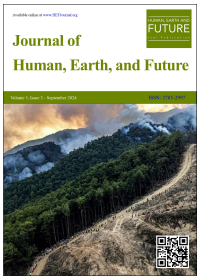
Available online at www.HEFJournal.org

ISSN: 2785-2997

Journal of
Human, Earth, and Future

Vol. 5, No. 3, September, 2024



Inquiry-Based Approach in the Context of Undergraduate Teacher Training

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Received 21 May 2024; Revised 16 August 2024; Accepted 21 August 2024; Published 01 September 2024

Abstract

The aim of the study is to present information about the main findings of a research study on the application of the inquiry-based approach in undergraduate teacher training in the field of technical education. The authors seek the answer to the question 'To what extent are the graduates of teacher training programs prepared for the application of the inquiry-based approach in technical education?' For the above purposes, an exploratory qualitative research design was used. A qualitative pedagogical experiment was carried out, which was supported by additional research tools and methods (essays, microteaching, participative observations, an analysis of the research subjects, and reflection). The obtained findings show that, in the process of experiments, it has come to a shift in the participants' opinions about the application of the inquiry-based approach in technical education. The participating future primary school teachers showed an inclination to using the method of inquiry, and the results suggest that they are sufficiently equipped with competencies for its realization. Since there is a lack of research in the field, the present study provides unique data that can help experts (primarily field didacticians) understand the need for searching for an optimal teaching model that can contribute to increasing the quality of education.

Keywords: Technical Education; Inquiry-Based Approach; Undergraduate Teacher Training; Competencies For Inquiry-Based Teaching.

1. Introduction

At the end of the 20th century, under the impact of several factors, a deep crisis in technical education started. Firstly, the crisis was caused by certain social changes related to the transition from a technical and technological society to an information and learning one. Gradually, new information and communication technologies were developed, and working with information (searching, sorting, and critically evaluating) became a necessity. The applied transmissive approach to technical education, since it was focused on developing craft skills in students, proved to be unsatisfactory.

Another reason for searching for a new paradigm of technical education in central Europe is the increasing disinterest of students in natural and technical sciences. This trend can be observed at all levels of education and is also reflected in the number of study applicants in secondary schools and universities orientated on technical and natural sciences [1]. On the contrary, in countries such as China or Japan, where educational systems apply a more practical and technical approach to education and technologies and inventions are introduced to students at an early age, the situation is different. In those countries, no decrease in student interest in technical sciences can be observed, but, as

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http://dx.doi.org/10.28991/HEF-2024-05-03-09

Naganuma [2] claims, the trend of a decline in students' interest in science education during their primary and secondary school studies is present even in Japan. Many developed countries started considering the necessity of changing their educational systems as traditional schools do not sufficiently prepare their students for living in the postmodern society. The European Commission clearly declared the need for high-quality education and subsequently released a document entitled 'Science Education Now! A renewed Pedagogy for the Future of Europe', in which the opinion that "changes in education can be achieved by implementing the methods of active inquiry" [3] is expressed. These and other reasons led to introducing school education reforms in the European Union, including the Slovak Republic.

In the case of the present research study, the starting point is represented by the changing approach to education determined by the need to develop students' scientific literacy. The importance of focusing on developing research competencies and understanding key concepts and phenomena associated with the inquiry-based approach in students is evident, and so the declared aim of universities is to prepare prospective teachers who will teach pupils and students how to search information, discuss things, solve problems, and formulate logical arguments. For their further development, it is necessary to 'learn to think'. It is crucial to draw all prospective teachers' attention to the fact that from the point of view of field didactics, not only is vocational knowledge important, but especially pedagogical-psychological and psychological-didactic competencies have a crucial role to play, and these must be continuously developed in them throughout their entire active lives and educational practice within the framework of lifelong learning activities.

In the present research study, a theoretical elaboration of the topics of inquiry-based instruction and teacher training in the field of using the method of inquiry is presented. The second part of the paper contains a qualitative study on the application of the inquiry-based approach in undergraduate teacher training in the context of technical education.

2. Basic Principles of Inquiry-Based Teaching

Notions like inquiry, research, but also the research-oriented concept of education have recently become extremely popular in the context of desirable changes in education. These are usually associated with high expectations. On the other hand, there are doubts whether these notions denote something really new in the processes of learning and teaching or only underline certain aspects of something that has de facto been implemented in the educational practice for a long time. Many significant changes in pedagogy and in psychology were based on the idea of supporting the process of 'inquiry', but their authors (e.g., Dewey [4], Vygotsky [5], Piaget et al. [6], and Ausubel [7]) did not use this term. The notion of inquiry was introduced at the end of the 1960s by the founder of the concept 'Philosophy for Children'. This concept is based on the construct of multidimensional thinking, aiming to create balance between reason and affectivity, between understanding and creating concepts, between what can be regulated by rules and what cannot be influenced by them. It is the intersection between critical, creative, and engaged thinking, which cannot be separated in practice [8]. It means developing multidimensional thinking that takes place during discussions in the so-called 'community of inquiry', a community of students and a teacher who explore and search for the truth together. The main objective of inquiry is developing critical thinking, which promotes individuals' ability to make good judgments, as it relies on logical criteria, it is self-corrective and context-sensitive, and considers the results of others' inquiry [9]. Inquiry is defined in a variety of ways, but their overlap is important. Several authors who focus their activities on studying the concept of an inquiry-based approach declare that it is a process of knowledge construction based on experiences. They define inquiry as an intentional process of formulating a problem, critical experimenting, evaluating alternatives, planning, researching, and verifying, making conclusions, searching information, developing models for studying actions and discourses with others, and formulating coherent arguments [10–12]. It means that inquiry can be characterized by its own processes [13–15] and can be applied in a broad spectrum of contexts [16–18].

The inquiry-based approach has a century-old history. First, its positions, such as that students gain knowledge through experiences and situations that allow them to create and innovate its content in the context of the educational process, were proposed and discussed. It was the first draft of the basic conceptual phases of inquiry, that is, defining the problem, formulating hypotheses, and their verification [19]. The current instructional cycles only represent further elaborations of the above phases [20, 21], and the existing contradiction in the framework of the inquiry-based approach is frequently highlighted. On one hand, the inquiry-based approach encourages students to ask questions; on the other hand, their activities are guided by their teacher; e.g., the structured model of inquiry can have a negative influence on students' impulsive and spontaneous questions, which can become a barrier to expressing their points of view and their active participation when applying a student-centered approach [22]. To eliminate this discrepancy, the following Dewey's arguments and his philosophy of experience [19, 21] can serve as a starting point:

- Using a scientific stimulus present in individuals' close environments can serve as the best model to demonstrate how learning experiences can contribute to their development [19]. In this way, teachers can take advantage of opportunities to improve the educational process in the interaction between students and the world around them.

- The most recent resources focus on the similarities and differences between free play and inquiry-based learning [23]. To achieve balance between the natural playfulness of students and the role of teachers in the process of students' learning, the main challenges to be met were identified. There appear to be certain persisting problems between games as means of learning and the role of teachers in teaching natural and technical sciences.
- According to Dewey's philosophy [19], there is a significant difference between scientific research and student inquiry – the essence of inquiry-based teaching is teachers' awareness of what their students are capable of learning, but as for scientific research, it is not clear. Furthermore, another difference is in the amount of knowledge that researchers possess compared with students. The management phase of inquiry-based teaching includes working with experiences that allow students to develop their understanding of the scientific aspects of the world by developing and applying research and inquiry competencies in the educational process [24]. When selecting teaching strategies, teachers should consider the learners' interests as soon as in primary schools. It is important to pay attention to learner questions since these are driven by pure curiosity [19]. Pupils and students, as well as children from an early age, long for experiences, therefore, they should explore, reflect, and discuss a lot. Teachers should use all available pedagogical tools that promote experiential learning in their pupils and students when learning about the surrounding world. Learner curiosity should be in the centre of attention and also represent the starting point for inquiry.

To be able to explore, learners' inquiry competencies must be developed. These include procedural competencies important in, for example, problem-solving procedures, but most definitions of inquiry competencies emphasise knowledge, skills, and the ability to use them in complex situations [25]. In this study, the affective aspects of learner inquiry competencies are examined and concepts such as curiosity, emotions, attitudes, values, and willingness to act are worked with. Among affective competencies, collaboration and participation in decision-making processes can be mentioned [25, 26]. As pointed out by Singleton et al. [27], collaboration in scientific sensemaking is an important component in increasing students' interest in science. This understanding of learning inquiry competencies can be much broader than is usual in science.

Students should be provided with sufficient opportunities to explore and develop their ability to think and act in an exploratory way, i.e. to formulate questions, plan and carry out inquiry, use appropriate means and procedures for data collection, think critically and logically about the links between results and explanations, construct and analyse alternative explanations and argue. This approach to teaching promotes learners' self-confidence when solving problems and helps them think critically.

Meaningful inquiry is composed of many individual steps that follow each other, and their order cannot be changed. These steps were suggested and described by several authors, for example, the '5e' model consisting of five steps [28, 29]: 1. Engaging students in inquiry (engage); 2. Exploring the field by using methods of inquiry (explore); 3. Explaining the results of the inquiry (explain); 4. Evaluating the process and the results of the inquiry (evaluate); and 5. Extending the field of inquiry into other areas (extend). Several authors recommend the application of similar inquiry-based student activities that should include collecting data, asking questions, observation, and interpretation of observed phenomena [21]. Inquiry usually starts with formulating a research question, but in compliance with the constructivist approach, teachers should first try to find out about the current knowledge on topic the learners possess. On the basis of the obtained information, they introduce a practical activity focused on phenomena related to the subject of inquiry. The practical situation should be similar to the situations that learners can encounter in their real lives. The learners analyse the practical situation and implicitly ask questions that lead to the formulation of research questions that arise during the phases of observation and exploration. Learner curiosity is in the centre of attention, as well as the starting point for research. It is important to promote expressiveness in learners, their ability to share ideas with others, search for alternative solutions, and encourage them to express their own ideas and opinions as an important part of inquiry-based science education (IBSE) [30]. In this phase, it is recommended to use specific media (drawings, models, digital tools, Play-Doh, etc.) [31]. The next step of inquiry is formulating presumptions (hypotheses). The validity of hypotheses can be verified by an experiment, modelling, reviewing secondary sources, observation, and based on the obtained data (research results), the learners formulate conclusions. The stage of formulating conclusions is very important. This process is managed by the teacher, who asks the learners about how they have come to their conclusions and the learners analyse their own cognitive procedures applied during inquiry. The process of learning is based on a guided, bound, targeted, and confirming inquiry, which appears to be a promising method of scientific education [32- 34].

2.1. Metacognitive Skills in the Context of Inquiry-Based Learning

Metacognition, which is deeply rooted in constructivist theories of learning, represents a key concept in understanding the processes of learning and inquiry. It can be definided as an awareness and regulation of own cognition [35]. In inquiry-based teaching, metacognition provides a theoretical framework for understanding how students actively construct their knowledge and has an impact on students' learning from several aspects. From the

perspective of inquiry-based learning, especially its role in solving problem situations [36] is important, since it helps students analyse problems, select appropriate problem-solving strategies, and monitor their progress. It also enables students to analyse their constructs and modify them based on newly gained experiences. Metacognition has an important role in self-regulated learning [37] as well. It helps students set goals, monitor their progress in learning, and adjust the selected learning strategies. From the point of view of the social cognitive theory, the social context is important in developing cognitive processes [38], including metacognitive skills, as interactions with others (teachers, peers, etc.) provide students with opportunities to reflect on their knowledge and gain new perspectives. Based on the above, it can be assumed the metacognitive skills play an important role in inquiry-based teaching as: 1. allow students to become active participants of inquiry and learning; 2. promote critical thinking; 3. help students solve complex problems; 4. affect students' motivation [39]; and 5. are necessary for lifelong learning. Developing students' metacognitive skills deserves increased attention in schools because it helps students became independent learners who are able to solve complex problems and construct their own knowledge.

3. Teacher Training in the Context of Inquiry-Based Teaching

Teacher training is a complex phenomenon that has an impact on several variables [40]. In Slovakia, this complexity is associated with the undergoing curricular reform in primary and lower secondary schools [41], which has led to a change in undergraduate teacher training programmes. One of the main goals of the new curriculum is to improve pupils' and students' research and inquiry competencies under teachers' supervision.

A teacher's task is to support learners in finding the pathway to effective learning and to implement teaching strategies that activate cognitive processes in learners [42]. The application of efficient approaches to teaching requires several fundamental changes in the current system of undergraduate teacher training. A high-quality training programme should not be exclusively focused on knowledge and developing skills in field didactics, but a broad scale of teaching methods and forms of teaching should be introduced to teacher trainees. Not a long time ago, in teacher training, acquiring theoretical knowledge prevailed and teacher trainees did not have sufficient opportunities to develop their practical skills nor learn how to teach [43]. Teacher trainees, as well as a carried-out analysis of existing undergraduate teacher training programmes confirmed that in the process of preparing future teachers, mainly lectures are used. Although teacher trainees learn about various activating methods during lectures and understand their principles, it is not enough. Considering that they possess only theoretical knowledge about activating methods, it is difficult to predict the extent to which they will be able to apply them in their practice. Therefore, it is necessary to improve primary school teacher trainees' inquiry and research competencies. Inquiry-based teaching represents a shift from the system of education based on memorising facts to a system of teaching that places emphasis on conceptual understanding and the process of gaining knowledge and developing competencies. Since 2022, the inquiry-based approach has been applied primarily in teaching natural and technical subjects and mathematics in Slovakia. Currently, several research activities have been carried out on inquiry-based teaching and on improving future primary school teachers' inquiry competencies in the country.

Unfortunately, although the importance of continuous training where teachers can master the strategies of inquiry-based teaching is emphasized [44], there are not many available studies focused on undergraduate teacher training in the field, however, even those few published can be considered a contribution. The key characteristic of learning based on problem-solving is that teacher trainees take part in problem-solving activities before entering the educational environment of primary schools [45-47]. They need to develop their inquiry skills, including planning, inferences, and evaluation [48]. This kind of training motivates them to implement problem-solving activities, encourages teamwork, discussions with other learners, and it can be assumed that these teacher trainees have more solid knowledge than their peers [46]. Most experts agree that well-prepared teachers are able to apply the inquiry-based approach as part of their work in the school environment [49, 50], which is important because it provides opportunities to strengthen the ties between research and teaching, increasing the quality of acquired knowledge, and also opportunities for collaboration between learners, as well as between learners and teachers. The inquiry-based approach also provides future teachers with autonomy since it applies an open approach allowing participants to ask questions and suggest procedures by themselves [51].

Most authors believe that teacher trainees should gain experiences with inquiry-based teaching as soon as during their undergraduate studies in the form of authentic scientific experience and should acquire knowledge on how to implement it into their teaching practice with their future pupils and students [52, 53]. If this is the case, affective variables are used since future teachers take over responsibility for applying the inquiry-based approach in their teaching practice or, more precisely, for applying it in a way that allows using it meaningfully. Teachers who have no previous experiences with inquiry-based education cannot develop (or it is very hard for them) their learners' identity based on inquiry as teachers usually teach the way they were taught at school, i.e. apply methods that they are familiar with [54]. It can be assumed that teacher trainees without such experience will – with a high probability – prefer traditional forms and methods of teaching to the inquiry-based ones [55].

When applying inquiry-based instruction, teachers play the role of an 'architect' influencing the concept of teaching [16, 56]. The role of a teacher is irreplaceable in the classroom, and it can be assumed that teachers represent the most important determinant of the educational process. Teachers make decisions about the components of teaching, such as teaching methods, organizational forms, material means, etc., and can have either an accelerative or an inhibitory effect on achieving the goals of student personality development; although the curricular documents provide a framework for teachers' work and planning lessons. Inquiry-based teaching is relatively demanding and requires specific teacher competencies. Especially an erudite and conscious approach when planning students' activities is required. Therefore, it is important to carry out research activities examining the associations between teachers' professional development and students' learning outcomes [57].

Teachers' ability to apply the inquiry-based approach in the classroom depends on their own experiences [58]. Teachers who gain experiences with inquiry-based activities during their undergraduate training tend more to implement inquiry-based activities in their teaching compared with their colleagues and, therefore, it is desirable to use an inquiry-based design in conceiving undergraduate teacher training programmes in order to equip prospective teachers with inquiry competencies.

4. A Qualitative Study on the Application of the Inquiry-Based Approach in Technical Education

4.1. Research Problem

In the last decades, a lot of attention has been paid to the application of the inquiry-based approach in technical sciences worldwide. This type of education is associated with expectations in the field of increasing learners' interest and the quality of their learning. The global importance of these issues is manifested by the existence of specifically oriented pedagogical journals or centres of excellence that conduct pedagogical research focused on inquiry-based teaching. Most empirical studies on inquiry-based education are targeted on learners [59], but recently, in-service teachers have also been paid attention. Typically, teachers' ability to apply the inquiry-based approach in the classroom has been investigated into [60, 61]. It must be pointed out that there are not many available studies on the possible impact of inquiry-based education on teacher trainees, and the majority of those few that have been published are based on single or short-term interventions carried out in the framework of the didactics of technical education.

Therefore, the objective of the present study is to find out about the opinions of the participating teacher trainees regarding the application of the inquiry-based approach to technical subjects in primary education. In the study, teachers are considered the main actors of the educational process who intend to develop their pupils'/students' technical literacy and influence them with the aim of achieving the best possible results.

4.2. Research Methodology

In the present study, a qualitative research design was applied and exploratory research was carried out [62]. Qualitative methods allow one to identify several casual conditions in the educational process, since controlled participation in human activities is characteristic for them, and instruction is based on the application of cultural and discursive practices by both the learning and the teaching subjects. The educational process provides time and space to study phenomena and strategies impacted by various intervention conditions that have consequences. For a qualitative researcher, the entire educational process represents a specific interpretive framework. Postmodern researchers insist that people are not only observers of what is going on in the world around them, but rather participants of what they are trying to learn. It can be assumed that researchers are interested in the same things as most people do – they want to learn more about themselves and understand others. This does not mean that qualitative researchers want to eliminate the responsibility for collaboration in the field of constructing and interpreting the data obtained from the subjects of research. For the above reason, qualitative methodology is suitable to investigate the didactic reality, which is usually studied by inductive, practical, and socio-critical research [63].

4.3. Research Objectives and Research Questions

The aim of the present research study was to identify the participating teacher trainees' opinions on the application of the inquiry-based approach in technical education in the subject Technical Education in Primary Education. The following three research questions were formulated:

RQ1: What are the teacher trainees' ideas and expectations regarding the application of the inquiry-based approach in technical education?

RQ2: Does the application of the inquiry-based approach change the opinions of the participating teacher trainees about technical education?

RQ3: To what extent can the application of the inquiry-based approach potentially increase the participants' level of technical literacy and which factors have an important role to play in this process? What is it based on and where is it headed?

4.4. Methods

For the purposes of the present research study, the concept of STEM Education [64] in inquiry-based education was used. We were not interested in a complex integration of school subjects, but in the application of a more complex approach to the selected content areas in technical education. For the inquiry-based approach, the theoretical framework of open-ended activities was applied. The selected open-ended activities met at least one of the following criteria: (a) open entry situation – various ways of approaching a problem; (b) open solution process – various ways of solving the problem; (c) open output situation – various solutions (results/outputs) of the problem; (d) open approach to further activities (a variety of ways, in which a problem can be developed into a new problem). Considering the characteristics of open-ended activities, a methodical guide was developed for the application of the inquiry-based approach in technical education by the teaching subject.

The developed methodical guide was used with prospective primary school teachers within a qualitative pedagogical experiment [65] in combination with other research methods and instruments [66]. The asigned essays allowed the investigated subjects to express their opinions stemming from their practical experiences with the thematic core of the research study. The main advantage of the applied qualitative research design was the emphasis placed on individual and collective understanding of the world, which allows one to examine the motivation, attitudes, and behaviour of the subjects in the classroom [67]. As additional research methods, participative observation, analysis of the participants' products/outputs, and reflection were used in the research process. In the research study, special attention was paid to those manifestations of the investigated subjects that are associated with the application of the inquiry-based approach to technical education.

4.5. Research Sample

In the study, intentional sampling was used. We worked with a convening sample enabling gathering appropriate information in the shortest possible time and in accordance with particular circumstances, as the practical character of activities was considered. This has an impact on both the researcher and the subject of the research or a group of subjects in the research process [68]. The research sample consisted of 52 university students (teacher trainees) studying full-time in the study programme Teaching for Primary Education at the Faculty of Pedagogy of Comenius University Bratislava. All participants were enrolled in the university course Technical Education in Primary Education and were willing to present their own professional perspectives on the predetermined theme and the investigated issues.

4.6. Realisation of Research

The main research strategy of the conducted research was to carry out a pedagogical experiment focused on the application of the inquiry-based approach in primary technical education using the concept of STEM education as part of undergraduate teacher training within the university course Technical Education in Primary Education. The research study was carried out in the Department of Pre-Primary and Primary Education at Comenius University Bratislava, Slovakia, in the academic year 2022/2023.

The realisation phases of the present study are displayed in Figure 1:

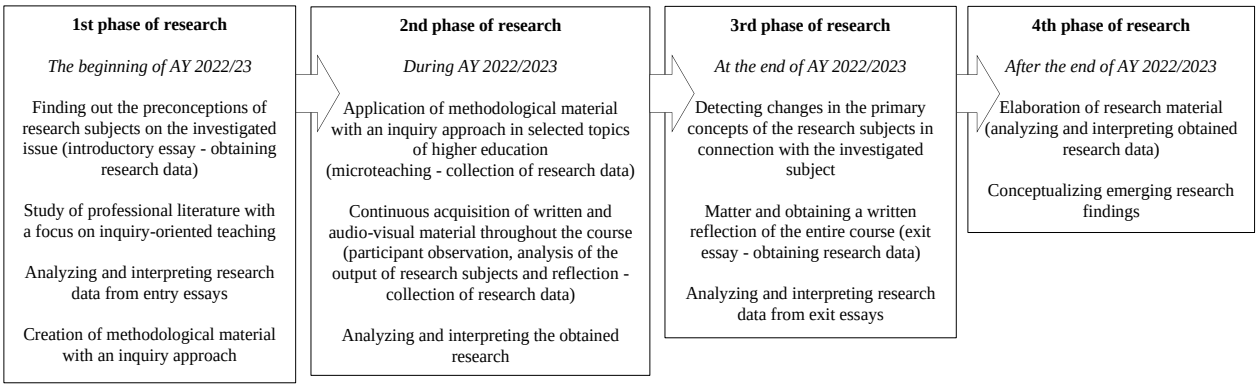

Figure 1. Conceptual framework of the research design in our study

4.7. Data Analysis

In the present study, the principles of qualitative methodology [69] were followed: (1) reproducibility – the standard of the research study is relevant for generating significant information and is also applied within several other research activities; i.e. it is reproducible both inside and outside; (2) systemicity [70] – analysis – interpretation of any data should be systematic, focused on developing constructs and relationships between them, which means that by using a qualitative research design, theorization can be achieved in a holistic way; (3) credibility – the methodological inventory and research apparatus are appropriate for the examined phenomenon; (4) transparency – a detailed description of the present research study is provided and the applied strategies of data collection, their elaboration and interpretation are presented. The present research study is transparent as it was carried out in collaboration with subjects who showed congruence with the researchers, as well as their motives, the entire process, and the research findings.

In the initial phase of data analysis, in the case of the entry essays, open coding [71] was used. During content analysis, non-structured data from the analysed text units, that can be considered the participants complete statements, were processed by descriptive coding. This allowed us to capture the most prominent interpretations, repetitive or additional thoughts and beliefs, and to identify the main dimensions of the key concepts. Through open coding, the process of data analysis, categorising, coding, and conceptualization was carried out. The aim was to interpret the cases as an integrated system (complex analysis of data collected from the entry and exit essays), which means that we did not intend to highlight individual events, but worked with the case as a whole. For data analysis, the inductive coding technique was used with the aim of finding regularity in individual cases. This technique was primarily developed for the purposes of the grounded theory method, but in the context of data analysis, it has a relatively universal application [72]. By coding, the collected data were gradually analysed, conceptualised, and re-created in a new way. The analysed texts were divided into units to which codes (numbers) were assigned. All the collected essays were coded manually – the traditional pen-and-paper method was applied.

In the following phase of data analysis, systematic categorisation was carried out. Categories emerged by comparing and sorting meaning units (grouping codes based on similarities and assigning them a more abstract denomination). Also, the process of describing these categories (specification of characteristics – the so-called dimensionalization) was important [73]. To create more abstract categories, the second (axial) stage of coding was applied, which decreases the number of categories [71]. Constant comparison was applied during the next phase of qualitative analysis within the research study, which allowed monitoring the saturation of the identified categories. Individual events within categories were compared, categories and their characteristics were integrated, the supporting elements of the theory were defined, and the theory was conceptualised. The conceptualised theory is the result of the identified concepts' verification and their comparison with the aim to find out whether they are part of inquiry-based teaching or not.

The methodological principles of triangulation were applied in order to understand and reconstruct the meaning. We used a flexible way of understanding information based on an inductive and participatory method of searching for them. The teacher trainees' thinking processes and actions associated with manipulation, conceptual, and evaluation activities in the context of inquiry-based teaching were analyzed with a focus on their ability to retain and reproduce the gained experiences and transfer meanings. Special attention was paid to the validity of the study, including its truth. The truth of research means that the presented results are associated with the observed phenomena. This procedure ensured the saturation of the desired information [74]. In the context of ensuring the validity and the reliability of the present study, only arguments collected based on a thorough analysis were used and the sources of data were strictly considered. The verification process was carried out by revision and assurance through retrospective following action and reflection. The collected data were supported by several methods – by the technique of contrasting and forms of evidence, such as direct experience, direct and indirect observations with the help of research subjects and the use of various artifacts. The aim of the interpretative phenomenological analysis carried out was to formulate themes capturing the essence of the phenomenon, which is the object of the research.

The statements protocols from entry and exit essays contained the main ideas expressed in particular sentences (concepts), from which categories and subcategories were created. Following the hierarchisation of the identified categories, eight interpretation categories and twenty-four subcategories emerged. To ensure research validity and reliability, in Tables 1 and 2, segments of the research subjects' statements are shown. They show teacher trainees' pre-concepts related to the application of the inquiry-based approach in technical education (Table 1) and the changes in their initial concepts about the investigated issue (Table 2). These were used to interpret the research results.

Table 1. Summary of interpretive categories, subcategories, and concepts from entry essays

Interpretive categories	Subcategories	Concepts
Inquiry-based concept	Professional activity of the teacher	… innovative approach targeted at the learner … based on identifying the problem … proposing a suitable solution … using alternative options … planning the research procedure … searching for information about the given problem … teacher's approach based on creating model situations … discussing and arguing with classmates … formulating conclusion … applying the solution …
	Teacher performance	… develops autonomy, patience, cooperation and empathy in the learner … the technique affects the development of motor skills and skills that can be used in various areas of life …
	Learners' personality	… personal experience, trying out something … topics according to the interest of the learners …
	Learners' performance	… learning about materials based on own experiences, abilities, or practical activity … using theoretical knowledge … following progress, presenting acquired knowledge, solutions for a particular problem … using technical tools for making products, such as a needle, scissors, pliers, wire ... proposing own problem-solving procedures … discussing problems with classmates … arguing and drawing conclusions …
	Preconditions for implementation	… the learner must meet the requirements of research … be able to work with time … understand the individual steps in the research process … be able to present the manufactured products …
Topics of inquiry	Educational content	… in technical education, I expect topics that support students' thinking … activating learners in class … expressing one's opinion when solving tasks … improving manual skills … work mainly manually and produce something … learn interesting procedures … we will use in practice … personal experience without limited solutions …
	Teachers' position	… the teacher as an observer … creates situations where learners, on the basis of their own and acquired knowledge, consolidate and deepen their acquired knowledge of subjects … the teacher as a constructor presents problem tasks … the teacher gives clear instructions during the lesson so that the learners understand them and can propose their own strategies and solutions … to use technology not only in school, but also outside it …
	Tools and means	… I expect demonstrations of various tools … to be able to try them by themselves, e.g. using computers and videos, analysing working procedures captured by a camera … we can then use them in practice with learners …
	Forms of teaching	… group work, practical activity of learners … individualized education …
Teacher trainees' approach to inquiry-based teaching	Learning activity profile	… plans research procedures … creates … discovers new knowledge … plays … learns to tolerate, listens, re-evaluates the opinions of others, seeks compromises … cooperates … gains experience for life … for students, it can be stressful if that are not confident about their own skills …
	Problem solving	…learn about the reality based on research, inquiry … trial and error … independence based on the ability to reach something, discover something … make … feel important … understand the curriculum based on solving problem tasks … rational reasoning when solving tasks … creating models and experiments … prove/disprove statements … they try to come to a solution by themselves … to verify hypotheses rationally /mechanically …
	Practical activity	… find a hobby in technical skills … which they will use in their lives … more attractive for the student … is fully practical, it is not a matter of memorising knowledge … the disadvantage may be the potential danger of injury when handling some tools, if it concerns pupils of the 1st grade of primary schools …
The role of the teacher in inquiry-based approach	Motivator	… motivates - doesn't tell them exactly what to do, that's what students are here for, evokes … involves students in activities and leads them towards thinking … activates students using appropriate methods, encourages them to think …
	Facilitator	… leads pupils to independence … understanding of the subject matter based on their own investigation … appropriately manages and helps students according to their needs … accepts different methods and solutions … supports students' thinking and skills … teaches them that the fact that a mistake is nothing bad …
	Diagnostician	… determines the pupils' level of thinking … places realistic requirements and uses appropriate methods of assessment …
	Observer	… observes pupils' activity … to avoid injuries, is present as a quiet and objective observer of the class in order to learn about the pupils …
	Didactician	… the inquiry-based approach may not suit every teacher … the teacher should consider its use in technical education … lesson planning is demanding as the teacher has to think over the assignments and evaluate the assigned tasks …
	Innovator	… an innovative approach applied by the teacher … learning in a non-traditional way … the learners have an opportunity to express their own opinions and propose a solution to the problem task … develops critical and creative thinking in the learner … learners can come up with new solutions that enrich the teacher … a teacher who makes teaching special … is inventive … creative … innovator …
	Constructor	… presents problems … creates activities that learners check at the end … mediates own knowledge to pupils, but not directly … takes into account that pupils take over the role of a researcher …
	Debater	…creates space for questions, thinking, analysing and formulating own conclusions …a teacher, who participates in the discussion and continues the discussion with the pupils …

Table 2. Summary of interpretive categories, subcategories, and concepts from exit essays

Interpretive categories	Subcategories	Concepts
Principles of the inquiry approach	Methods of inquiry	… experiential learning: asking open questions, brainstorming, creating answers, thinking aloud, discussion, practical activities … effective and active learning: own experience, motivation, interesting and more fun way of teaching without stress … experimentation, modelling, observation, trial and error, design work, laboratory work, illustrations, 3D aids, etc. … learning without teacher's explanation, learners' preconceptions connected with the reality as the main aspect and own experience, more relaxed atmosphere … the learner is in the position of a researcher, own work and use of aids … heuristic methods and procedures: 1. defining the problem; 2. finding out about the given problem; 3. creating a solution; 4. choosing a suitable solution; 5. implementation of the solution … STEM and STEAM concept, experiments, as well as the actual preparation of the activity and aids, attempts to plan for two lessons, we learned to work with time … positive is the independent activity of the learner in smaller groups, teamwork versus individual work, obtaining of own results independently …
Curriculum in the inquiry-based approach	Content of technical education	… interesting and playful topics that can be used in teaching with students, e.g. textile and its proper-ties, weight measurement and absorbency of textiles … magnetism and its properties, objects in the home environment that are attracted by magnets … use of various technologies that help us in everyday life … investigation of phenomena and relationships, real writing, creation of recording sheets …. activities with the Quiver application, digital toy BeeBot, electronic kits, electric circuit based on the preparation of space for own activity … activities with "Slow Motion" when assembling a Lego and Merkur kit, steps of the research cycle, taking pictures of individual activities and subsequent video creation … own observation, investigation, group work on solving assignments … variety of aids, own independent preparation, pleasant alternative, entertainment and learning, being part of research, being in the role of a researcher … working with alternatives rather than memorising facts about the given issue … searching for current information on the Internet … proposals for other activities that will be focused on, e.g. a bicycle, wood, etc. …
Learning processes in the inquiry-based approach	Active learning	… the curriculum is the main means of developing pupils' knowledge, skills and competences … it supports pupils' cognitive processes, independent thinking, sensorimotor skills and memory based on the formulation of questions and hypotheses, working with resources, on analysis and interpretation of results with an emphasis placed on key competencies … understanding science and pupils' engagement in science, scientists ask questions, carry out various experiments, it promotes pupils' scientific literacy, scientific and technical thinking … group (team) work, the basis for which is communication: formulating questions, defining a problem and solving it; students formulate hypotheses, working with the Internet, argue, present own results … responsibility for own learning … creative thinking … cooperation, observation, evaluation, classification, making assumptions, measurement, own activity … learning from own mistakes … pupils engage in activities that they are interested in, building on curiosity, formulating initial ideas … pupils gain experiences through practical activities, which can have an impact on their perception of the world and its functioning … learning based on own experience promotes pupils' curiosity and creativity …
Teachers in the inquiry approach	Teaching strategies	… the teacher as a facilitator … finds out about pupils' preconceptions and learning styles … creates space for activities that promote creative, critical and engaged thinking … teaches through scientific research, applies social constructivism in teaching … supports the development of pupils' communication skills by motivational conversations and discussions, by inducing questions of interest … applies the problem principle, overcoming the contradiction between previous and current knowledge … based on controlled research … tied and open research … observation … experiments, practical activities using real objects, pupils can, for example, take the object in their hands, feel it and determine its thickness, shape … the teacher uses the illustrative-demonstration method, activities with a digital scale … heuristics, concept mapping, didactic games … teachers use praise, encouragement, formulate conclusions and make evaluations … group form of teaching … the teacher is more creativity and has more freedom in planning, lesson planning is difficult …

In the present research study, selective coding [71] was used during the last stage of the qualitative analysis (the process of constructing and validating categories). As the central category, 'teacher trainees' interaction inclination to the application of the inquiry-based approach in education' was abstracted. To interpret the findings, a conceptual map was developed. The presented conceptual map displays the identified relationships, the associations between them, and the examined phenomena (Figure 2).

5. Research Results and Their Interpretation

The research results point to the existence of differences in the opinions of teacher trainees prior to and following the application of the inquiry-based approach in technical education. The participating future primary school teachers inclined to using the inquiry-based approach and the results suggest that they were sufficiently equipped with the competencies necessary for its implementation in the teaching process.

5.1. Teacher Trainees' Preconceptions and Expectations regarding Using the Inquiry-Based Approach in Technical Education

The participants' preconceptions regarding the application of the inquiry-based approach in technical education were orientated on learners' performance in the field of discovering materials and their characteristics based on their experiences, abilities, or practical activities, and using their existing theoretical knowledge. Alongside that, teacher trainees pointed out that the content of technical education can be mediated by applying the inquiry-based approach, especially when solving problem situations or using technical tools for making a variety of products. It offers learners opportunities to present their own strategies for accomplishing a task, which can be later modified based on

discussions, argumentation, and drawing conclusions with other learners in the learning group. In this context, teacher trainees reported that the inquiry-based approach to education influences and promotes the development of motor skills, but also a broad range of learners' abilities, as well as their independence, patience, cooperation, empathy, which they can take advantage of also in other areas of their lives. According to the participating teacher trainees, the inquiry-based approach in technical education is closely related to teachers' professional activities and their activity profiles. The research participants considered it an innovative student-centred approach, specifically aimed at identifying a problem; searching information on a particular issue; using alternative ways of planning the process of inquiry; as well as suggesting appropriate solutions for problem situations [20]. Most of students recorded that during the application of the inquiry-based approach in technical education, teacher guidance is required. It means that in the classroom, the learning subjects should learn how to manage time; understand the procedures of inquiry; and should be able to present the obtained knowledge, skills, competencies, values, and attitudes. In the participants' responses, themes related to promoting the learning process were present, e.g. developing manual skills (production) and the ability to express their own opinions during solving problem situations. From the perspective of a majority of teacher trainees, in the case of the inquiry-based approach, university teachers should take over the roles of constructors and diagnosticians presenting problem situations to teacher trainees and providing them with opportunities to deepen their gathered knowledge. Based on the above, it can be assumed that thanks to the inquiry-based approach, teacher trainees can better understand problem situations and suggest their own strategies and solutions for them in the classroom, which can be well applied outside the school as well. Teacher trainees agreed that the application of the inquiry-based approach in teaching requires using practical group work in the classroom with the aim of building and re-constructing the learners' didactic schemes.

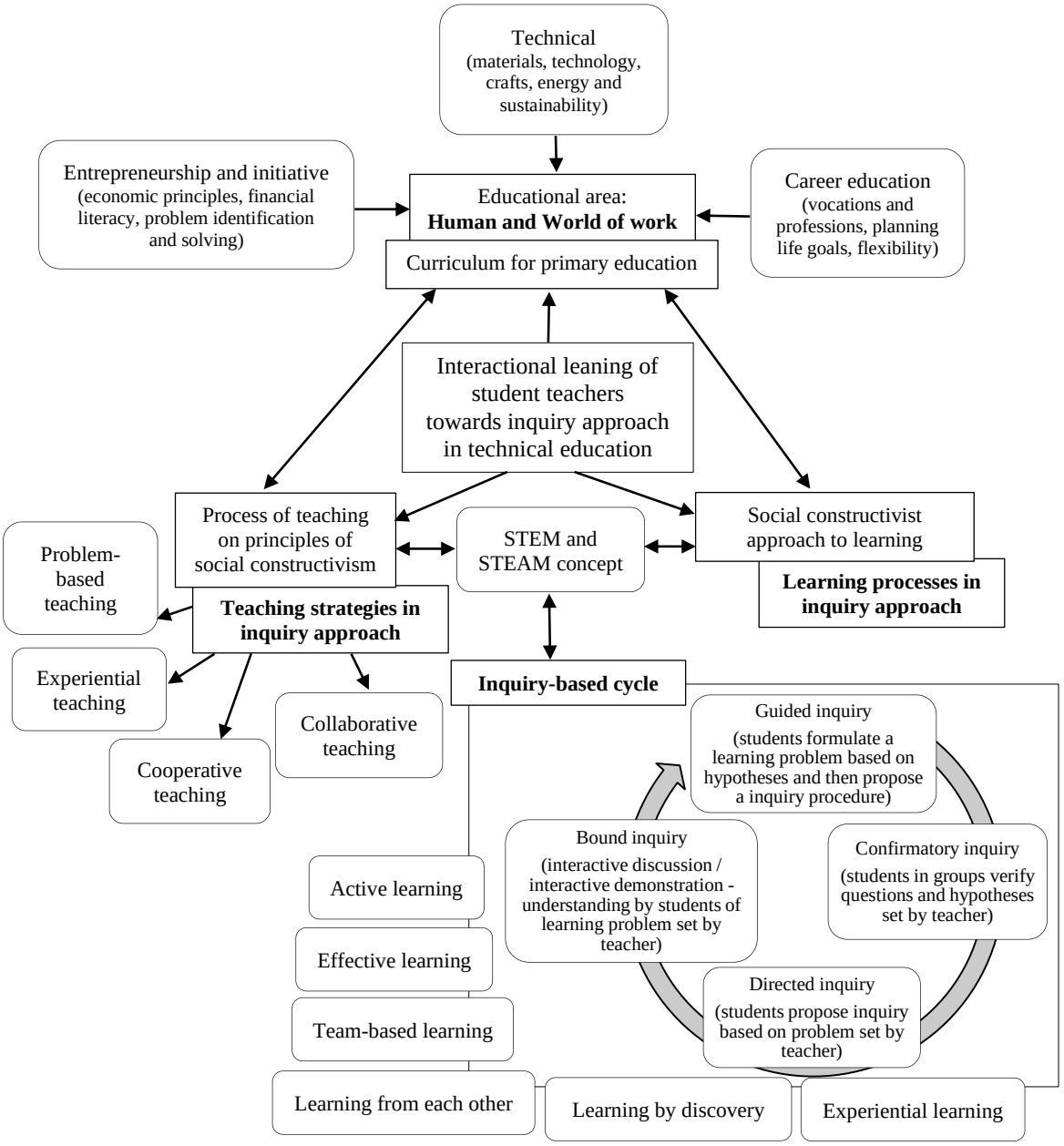

Figure 2. Conceptual map

The investigated subjects understand the importance of the position of a learner in the classroom, where the inquiry-based approach is applied in technical education. In their statements, they reported that learners in such learning environments learn about the reality by means of inquiry, exploration, or the method of trial and error, etc., take over responsibility for their actions, and feel important when solving problem situations. According to them, learning subjects independently and based on own abilities find out, discover, or produce something. They believe that, for learners, the inquiry-based approach brings benefits, as it helps them find solutions based on the formulated hypotheses that are subsequently verified. This way, interest in technology is promoted in them and they gain technical skills that they can use in their daily lives or in their future occupation [17].

Teacher trainees pointed out the disadvantages of using the inquiry-based approach in technical education from the perspective of learners as well, e.g. a danger of injury when manipulating with objects, tools, etc. The participants also reported that lesson planning – when the inquiry-based approach is applied – is demanding (thinking over and evaluating problem situations). In this context, the participating teacher trainees noted that the inquiry-based approach does not necessarily suit every teacher, but each teacher should at least consider its implementation in the teaching process. In the inquiry-based approach, the following teacher roles have an important role to play [61]: 1. motivator (a teacher inspiring and stimulating the learning subjects); 2. facilitator (a teacher supporting the learning subjects); 3. diagnostician (a teacher who diagnoses the learning subjects); 4. observer (a teacher observing the learning subjects); 5. innovator (a teacher who makes the teaching process special); 6. constructor (a teacher who presents problem situations in the classroom); and 7. debater (a teacher who leads discussions with the learning subjects). The above suggests that in the interpretations of the participating teacher trainees, the concept of social constructivist approach can be observed.

5.2. Changes in Teacher Trainees' Preconceptions Regarding the Application of the Inquiry-Based Approach in Technical Education after Intervention

The respondents stated that the themes of the school subject Technical Education mediated to them by applying the inquiry-based approach had met their expectations. According to them, the teaching content was presented in an interesting and playful way and they reported that they would like to use similar activities in their future teaching practice. They examined a wide range of phenomena, tested the characteristics of a variety of objects, and recorded their experiences in observation sheets. Teaching individual themes through the application of the inquiry-based approach was based on real lesson plans designed by the participants, which provided space for their own activities. They could take advantage of their previous classroom observations using relevant means and teaching aids. In their interpretations, the teacher trainees accentuated the necessity to apply the concepts of STEM and STEAM [64]. According to them, this type of learning can be considered experiential with themes carefully selected by the teacher that are based on reflection, critical analysis, and synthesis by means of such methods of teaching as brainstorming, asking open questions, thinking out loud, formulating answers, discussions, demonstrations, practical activities, etc.

For the learning process, as reported by the teacher trainees, group work using heuristic methods and inquiry is characteristic. They are also aware that carrying out inquiry-based activities requires searching for information about a particular issue from up-to-date and relevant resources. They suggested applying inquiry in other school subjects, too. According to them, introducing various themes by using the methods of inquiry-based teaching promotes developing key competencies in learners, especially their learning process (sensorimotor skills, cognition, and remembering), teaches the learning subjects how to formulate (research) questions [75] and hypotheses. If compared with the traditional approach, the main advantage of the inquiry-based approach, as stated by the participants, is providing opportunities for experiential learning, which helps comprehend research principles [76] and increases learners' engagement in the classroom [77] (e.g. understanding how researchers formulate research questions, conducting experiments according to them, etc.). Inquiry-based teaching creates space for developing scientific and technical thinking, and scientific literacy [78] is promoted in the learning subjects. A majority of the teacher trainees expressed their opinion that learning from their own mistakes is an important part of inquiry-based learning. Repeated examination of phenomena and formulation of conclusions contribute to a more relaxed classroom climate and learning with reduced stress. The participants also pointed out that the inquiry-based approach ensures a certain continuity of learning and promotes taking over the responsibility for their own learning. Such processes promote the learning process and build on learners' curiosity, creativity, etc. [8]. It is a process of effective learning, in which learners are engaged in activities based on their interests. It is enriched by own experiences and practical activities, the quality of which can be increased by carrying out experiments, observations, etc. As stated by the respondents, in inquiry-based education, communication, e.g. in the process of formulating questions, specifying the problem and proposing solutions (the learner formulates and verifies hypotheses; works with resources, the Internet; argues, and presents own results), is crucial with an accent placed on key competencies that are necessary to promote critical thinking development in learners [79].

The participants emphasised that – in the process of inquiry – group (team) work has an important role to play (e.g. the learners select their roles based on own abilities, preferences, and are able to collaborate with other learners in the team). There are several types of inquiry that can be well applied in the classroom: 1. guided inquiry (the learning

subjects formulate the learning problem based on hypotheses and, subsequently, suggest procedures for solving it); 2. confirmation inquiry (learners in groups verify the questions and hypotheses formulated by the teacher); 3. directed inquiry (the learning subjects propose procedures for the problem introduced by the teacher); and 4. bound inquiry (interactive discussion/interactive demonstration – understanding what the learning problem introduced by the teacher is) [80]. It is necessary to lead discussions with the learning subjects about their successes and failures when solving a range of problem situations. From the aspect of social constructivism, the learning process always starts with what the learning subjects already know, what they have experienced and subsequently, their knowledge can be deepened and re-constructed. The problem principle, constructing knowledge and trying to find the answers for the formulated problem are accentuated [81]. The participating future teachers also emphasised that teachers applying the inquiry-based approach in technical education should trust their learners even if they are unable to succeed in finishing an activity or cannot perform it out at all. Overcoming the contradiction between previous and current knowledge is in the centre of attention. Learners are in the position of researchers and search for the answers for a formulated question (problem situation) [65], feel the need to overcome obstacles, want to learn more independently or in groups, modify their existing concepts, test materials and new technologies, and finally comment on their knowledge and products that represent the results of their learning process [31, 82]. A majority of the participating teacher trainees accepted the model of teaching based on the principles of social constructivism.

6. Main Findings

In the research study, the participating teacher trainees themselves were an inherent source of knowledge, as they were those who were in the process of preparation for the role of a primary school teacher in the context of social, cultural, technical, and technological requirements. The application of the inquiry-based approach in technical education is demanding from the aspect of lesson planning, and therefore, each teacher should consider using it in technical education with the aim of increasing pupils'/students' technical literacy.

The most important research finding is that students enrolled in primary school teacher training programmes had particular, inconsistent, diffusive, and empirically not supported preconceptions about inquiry-based teaching and assigned an undeniable importance to the application of the inquiry-based approach in technical education. They interpreted the concept of inquiry-based teaching accurately, in an erudite and explanatory way, and its application considered extremely important from the point of view of the learning subjects in primary technical education.

The next research finding is that the participating teacher trainees' expectations regarding the themes of inquiry-based approach in university education in the course Technical Education were met. This innovative approach to the realisation of the themes of field didactics focused on the context of primary technical education – as perceived by teacher trainees – enriches the educational process, makes it fun, and learning becomes more appealing to the learners. It allows taking advantage of own observations when solving problem situations in groups and appropriate teaching aids and means are used. They also recommend including additional themes creating the content of technical education at the primary level of education among those mediated by the methods of inquiry-based teaching.

Another research finding is that the participants modified their initial concepts regarding the application of the inquiry-based approach in the classroom. They developed a broad range of competencies necessary for inquiry-based teaching and were introduced various activating methods that create space for the development of technical thinking.

7. Discussion

The main goal of the research study was to find out about the participating teacher trainees' opinions prior to and following the application of the inquiry-based approach in the university course Technical Education. This method of teaching is associated with expectations in the field of increasing pupils'/students' interest in technical education, as well as the quality of their learning. We consider teachers to be important actors in education who attempt to develop their pupils'/students' technical literacy and influence them in a way that helps them achieve the best possible results. By using an exploratory qualitative research design, we were able to penetrate into, learn about, and understand teachers' activities and behaviour in the context of inquiry-based teaching. The research subjects were the actors (executors) of education and gained direct, but also indirect experience as observers. In the present research study, a qualitative pedagogical experiment was carried out, which was supported by further research tools and methods (essays, microteaching, participative observations, analysis of products/the research subjects' outputs, and reflection).

RQ1. The participating teacher trainees' expectations regarding the implementation of the inquiry-based approach in the teaching process in technical education point to the fact that inquiry – in conjunction with the availability of appropriate teaching materials [42] – requires high-quality lesson planning. Teachers must change their perception of their role of a teacher as a mediator of knowledge and become facilitators of pupils'/students' learning activities [18]. It is an exclusive innovative approach inspired by the research cycle, which is used by teachers, targeted at learners, and realized in the form of practical group work with the aim to construct and re-construct the didactic schemes [80, 81].

RQ2. In the framework of the applied inquiry-based approach in technical education, we focused on managing the process of inquiry-based learning [33]. During two semesters, a second lecturer was present in the classroom who had the role of an observer. Their task was to analyse teachers' inquiry skills [21]: (a) their ability to introduce a problem to learners and to justify the realisation of inquiry; (b) their ability to motivate learners to learn; (c) their ability to integrate interdisciplinary knowledge and interdisciplinary relationships; (d) their ability to manage the inquiry process on a scientific basis; (e) their ability to draw conclusions based on the results of the inquiry and interpret the process and results of inquiry-based activities; and (f) their ability to diagnose the newly gained knowledge. According to the national curriculum for primary and lower secondary education in the first two cycles, within the educational area Human and the World of Work [41], pupils and students learn about the characteristics of natural and technical materials and opportunities to use them, therefore, adequate attention should be paid to these phenomena during undergraduate teacher training [46]. Problem-based tasks allow for the introduction of the inquiry-based approach and provide teacher trainees with opportunities to use it in primary education [15, 16]. Learning organized in this form was perceived by the participants as a collaborative process of sharing and comparing opinions and points of view through conversations, discussions, and mutual constructive criticism. This can be explained by the fact that prior to conducting inquiry-based activities, the participating teacher trainees were asked to study materials about a particular theme in advance. Through inquiry-based activities, we tried to find out about the learning trajectories in relation to the evaluation of their own activities and performance, in addition to that, we identified problems related to their activities [61]. For this reason, we wanted to find diverse ways of improving this process. We also attempted to support our framework for learning activities (by limiting proposals, planning, making decisions, consultations among each other and with the teacher, etc.), and to provide space for reflection on where they come from and where they are headed [30].

RQ3. The changes in the preconceptions of the participating teacher trainees regarding the application of the inquiry-based approach in technical education point to the necessity of working with the concepts of STEM and STEAM [52]. For the above reason, it is necessary to find opportunities to implement inquiry-based teaching in individual segments of STEM and STEAM in the future, as teacher trainees call for opportunities for spontaneous learning based on individual participation and processes linking knowledge with practice [32]. Based on the obtained research results, it can be assumed that the applied type of teaching has a significant impact on teacher trainees' cognitive skills and, subsequently, on their competencies for inquiry-based teaching [1, 79]. The inquiry-based concept of technical education uses the elements of scientific research, but it is evident that pupils are not able to find the answers for the same research questions as experienced researchers. Despite this, it can be assumed that various research procedures are applicable to a broad scale of more or less complex natural science, technical, and mathematical problems [43]. The process of finding answers for the identified problems is influenced by existing concepts (theories). This process can include, for example, the method of pedagogical experiment, observation, or other methods of research [44] to ensure the pupils'/students' involvement in the process of inquiry and understanding of the formulated question (they are able to identify with it). The teacher plays the role of a facilitator [79].

Our results suggest that inquiry-based instruction has a significantly positive effect on stimulating thinking processes in learners. It promotes critical evaluation of any information presented to them. In a school environment where inquiry-based instruction is supported, learners are encouraged to question the received information and create their own solutions, which contributes to developing their problem solving and critical thinking skills [83]. Inquiry-based teaching, e.g. the interactive method [84], helps achieve the set educational goals in the classroom and also promotes the development of soft skills (communication, cooperation, flexibility, creativity, independence, the ability to work under pressure, panning, and organisation), which the learners can take advantage of also in other fields of their lives [85, 86].

Currently, teachers face a professional challenge seeking an answer to the question of how to manage classrooms, how to pay sufficient attention to pedagogical questions, develop a didactically appropriate framework for both individual and group processes of learning and acquire a socially and culturally desirable learning experience, which is also valuable from the educational aspect. These can be considered strategies that appear to be highly applicable and transferable to a variety of fields of education (teaching/learning) and can be used, for example, in concentrically integrated curricular projects, for developing concepts and strategies for group discussion. It must be noted that teachers should not forget about the ambiguity and multidimensionality of the teaching process, which especially applies to the requirement that pupils/students should primarily learn at school and not only observe things, listen to the teacher, or answer fast-paced questions. As part of teacher strategies, the learners' internal motivation should be stimulated. It should lead to self-motivation instead of being motivated (only) because the teacher wants so. Teachers must always remember that the learners in the classroom are their equal partners (understand it relativistically), and their experiences are of a diverse quality.

8. Conclusions

The results of the present research study confirm that the implementation of the inquiry-based approach in undergraduate teacher training brings benefits. The findings show that the participating teacher trainees developed their competencies in the field of inquiry-based teaching during the experiment, and therefore, we find it important to continue using this approach in teacher training at universities. It can also be expected that the participating teacher trainees will apply the inquiry-based approach in their future teaching practice. Although field didactics are specific to a certain extent, the applied educational approaches are transferable, i.e., valid for several fields. The same applies to the inquiry-based approach to education in the context of technical education, as a large amount of knowledge is valid for natural sciences and mathematics as well. In the future, it will be important to look for opportunities for inquiry-based education in other scientific fields as students prefer spontaneous learning based on individuals' engagement and processes that contribute to creating knowledge [87, 88].

In the present research findings, the stages of teacher trainees' preparedness for their future profession, their direct experience, and the types of their judgments associated with inquiry-based instruction were considered. Based on the above, it can be assumed that:

- University teachers – researchers should focus on developing student-produced generalizations derived from the speech acts of the subjects concerned.
- University teachers – researchers should focus on studying group interactions in the context of the inquiry-based approach by using a broad scale of materials and other didactic means with an accent placed on increasing students' autonomy in their thinking and actions when working in teams with their peers. Special attention should be paid to the coordination processes from a variety of teacher trainees' points of view both in real and potential fields of interest.
- University teachers – researchers should focus on teacher trainees' competencies, including their professional competencies.

The present research findings point to the need to apply the inquiry-based approach to technical education during undergraduate teacher training to increase the level of technical literacy in teacher trainees and so, in pupils in primary education and older students, too. Therefore, further qualitative research activities will be focused on the application of the inquiry-based approach by teacher trainees in their own teaching practice in order to find out about the quality of instruction and objectively evaluate their competencies for inquiry-based teaching.

9. Declarations

9.1. Author Contributions

Conceptualization, E.S., M.K., and S.B.; methodology, E.S., M.K., and S.B.; writing–original draft preparation, E.S., M.K., and S.B.; writing–review and editing, E.S., M.K., and S.B. All authors have read and agreed to the published version of the manuscript.

9.2. Data Availability Statement

The data presented in this study are available on request from the corresponding author.

9.3. Funding

This study was supported by the Scientific Grant Agency of the Ministry of Education, Research, Development and Youth of the Slovak Republic and the Slovak Academy of Sciences: VEGA grant 1/0033/22 Inquiry-Based Teaching in Mathematical, Science, and Technical Education.

9.4. Institutional Review Board Statement

Not applicable.

9.5. Informed Consent Statement

Informed consent was obtained from all individual participants included in the study.

9.6. Declaration of Competing Interest

The authors declare that there is no conflict of interests regarding the publication of this manuscript. In addition, the ethical issues, including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, and redundancies have been completely observed by the authors.

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