | % |
| low | 18 | 8.70% | 12 | 6.06% |
| critical | 39 | 18.84% | 24 | 12.12% |
| medium | 86 | 41.55% | 70 | 35.35% |
| sufficient | 49 | 23.67% | 68 | 34.34% |
| high | 15 | 7.25% | 24 | 12.12% |
| Total | 207 | 100% | 198 | 100% |

An examination of students' internal motivation for professional activity as a software engineer revealed the following: 76.82% of participants in CG (159 persons) and 83.83% of participants in EG (166 persons) had a medium, sufficient or high level; 23.19% of participants in CG (48 persons) and 16.16% of participants in EG (32 persons) had low or critical level (see Table 7). The most significant difference between CG and EG was recorded at medium (+9.27%) and high (-8.47%) levels, i.e. the percentage of students with the medium level of educational motivation in CG exceeds the same percentage in EG, and the percentage of students with a high level of educational motivation in the EG exceeds this percentage in CG. In addition, as at the ascertaining stage, students had a greater motivation to continue professional activities than to continue learning.

An examination students' reflective skills revealed the following: 65.22% of participants in CG (135 persons) and 77.27% of participants in EG (153 persons) had a medium, sufficient or high level; 34.78% of participants in CG (72 persons) and 22.73% of participants in EG (45 persons) had low or critical level (see Table 8). The most significant difference between CG and EG was recorded at critical (+8.98%) and sufficient (-11.50%) levels, i.e. the percentage

**Table 7.** Students' internal motivation for professional activity as a software engineer at the formative stage

| Level | Control group | | Experimental group | |
|---|---|---|---|---|
| | persons | % | persons | % |
| low | 17 | 8.21% | 10 | 5.05% |
| critical | 31 | 14.98% | 22 | 11.11% |
| medium | 84 | 40.58% | 62 | 31.31% |
| sufficient | 57 | 27.54% | 70 | 35.35% |
| high | 18 | 8.70% | 34 | 17.17% |
| Total | 207 | 100% | 198 | 100% |

of students with a critical level of reflective skills in CG exceeds a similar percentage in EG, and the percentage of students with a sufficient level of reflective skills in EG exceeds a similar percentage in CG.

**Table 8.** Students' reflective skills at the formative stage

| Level | Control group | | Experimental group | |
|---|---|---|---|---|
| | persons | % | persons | % |
| low | 21 | 10.14% | 14 | 7.07% |
| critical | 51 | 24.64% | 31 | 15.66% |
| medium | 75 | 36.23% | 65 | 32.83% |
| sufficient | 41 | 19.81% | 62 | 31.31% |
| high | 19 | 9.18% | 26 | 13.13% |
| Total | 207 | 100% | 198 | 100% |

*Valuation of the empirical data.* Checking the hypothesis about the absence of statistically significant differences between control and experimental groups was performed using KS-test and F-test:

- null hypothesis $H_0$: there is no statistically significant difference between the samples;
- alternative hypothesis $H_1$: there is a statistically significant difference between the samples.

Critical value of KS-test is $\lambda_{cr} = 1.36$ for the level of significance $\alpha = 0.05$. Critical value of F-test is $\phi^*_{cr} = 1.64$ for the level of significance $\alpha = 0.05$. The results of testing these statistical hypotheses are given in Table 9.

Thus, statistical test shown that there were statistically significant difference between control and experimental groups.

During the pedagogical experiment, the level of students' educational motivation and reflective skills in the control and experimental groups was determined using the indicator of the percentage of persons for each of the levels. Based on this, conclusions were made about the dynamics of these characteristics, as well as the effectiveness of the implementation of educational

**Table 9.** Results of valuation of the empirical data (formative stage of the experiment)

| Criterion | KS-test | F-test | Conclusion |
|---|---|---|---|
| Internal motivation to continue education and training | $\lambda_{emp} = 1.565$ ; $\lambda_{emp} > \lambda_{cr}$ | $\phi^*_{emp} = 3.239$ ; $\phi^*_{emp} > \phi^*_{cr}$ | Hypothesis $H_1$ is accepted. |
| Internal motivation for professional activity as a software engineer | $\lambda_{emp} = 1.64$ ; $\lambda_{emp} > \lambda_{cr}$ | $\phi^*_{emp} = 3.32$ ; $\phi^*_{emp} > \phi^*_{cr}$ | Hypothesis $H_1$ is accepted. |
| Reflective skills | $\lambda_{emp} = 1.554$ ; $\lambda_{emp} > \lambda_{cr}$ | $\phi^*_{emp} = 3.239$ ; $\phi^*_{emp} > \phi^*_{cr}$ | Hypothesis $H_1$ is accepted. |

technique. The dynamics of students' educational motivation and reflective skills in CG and EG was positive, i.e. the percentage of students with a sufficient and high level at the end of the formative stage of the experiment increased compared to the results of the ascertaining stage.

In particular, the percentage of participants with a sufficient and high level of educational motivation by the criterion of formation of internal motivation to continue education and training increased by 12.08% in CG and by 26.76% in EG; the percentage of participants with a sufficient and high level of educational motivation by the criterion of formation of internal motivation for professional activity of software engineer increased by 13.52% in CG and by 26.77% in EG. the percentage of participants with a sufficient and high level of reflective skills increased by 15.46% in CG and by 28.78% in EG. Therefore, the positive changes in the experimental group were more significant than in the control group. We explain these changes by the fact that our educational technique was implemented in the experimental group.

## 5. Conclusion

Nowadays, psychological and learning training are widely used in formal and informal education, especially in adult education. They have significant potential for improving of learners hard and soft skills. Considering this, we decided to develop pedagogical technique which involves motivational training, training exercises, and learning training, and then to examine its efficiency for IT education.

At the end of the formative stage of the experiment, a positive trend in the formation of students' educational and professional motivation and reflective skills was recorded in the experimental group due to the implementation of the developed educational technique based on using psychological and learning training. So, we can state that its implementation is effective and has a positive impact on the improving of motivational and reflexive spheres of the personality of future IT specialists.

Further research is aimed at developing and testing personalized training programs for use in the educational process of universities.

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