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- FULL RESEARCH PAPERS
- SHORT COMMUNICATION
- REVIEW STUDY

Papers are published in English. A paper may comprise an empirical study using an acceptable research strategy, such as survey, case study, experiment, archival analysis, etc. It may contain a theoretical study aimed at advancing current theory or adapting theory to local conditions or it may arise from theoretical studies aimed at reviewing and/or synthesizing existing theory. Concepts and underlying principles should be emphasized, with enough background information to orient any reader who is not a specialist in the particular subject area.

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The paper. The paper is carefully formatted according to the template of the journal (see bellow). Special attention is paid to the exact application of the Harvard referencing convention to both continuous citations and list of references. If an electronic source has the DOI number assigned, also it will be provided in the list of references. Manuscripts are submitted via the editorial system in the DOC.

Research highlights. The core results, findings or conclusions of the paper are emphasized in 2-4 bullet points (max. 150 characters per bullet point including spaces). The highlights are submitted as a text into the submission form in the editorial system.

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Tables, graphs and illustrations should be drawn using a suitable drawing package. Colour may be used. Place all diagrams and tables where you wish them to appear in the paper. Ensure your diagrams fit within the margins and are resizable without distortion.

Review procedure

Following Editorial recommendation, papers are submitted to a double-blind peer review process before publication. Commentary by reviewers will be summarized and sent by email to authors, who can choose to revise their papers in line with these remarks. Re-submitted papers should be accompanied by the description of the changes and other responses to reviewers' comments (see above), so that the desk-editor can easily see where changes have been made.

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We are pleased to present you the third issue of the year 2022 (vol. 15, no. 3). We are happy that ERIES Journal keeps attracting submission from different regions around the world, as this issue includes six articles of authors from the Czech Republic, Indonesia, Slovakia, and Ukraine. The central topic of this issue is related to students' and teachers' personal development to enhance learning outcomes.

In the first article "Evaluation of Virtual Workspace Laboratory: Cloud Communication and Collaborative Work on Project-Based Laboratory", Juli Firmansyah, Andi Suhandi, Agus Setiawan and Anna Permanasar evaluated the success or failure of using Virtual Workspace (VW) in a project-based physics laboratory. For this purpose, a qualitative approach with 4E evaluation methods (educational effectiveness, ease of use, involvement, and environment) was used with a participation of 104 prospective physics teacher students, 12 lecturers of basic physics courses, and ten laboratory instructors representing public and private teacher education universities in Aceh in Indonesia. The results revealed that the use of virtual workspaces as a tool in practical work is very effective in training critical thinking, creative thinking, communication skills and collaborative skills.

In the second article "Formation of Financial Literacy in Primary School Students", Iryna Kuzma, Hanna Chaikovska, Iryna Levchyk and Oleksandra Yankovyc described a detailed structure of the designed model of the methodology of financial literacy formation in primary school students. To do so, the authors collected answers from 209 pupils from three secondary administrative regions in Ukraine. The experimental methodology resulted in a significant increase in the growth of financial literacy indicators. More in detail, pupils with a low level of formation of financial literacy demonstrated positive dynamics in the growth of their indicators after the experimental study, as well as representatives of pupils with a sufficient level of financial literacy formation.

In the third article "Czech Preschool Teachers' Contrasting Beliefs about Inquiry-based Activities", Peter Gavora and Adriana Wiegerová investigated Czech preschool teachers' contrasting beliefs about inquiry-based activities (IBA). The research includes responses from 1,004 preschool teachers from all 14 regions in the Czech Republic. The results show that teachers are convinced that IBA provide appropriate opportunities to support science learning by stimulating children's cognitive abilities and developing favourable attitudes towards science. They also believe that IBA engage non-attentive children through hands-on tasks. At the same time, teachers are aware of the challenges associated with implementing IBA, such as the possible "mess" the children make when they experiment with objects and substances.

In the fourth article "Personality Development as a Key Aspect of Teacher Learning: A Pilot Study of the Training Programme Effects within the CLIMA Concept ", Irena Stejskalová, Lenka Komárková, Jiří Sláma, Vladimír Přibyl and Přemysl Štych examined the usefulness of professional education for kindergarten and primary school teachers focused on personality development, emotional intelligence, and other social areas with an emphasis on creating a favourable classroom climate. The pilot study aimed to discover which specific areas of this education approach contributed to the teaching practice. The training effects were evaluated using two questionnaires collected from 11 kindergarten teachers and 16 primary school teachers. The results of the pilot study confirmed that the positive effect of all the areas supported by the training programme has significantly increased. This is important as the main idea and objective of the training programme was a change in the behaviour of the teacher to trigger a future change in the pupils' behaviour.

In the fifth article "Meta-Analysis Study: The Relationship Between Reflective Thinking And Learning Achievement", Muhamad Chamdani, Furtasan Ali Yusuf, Moh Salimi and Laksmi Evasufi Widi Fajari presented a review study to prove and determine the relationship between reflective thinking and learning achievement and its effect size. For this purpose, the authors used a quantitative meta-analysis method, where reflective thinking was the independent variable and learning achievement was the dependent variable. The data were collected from online database searches on Google Scholar and international journal platforms from 2012 to 2021. The study observed a significant relationship between reflective thinking and learning achievement. The more skilled students reflect the relationship between concepts, causal relationships, analogous relationships, or differences, the more skilled they are in making decisions, conclusions, and working on questions quickly and precisely for better learning achievements.

Finally, in the sixth article "Identification of Effectiveness Measurements and Bias Publication of Literature Results Study", Rais Ridwan, Samsul Hadi and Jailani conducted a review study to determine the impact of cooperative learning model research findings on the mathematics learning outcomes of Indonesian vocational high school students. For this purpose, the authors employed a meta-analysis approach consisting of 16 research studies published in journals and five published

in proceedings to uncover efficacy and publication bias measures in research studies. The analysis shows that the cooperative learning model positively impacts the mathematics learning outcomes of the Indonesian vocational high school students. This study provides information to teachers regarding the application of effective cooperative learning models to mathematics learning outcomes at the 10th and 11th-grade levels and the efficiency of learning to the number of students in the class.

We would like to thank all authors who have submitted their articles to ERIES Journal and special thanks to all reviewers for their endless effort in revising the articles. We hope that all our readers will find this third issue of the year appealing. You can follow the latest updates related to the ERIES Journal on its LinkedIn page, where we post information about the highest cited articles and related upcoming events.

Sincerely

Martin Flégl
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CONTENT

Full research paper

EVALUATION OF VIRTUAL WORKSPACE LABORATORY: CLOUD COMMUNICATION AND COLLABORATIVE WORK ON PROJECT-BASED LABORATORY

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ABSTRACT

This study evaluated the success or failure of using Virtual Workspace (VW) in a project-based physics laboratory. This study uses a qualitative approach with 4E evaluation methods: educational effectiveness, ease of use, involvement, and environment. Data were collected through a questionnaire to evaluate the implementation and practical functions of the VW CCCW. In addition, data were also collected using interview techniques to find out how the perceptions of students and instructors or lecturers during project-based physics practicums apply VW CCCW. The sample of this study consisted of 126 respondents consisting of 104 prospective physics teacher students, 12 lecturers of basic physics courses, and ten laboratory instructors representing public and private teacher education universities in Aceh. The evaluation findings show that VW has been successfully implemented and tested. The use of virtual workspaces as a tool in practical work is very effective in training 4C skills. Therefore, as an implication in the 4.0 revolution era, virtual workspaces in practicum can be a new way to work collaboratively with task management, creative action plans, communication and problem solving, critical thinking and completing projects, and practicum performance evaluation and assessment.

KEYWORDS

Cloud communication, collaborative work, project-based laboratory, virtual workspace

HOW TO CITE

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Highlights

- *Virtual workspace effectively used in research laboratory activities and project management in Universities.*
- *Proposed Practicum Model for the higher education system that will permanently implement distance learning with technology integrated.*
- *The implications of using Virtual Workspace in laboratory activities (pre-lab, lab, and post-lab) have an impact on 4C skills and answer the challenges of the 21st-century.*

INTRODUCTION

The use of Information and Communication Technology (ICT) in practicum has provided many changes in prospective physics teacher students' success in understanding concepts and forming attitudes. However, ICT integration at every practicum stage still faces serious challenges. The type of ICT used significantly impacts prospective student teachers' skills in the era of the industrial revolution 4.0 (IR4) in the 21st-century (Liesa et al. 2020). The term IR4 comes from the German government project to promote computerized manufacturing. The era of the industrial revolution is also called the digital revolution and the era of disruption (Sima et al. 2020), where fundamental changes occur due to technological changes in every aspect of people's lives. The industrial revolution began with a) Industrial Revolution 1.0 occurred in the 18th century after the invention of the steam engine, thus allowing goods to be mass-produced, b) The Industrial Revolution 2.0 occurred around the 19–20 century through the use of electric power in

machines which made production costs cheap, c) The Industrial Revolution 3.0 occurred around the 1970s through the use of computers in various aspects of factory production for the needs of people's lives, and d) The Industrial Revolution 4.0 occurred around 2010 through artificial intelligence and the internet of things as the backbone of movement and connectivity between humans and machines.

21st-century skills in the 4.0 industrial revolution era are considered capable of strengthening social and intellectual skills, critical thinking and problem-solving skills, creative thinking skills, communication skills, and collaboration skills, commonly abbreviated as 4C Skills (Stehle and Peters, 2019). Operationally, the 4C Skills can be discussed in four aspects: First, ways of thinking, including creating, innovating, being critical, solving problems, making decisions, and proactive learning. Second, how to work, including communicating, collaborating, and working in teams. Third, how to live as a global and local citizen simultaneously; fourth, tools for developing 21st-century skills, namely information technology, digital networks, and literacy.

Previous research has used ICT in hands-on practicum and virtual practicum (Banerjee, Murthy and Iyer, 2015), which shows that ICT is effectively used in practicum as a tool for visualization (Hillmayr et al., 2020) and easy access to experimental data (Wang and Tahir, 2020). However, ICT in practicum has only been used in data processing activities (Rogers and Finlayson, 2004). The pre-practicum and post-practicum stages, including practicum performance assessment activities, are carried out manually or without using ICT (Mabunda, 2013). Several strategies can be done to improve the quality of practicum using ICT (Gogoulou and Grigoriadou, 2021), one of which is to consider using the Workspace to facilitate collaboration and communication skills during the practicum (Lima and Siebra, 2021; Cheung and Vogel, 2013; Dávideková and Hvorecký, 2017) and to practice critical and creative thinking skills (Stehle and Peters, 2019).

Based on previous research, the use of ICT in practicum is suggested to be broader, starting from the pre-practicum, practicum, post-practicum, and assessment stages (Trepulė et al. 2021). One way to apply ICT widely in practicum is to use virtual Practicum Workspace. The use of workspaces in practicum has never been done before and can be an innovation value in the 21st-century practicum. An illustration in figure 1 shows the application of a virtual workspace extensively in the practicum.

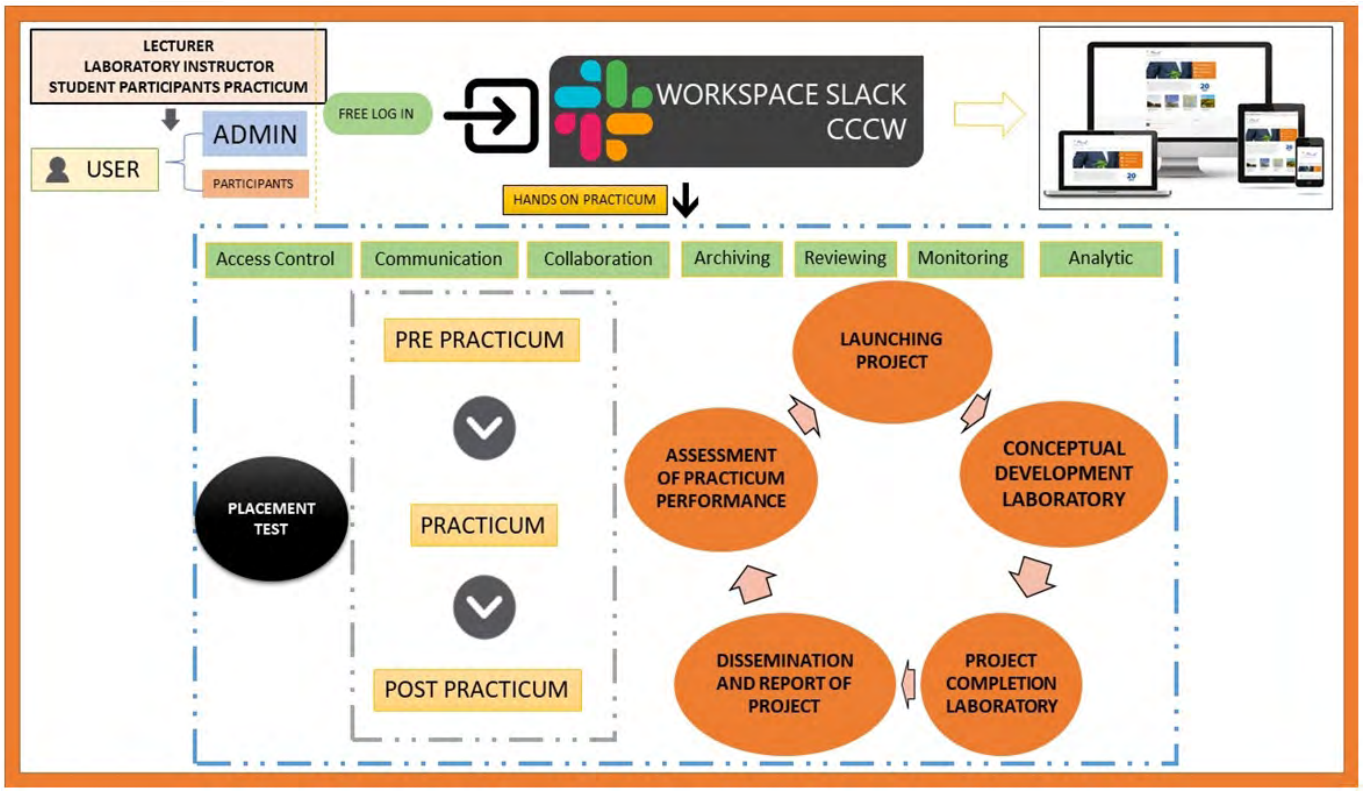

Figure 1: CCCW Workspace Integration Model in Project-Based Practicum, 2020

Workspace-assisted practicums can foster powerful learning and practical experiences by allowing virtual teams to engage in synchronous and asynchronous discussions anytime, anywhere and are very effective at saving time (Sikkel, Gommer and Van Der Veen, 2002; Bell and Kozlowski, 2002); this is very difficult to achieve in real laboratories (Collis, Peters and Pals, 2000; Hew and Cheung, 2012). In conducting workspace-assisted practicum, communication activities and collaborative practices must be encouraged to develop by adding projects that involve the team (Bond-Barnard, Fletcher and Steyn, 2018), by staying in touch with each other (exchange and store data) in the cloud, and collaborative work in the workspace (Darmaji et al. 2019). One of the workspaces suitable for project-based practicum is the Slack workspace.

Therefore, this study investigates the possible success or failure of using Slack workspace in a project-based physics practicum. Slack is a cloud-based digital workspace and information management system used to manage productivity and increase group work efficiency (Johnson, 2018). Using Slack allows students to communicate, collaborate with instructors and peers, discuss in their respective groups, save documents, and download videos (Rombaut, 2016). Slack has 80+ integrations, such as google drive and Trello, so that not only is it easy to share documents and project planning, it also works together in collaboration and cloud-based communication quickly. It shares essential documents seamlessly so that in this case, Slack can also refer to as cloud communication and collaborative work (CCCW).

Consequently, it is necessary to organize a study to be structured to answer the following open questions. How can a virtual workspace (VW) effectively and efficiently support project-based physics practicum activities? How to know that the features in CCCW are functioning effectively in supporting the implementation of project-based physics practicum? Thus, the main objective of this study was to evaluate the success or failure of using Slack's Virtual Workspace (VW) in a project-based physics laboratory.

Basic Support to Cloud Communication and Collaborative Work

Slack, or it can be referred to as CCCW, is a virtual workspace that can be accessed via a web browser and smartphone application with access restrictions for participants who have registered as participants in the workspace (Johnson, 2018). The primary function of VW CCCW is for more effective project management with easy document storage so that participants in the workspace can have access to collaborative work in groups that do not meet face-to-face often.

VW CCCW Slack makes it easy for users to collaborate in cloud-based work because it is connected to Google Drive through all types of documents such as pdf, office, video, audio, and jpg. During collaboration in VW CCCW, users can communicate directly (direct messages) with fellow users and collaborate with instructors or lecturers even through conference connections with zoom meeting links.

Using the Virtual Workspace CCCW

VW CCCW is applied in project-based physics practicum activities to manage project practicum products. As practicum participants who have been invited to VW CCCW, they fill out their biodata and upload photos on the available channels. After that, students take a pre-test response through the link that has been prepared in the discussion column. Based on the pre-test responses, students occupy the practicum group with an even distribution in each group. In the next stage, students can read project-based practicum modules and videos according to the project needs to be provided in the workspace. Students can download attachments in the form of student worksheets in practicum and projects. Project management begins after strengthening the physics concept in the form of practicum has succeeded in finding the physics concepts involved in the project to be undertaken. In the end, students re-upload their practicum and project performance reports to the available channel. CCCW Workspace Slack has many features that support collaborative work between practicum participants. The interface is easy to navigate. There are hundreds of things you can do quickly on Slack, including embedding messages, sending notifications to everyone, conducting public group chats, private group chats, or direct messages (Rombaut, 2016).

The interface of the virtual practicum workspace which has several channels is shown in figure 2. Slack can be meaningful through the communication feature; prospective physics teacher students can communicate with instructors and other members.

VW CCCW facilitates students to discuss and share information during practicum. Sending chat messages and discussions can take place with specific groups and in general. The direct message feature helps students communicate, discuss, send files (pdf, office, jpg, mp4, etc.). VW CCCW makes it easy for students to save and collect various files, files can be in the form of practicum guides, project modules, practicum and project assessment sheets, practicum performance attachments, or videos and animations related to project work.

VW CCCW facilitates participant collaborative work during project-based practicum. Participants and instructors or lecturers can provide responses and assessments of practicum participants' work sent or stored in the Slack workspace. Instructors or Lecturers can monitor project-based practicum activities through the Slack workspace. Because VW CCCW has limited access to passwords, VW CCCW admins can control access so that document and data access can be restricted to specific subgroups and cannot be accessed by the public at large.

Participants' activities in the VW CCCW can be recorded and monitored with the analytic feature to review the activities of members/practicum participants. In the Analytics feature, the admins can check practicum participants' activities in VW CCCW. They are starting daily to weekly activity information on each channel to evaluate who reads messages or does not read statements. With this feature, the admin, in this case, is a lecturer who can assess practicum participants' communication and collaboration skills.

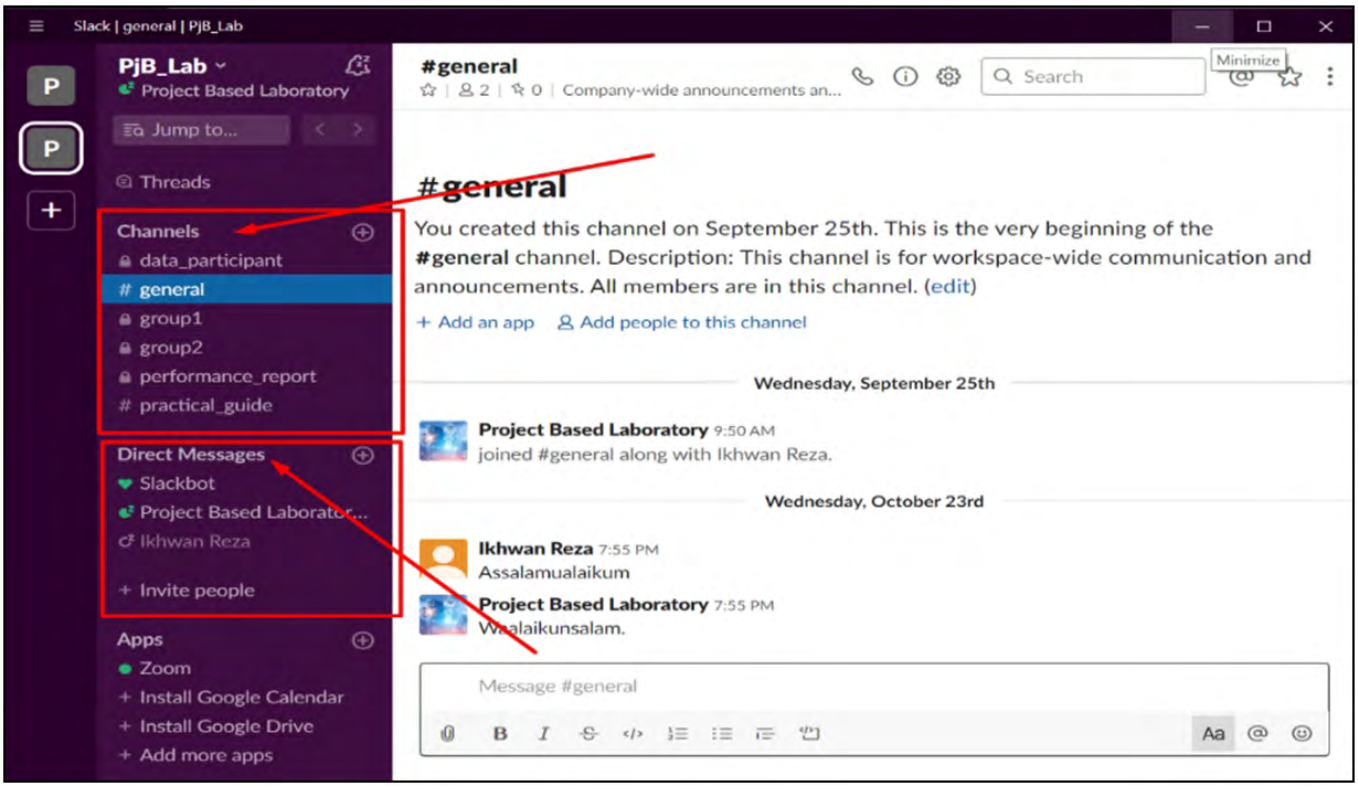

Figure 2: Virtual practicum workspace interface, 2019–2020 (Slack.com, 2020)

RESEARCH METHOD

The evaluation studies apply mixed methods, qualitative and quantitative methods used in this study. This method is used to investigate possible reasons for the success or failure of using workspaces CCCW in higher education. The success of implementing VW CCCW is then evaluated by four variables (Collis, Peters and Pals, 2000), namely Educational effectiveness, Ease of use, Engagement, and Environment (4E Models) through questionnaires and interviews.

The 4E Models are used to predict the likelihood of using workspace during practicum PJB-Lab. In the 4E model developed by (Collis, Peters and Pals, 2001), several variables to predict the success of implementing ICT applications in the educational environment are grouped into four general factors, namely Educational effectiveness, Ease of use, Engagement, and Environmental variables (related to organizational, social-cultural and technological factors). Table 1 explains the description of the four variables of the 4E model within the scope of using the VW CCCW during project-based practicum.

Aspect	Description
Educational effectiveness (E1)	• Relevance for practical tasks and problem-solving in group work. For example, bridging the distance between group members or overcoming the lack of opportunities for collaboration and communication. • One gain relative advantages from using VW CCCW compared to other modes can influence the users' perception in accomplishing practical tasks.
Ease of use (E2)	• It includes easy-to-learn tools, a friendly user interface, and efficient tasks that conform to typical work habits. • Ease of use also depends on the user's computer skills, previous experience with similar tools, easy access to network computers, availability of support (Google Drive, Trello, zoom, dan SurveyMonkey), and the costs associated with using telematics services.
Engagement (E3)	• Common willing to invest additional effort in starting and using telematics services for education. • Higher satisfaction with successful use of VW CCCW. On the other hand, a lack of confidence in one's personal skills to handle ICT results in negative engagement.
Environment (E4)	• Environmental factors outside the course include institutional, socio-cultural, and technological factors such as individual and institutional attitudes towards educational technology innovations; readiness of institutions to offer ICT services and support in an accessible, reliable and affordable manner.

Table 1: Description 4E Model Variabel, 2020 (Sikkel, Gommer and Van Der Veen, 2002)

There are several implications of using the 4E evaluation model of the CCCW WS as a 21st-century practical innovation. First, the descriptive implications, namely the results of this evaluation, can be used as new knowledge and insights on how individuals or practicum workgroups respond to the application of ICT in practicum. Second, authoritarian implications, the 4E model can identify essential parts of ICT tools that can help and solve learning and practicum problems. Third, various positive and negative responses can be used as the basis for further development and research on ICT application in science practicum. Finally, the 4E model shows the success of 21st-century science practicum innovations. This follows the scientific theory that science practicum can not be replaced by ICT without considering the characteristics of the practicum topic.

This study was conducted at two types of universities, namely public and private universities, involving 126 respondents from lecturers, laboratory instructors, and prospective physics teacher students. The explanation for the selection of the two types of universities is that the geographical role of the two universities in coastal areas provides a history almost the same as the two types of universities as teacher education institutions.

Participants

Participants involved in the research have a background in using ICT in learning; everyone involved in education must be trained to operate ICT in distance learning. The research sample consisted of students who had completed fundamental physics I courses, practicum instructors, and lecturers who taught basic physics practicum courses from two kinds of campuses in Aceh, Indonesia. The sample consisted of 63 representatives from private universities (PU), while 63 were from State University (SU). Table 2 shows the research sample.

Sample	Institution	Number of Samples	Male	Female
Lecturer	PU	6	4	2
	SU	6	3	3
Lab Instructor	PU	5	2	3
	SU	5	2	3
Students	PU	52	25	27
	SU	52	23	29
Total		126	59	67

Table 2: Research Samples, 2020

Data Collection

The study data were collected by questionnaire to evaluate the implementation of CCCW and were administered and sent to lecturers, laboratory instructors, and students after the practicum was completed. The questionnaire was given via a google form link which can be accessed through the CCCW WS by each practicum participant. Researchers triangulated data through open interviews with lecturers, lab instructors, and students participating in the practicum. Students are determined randomly from each working group. All data collection processes have obtained permission from institutions, respondents, and parents of students. They have signed the consent form for the publication of research data. However, the name or initials of the institution remain confidential for ethical reasons.

Questionnaire

The questionnaire of the 4E model was given to determine the extent to which VW CCCW was successfully used and supported project-based practicum activities. Scaled question items were used to measure the 4E aspect with each scale indicating a scale: 1 = I completely disagree – 2 = I usually disagree – 3 = I cannot say – 4 = I usually agree – 5 = I strongly agree. The 4E model evaluation questionnaire was adopted from the instrument developed by Collis, Peters and Pals (2001).

Cross comparison case, some of the VW Slack's functionalities on practicums activity were included in the other examined questionnaire: discussion (chat), archiving, collaboration, reviewing, monitoring, access control, and analytics. Evaluation of the function of the VW CCCW feature using three types of responses. The first response is successful (+), representing the feature successfully used and supporting the practicum. Second, the Neutral response (+/-) describes influential but not crucial features supporting the practicum. Finally, the negative response (-), which represents the feature, does not support the practicum or has not been used successfully.

Interviews

Open questions in the interview were given to investigate how practicum participants were perceived to use VW CCCW in project-based physics practicum. Lecturers, laboratory instructors, and some practicum participants (3–4 from each group) were invited to participate in an interview after the experiment to understand their perceptions and opinions about the use of VW CCCW in practicum.

Interview Questions for Laboratory Lecturers and Instructors: (1) How do you understand VW CCCW integration for a project-based physics lab? (2). After integrating the project-based practicum stage into VW CCCW, do you have a preference for VW CCCW or traditional hands-on practicum without ICT assistance? (3). Among these preferences, which one can help practicum participants better in practicum performance?

Interview questions for practicum participants are (1). How did you feel during the VW CCCW project-based physics practicum? (2). What did you do in VW CCCW when starting your physics lab project? Did you follow the instructions in VW CCCW step by step, or did you try it yourself first? (3). Does studying practicum guidelines through VW CCCW help you complete a science project?

RESULTS

The data that has been collected are then analyzed and presented following the stages of data collection. The reliability test used to reflect the scale's internal consistency based on the 4E model cluster directly in the questionnaire used in this study is presented in table 3. As shown in table 3, the four measures of educational effectiveness, ease of use, personal engagement, and environmental are above the acceptable level (0.600 and above). In other words, this questionnaire can be said to be reliable as a research data collection tool.

In figure 3, the person's mean score measure shows the number 0.99 or greater than 0.00. This value indicates that the tendency of the respondent's ability is greater than the level of difficulty of the questionnaire.

Instrument Scales (42 item)	Alpha Score
Educational Effectiveness	0.870
Ease of Use	0.813
Personal Engagement	0.806
Environmental	0.793

Table 3: Instrumen Scale Reliabilities from 4E Model Questionnaire, 2020

Cronbach's Alpha value (KR-20) is the interaction between respondents and the item as a whole. The alpha value is 0.82. This shows that the reliability of the test is generally satisfactory. The value of the person and item reliability is 0.74. This indicates that the consistency of the respondents' answers and the quality of the questionnaire items in the instrument's reliability aspect are good.

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-------------------------------------------------------------------------------
|           TOTAL                          MODEL          INFIT        OUTFIT  |
|           SCORE      COUNT      MEASURE    S.E.       MNSQ   ZSTD   MNSQ   ZSTD |
|-----------------------------------------------------------------------------|
| MEAN      116.6       42.0          .99     .58                              |
|   SEM       .6         .0          .16     .04                              |
| P.SD       5.0         .0         1.38     .36                              |
| S.SD       5.0         .0         1.39     .36                              |
| MAX.      125.0       42.0         4.56    1.83                              |
| MIN.      107.0       42.0        -1.01     .41                              |
|-----------------------------------------------------------------------------|
| REAL RMSE     .70 TRUE SD     1.19  SEPARATION  3.68  Person RELIABILITY  .74 |
|MODEL RMSE     .68 TRUE SD     1.20  SEPARATION  3.75  Person RELIABILITY  .75 |
| S.E. OF Person MEAN = .16                                                   |
-------------------------------------------------------------------------------
Person RAW SCORE-TO-MEASURE CORRELATION = .94
CRONBACH ALPHA (KR-20) Person RAW SCORE "TEST" RELIABILITY = .82  SEM = 2.13

-------------------------------------------------------------------------------
|           TOTAL                          MODEL          INFIT        OUTFIT  |
|           SCORE      COUNT      MEASURE    S.E.       MNSQ   ZSTD   MNSQ   ZSTD |
|-----------------------------------------------------------------------------|
| MEAN      349.7      104.0          .00     .28        .99   -.12   1.04    .02 |
|   SEM       1.5         .0          .11     .00        .03    .28    .08    .34 |
| P.SD        7.5         .0          .55     .01        .16   1.36    .40   1.65 |
| S.SD        7.7         .0          .56     .01        .17   1.39    .41   1.68 |
| MAX.      357.0      104.0          .98     .29       1.31   2.56   1.98   3.72 |
| MIN.      336.0      104.0         -.56     .26        .79  -1.84    .68  -1.47 |
|-----------------------------------------------------------------------------|
| REAL RMSE     .29 TRUE SD      .46  SEPARATION  3.61  Item   RELIABILITY  .72 |
|MODEL RMSE     .28 TRUE SD      .47  SEPARATION  3.68  Item   RELIABILITY  .74 |
| S.E. OF Item MEAN = .11                                                     |
-------------------------------------------------------------------------------
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Figure 3: Respondent Analysis and Item Reliability, 2020

The graph in figure 4 shows a questionnaire of suitable and reliable items used to determine the moderate ability level. The higher the peak of the information graph that can be achieved, the higher the measurement reliability value of the 4E model questionnaire.

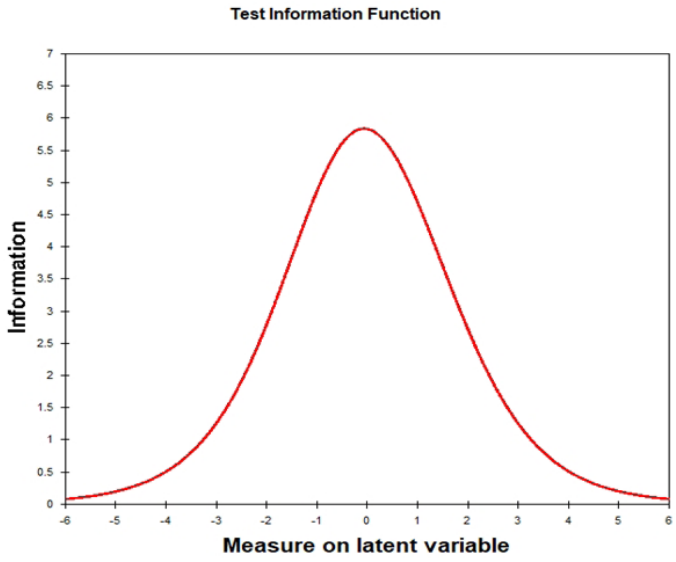

Figure 4: Test Information Function, 2020

Practical Functions

The reliability test of the alpha model was also used to reflect the internal consistency of the questionnaire scale for the success of the CCCW feature function presented in Figure 5. Alpha scores were above the acceptable level (0.600 and above). In other words, this questionnaire can be said to be reliable. The questionnaire results on the success of the CCCW WS feature function in the project-based physics lab are described in table 4.

The person's score means measure shows the number 0.94 or greater than 0.00. This value indicates that the tendency of the respondent's ability is greater than the level of difficulty of the questionnaire.

Cronbach's Alpha value (KR-20) is the interaction between respondents and the item as a whole. The alpha value is 0.74. This shows that the reliability of the test is generally satisfactory. The value of the person and item reliability is 0.74. This indicates that the consistency of the respondents' answers and the quality of the questionnaire items in the instrument's reliability aspect are quite good.

	TOTAL SCORE	COUNT	MEASURE	MODEL S.E.	INFIT MNSQ	INFIT ZSTD	OUTFIT MNSQ	OUTFIT ZSTD
MEAN	25.0	13.0	2.30	1.61				
SEM	.2	.0	.21	.05				
P.SD	1.6	.0	1.79	.40				
S.SD	1.6	.0	1.80	.41				
MAX.	26.0	13.0	3.46	1.89				
MIN.	21.0	13.0	-2.11	.95				

REAL RMSE	1.69	TRUE SD	.59	SEPARATION	3.35	PERSON RELIABILITY .71
MODEL RMSE	1.66	TRUE SD	.67	SEPARATION	3.40	PERSON RELIABILITY .74
S.E. OF PERSON MEAN = .21						

PERSON RAW SCORE-TO-MEASURE CORRELATION = 1.00
CRONBACH ALPHA (KR-20) PERSON RAW SCORE "TEST" RELIABILITY = .74 SEM = .82

	TOTAL SCORE	COUNT	MEASURE	MODEL S.E.	INFIT MNSQ	INFIT ZSTD	OUTFIT MNSQ	OUTFIT ZSTD
MEAN	349.2	104.0	.00	.51	.94	-.36	1.29	.05
SEM	2.4	.0	.56	.02	.15	.69	.41	.77
P.SD	5.5	.0	1.26	.04	.34	1.55	.91	1.73
S.SD	6.0	.0	1.38	.04	.38	1.70	1.00	1.89
MAX.	337.0	104.0	1.46	.58	1.46	1.95	2.72	2.64
MIN.	345.0	104.0	-2.10	.47	.49	-2.56	.41	-2.17

REAL RMSE	.54	TRUE SD	1.14	SEPARATION	2.11	ITEM RELIABILITY .72
MODEL RMSE	.51	TRUE SD	1.16	SEPARATION	2.27	ITEM RELIABILITY .74
S.E. OF ITEM MEAN = .56						

Figure 5: questionnaire scale for the success of the CCCW feature function

Some features of VW CCCW are considered not to support the overall practicum. At least 3% of students agree that the archiving feature is not very useful during the practicum and 13% agree that the collaboration and monitoring features of VW CCCW are not so crucial in the success of the project-based physics practicum.
The use of the CCCW Slack has been successfully implemented during the practicum with the support of valuable features such as discussion or chat features (100%), archiving (97%), collaboration (87.50%), reviewing (100%), monitoring (86.54%), access control (100%) and analytics (100%). This finding proves that all features are successfully operated and support project-based physics practicum, as shown in Figure 5.

Functional	Statement	*N* = 104			Percentage (%)		
		+	+/-	-			
Discussion	Using the CCCW helps you exchange information quickly and easily during the practicum	104	0	0	100	0	0
Archiving	The CCCW makes it easy to exchange data and files to discuss practicum issues	97	7	0	93	7	0
	The CCCW helps you access and upload data such as document and video files during practicum	100	4	0	96	4	0
	You can save all files in your CCCW account to your google drive	104	0	0	100	0	0
	CCCW makes it easy to follow practicum performance evaluations	104	0	0	100	0	0
Collaboration	CCCW helps you communicate with instructors and lecturers	104	0	0	100	0	0
	CCCW makes it easy for you to communicate to develop project plans and create practicum reports	87	17	0	84	16	0
	The CCCW makes it easy to discuss practicum issues found during practicum	85	19	0	82	18	0
	Makes it easy for your collaboration work during practicum	88	16	0	85	15	0
Reviewing	CCCW makes it easy to review the materials and results of discussions that have been conducted	104	0	0	100	0	0
Monitoring	You can view your peers' activities while using the CCCW in practicum	90	14	0	87	13	0
Control Access	The CCCW feature has certain access restrictions, so it requires permission from the admin to perform activities	104	0	0	100	0	0
Analytic	Analytic features help evaluate the involvement of practicum participants during practicum	104	0	0	100	0	0

Table 4: CCCW Feature Function, 2020

Based on the evaluation results using the 4E model with a scale range of 1 (strongly disagree) - 5 (strongly agree), the implementation of the CCCW workspace is considered effective in supporting the practicum process (4.69), ease of access, and availability of facilities and networks (4.69). In addition, it was found that students were interested in using VW CCCW in physics practicum (4.67). The application of VW CCCW in project-based physics practicum has institutional support and follows the concept of technological development (4.53).

Qualitative Data Results from Interviews

The feedback from lecturer and laboratory instructor interviews was collected and summarized into three points. First, VW CCCW helps practicum participants develop knowledge and find concepts with project completion. Practicum participants can read practical guides and concept summaries presented in VW. Before practicum participants collaborate directly, students communicate with each other to explore physics concepts that will be applied in the project by investigating the relationship of quantities and developing physics concepts as a practical product. During the work of practicum products, collaboration within CCCW and outside CCCW trains the critical and creative thinking skills of practicum participants.
Second, the attitudes of the practicum participants towards physics became better after CCCW was used during the project-based practicum; this can be seen at least from their motivation and concentration that were better than usual during the practicum. The participants have easy access to various types of data by using text, images, animation, and video, google drive, quick quiz, zoom, Trello, and accessible documentation of realistic data with tidy filing helps the participants link with other applications. These types of data and their use motivate practicum members to be passionate about and interested in physics practicum.
Finally, the lecturers and laboratory instructors suggested that VW CCCW could be used as a general tool in the hands-on physics practicum for documenting practicum data and, at the same time, as a space to assess the performance of practicum participants. Table 5 will provide an overview of some of the CCCW success feedback evaluated during the implementation of the project-based practicum from the participant.

Aspect	Descriptions
Educational Effectiveness	VW CCCW makes it easy to communicate and discuss significant matters quickly, as well as to attach different types of files
Ease of Use	Students ensure VW CCCW can be used easily with cloud data storage facilities and practical data collaboration work
	The practicum guide is easier to understand step by step because it is made interactive and dynamic
Engagement	Students think that they can do a quick review of the content of the short material and practicum guides in VW CCCW if they have problems
Environment	VW CCCW needs to be supported by a strong internet connection so that it is not constrained in data retrieval and implementation in general

Table 5: Participants' feedback on the VW CCCW project-based practicum, 2020

DISCUSSIONS

The Successful Use of VW CCCW Assistance in Practicum.

The successful use of VW CCCW in physics practicum must improve students' mastery of physics concepts. After VW CCCW was successfully integrated into practicum, Lecturers and Instructors of the Laboratory preferred using ICT in VW CCCW rather than doing traditional practicum because this method was better for improving student performance in practicum.

This finding follows the results of previous research (Darmaji et al. 2019) that ICT-assisted practicums in the form of mobile or web-based applications should be directed to foster better, interesting, meaningful, interactive cognitive experiences and foster social value. It shows that VW CCCW has a high value of effectiveness (Larsson et al. 2020) because students can access and study anytime and anywhere to achieve learning, not just replicating and extending practicum guides, student worksheets, animation, and video tutorial experiments (Mackay and Fisher, 2014). Students are more enthusiastic about carrying out practicum better to understand concepts (Koponen and Huttunen, 2013).

However, laboratory instructors have an essential role in the virtual team by positioning practicum participants into each group according to the results of the response before the practicum and facilitating and encouraging the team to produce productive results (Wang and Tahir, 2020). The practicum participants' performance can also be conveniently tracked and assessed by VW CCCW (Andamon and Tan, 2018) to significantly encourage laboratory instructors and lecturers of practicum courses for portfolio recording and practicum performance evaluation (Sarjono, Mardapi and Mundilarto, 2018).

Feedback from practicum participants from open questions and interviews has supported the application of VW CCCW in project-based practicum activities. Most of the practicum participants followed the project-based physics practicum with VW CCCW assistance. They expressed that they were challenged to think harder to make innovative, practical project products from the materials provided (Yusof, Awang Hashim and Kian, 2016). They also reflected that the animation and video on the practicum guide in VW CCCW could help them understand the physic concept in a contextual way to complete the practical product (Hung et al. 2020). Practicum participants from PU provided positive feedback on Educational Effectiveness and Ease of Use, namely the complete practical guide and stages in VW CCCW. Besides, they revealed that the practicum guide's text, images, and animated videos helped confirm the practicum process from anywhere, anytime, and time-efficient (Darmaji et al., 2019; Chiang, Yang and Hwang, 2014; Firmansyah et al., 2020). Feedback from SU practicum participants shows that CCCW is very helpful in communication and collaboration during practicum.

Participants in the practicum were satisfied that they could quickly revisit the quality of the short material and practical guide in VW CCCW after getting lost in the process (Cheung and Vogel, 2013). Other practicum participants will first communicate with their group members. If they cannot address the problem, they will finish the project according to the comprehensive practicum guide guidance (Mackay and Fisher, 2014). Practicum participants can communicate directly (discussion/chat), store data in the cloud, and work collaboratively on practicum observation data. Practicum participants can study the guidelines together before starting to complete the project as a practicum product. Several practicum participants mentioned that while working using VW CCCW, they could learn and complete assignments independently where previously they depended on the laboratory instructor's instructions (Pedaste and Sarapuu, 2014; Darmaji et al., 2019).

Practical Functions

All the features of the VW CCCW are believed to be suitable and successfully implemented to support the whole practicum stage. However, only three respondents, or 2.64% of the total respondents, considered that the archiving feature in the VW CCCW is not as necessary (neutral) due to the execution of actual practicum and project completion. At the same time, about 97.36% of students confirmed the success of using the archiving feature during real practicums. 12.5% of students answered that the collaboration feature in VW CCCW does not support practicum, while 87.5% percent said VW CCCW has succeeded in facilitating practicum to practice student collaboration skills (Basitere and Ivala, 2017).

Meanwhile, the monitoring feature also received a neutral response from students. At least 14 out of 104 students or

13.46% of respondents agreed that the monitoring feature was not crucial during the practicum. However, 86.54% of respondents positively confirmed the success of the monitoring feature in the practicum.

However, the VW CCCW feature was successfully used in project-based physics practicum. The evaluation results of the 4E model found that students considered the use of ICT in the form of CCCW virtual workspaces in project-based physics practicum positively (Kerr, Dale and Gyurko, 2019). Limited support for virtual Workspace CCCW during practicum (Voogt, 2009) indicates that VW CCCW can be recommended as a tool (assisted) in direct practice or project-based practicum to produce practical products (Zhai, Raver and Li-Grining, 2011).

CONCLUSIONS

Cloud Communication and Collaborative Work (CCCW) as a virtual workspace in a project-based physics practicum for prospective physics teachers have been successfully applied. The evaluation results show that the CCCW Virtual Workspace can be recommended as a practicum tool that is done directly (hands-on). Prospective physics teacher students expressed CCCW's effectiveness, ease of use, engagement, and environmental support, positively proving that project-based physics practicum successfully integrated ICT during its implementation. Functionally, the evaluation results of the features of the VW CCCW, namely communication, discussion, archiving, collaboration, monitoring, reviewing, and analysis, show positive results and are successfully used in guiding project-based physics practicum activities.

Implications

As an implication, the innovative application of VW CCCW in project-based physics practicum is a breakthrough as a tool for real practicum. ICT in physics practicum is not always well applied and too dominant, reducing process skills and not practising 4C skills. Therefore, as an implication in the 4.0 revolution era, workspaces can be a new way to work collaboratively with task management, creative action plans, communication and problem solving together, critical thinking and completing projects, and practicum performance evaluation and assessment.

As a new model practicum offer in the 4.0 industrial revolution era, VW CCCW can be used from the start before the practicum begins with an initial assessment (placement test). Practicum participants are placed in appropriate and proportional groups. In all stages of hands-on practicum, VW CCCW makes it easy to document data on the drive or cloud and collaborate and browse data from big data sources to solve problems and project tasks. In the post-practicum stage, students can prepare written and oral reports in the form of video reports to be sent to VW CCCW. Colleagues provide their comments and responses. Lab instructors or lecturers provide direction and improvement. Finally, the VW CCCW facilitates practicum performance assessment and records neatly in the analytical features. This new practicum model has a novelty both in ICT and the project-based practicum stage. The novelty of the model is the ease of communication and collaboration, which ultimately involves an authentic assessment process. The VW CCCW-assisted project-based practicum model can record student activities during practicum, meaning that student performance during the practicum process has measured by each performance and process skill trained.

As a further evaluation, the physics practicum has different topic characteristics. Therefore, the use of ICT cannot immediately replace a real practicum with a virtual practicum. VW CCCW is offered to answer the challenges of the 21st-century. VC CCCW can be used in virtual and real practicums; this depends on the characteristics of the physics topic.

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FORMATION OF FINANCIAL LITERACY IN PRIMARY SCHOOL STUDENTS

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ABSTRACT

The innovative methodology of the financial literacy formation in primary school students has been theoretically substantiated, the research has been carried out on the basis of education for success in life (integration of media education, financial education and education for sustainable development) and the relationship between the pedagogy of success and the pedagogy of heart.

The structure of financial literacy has been determined. The model of the methodology of formation of financial literacy in primary school students has been developed, the key components of the suggested methodology include aim, content (structure of financial literacy, theoretical and methodical foundations of its formation, expected results of educational programs) components; algorithm of the arranged activities of students, parents and teachers on the basis of partnership pedagogy; the selected forms, methods, means of formation of financial competencies, diagnostic tools and the expected result.

The experimental methodology resulted in a significant increase in the growth of financial literacy indicators in EG. The efficiency of the formation of financial literacy in primary school students has been proved with the help of the main findings of the research.

KEYWORDS

Financial literacy, media education, primary school pupils

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Highlights

- *The innovative methodology of formation of financial literacy in primary school students via education for success in life.*
- *Significant increase of indicators of all criteria of financial literacy in EG.*
- *Detailed structure of the designed model of the methodology of formation of financial literacy in primary school students.*

INTRODUCTION

In the XXI century mankind faced a number of global problems, namely, increasing total debt, unemployment, income inequality that caused such social issues like poverty, crime, discrimination, unequal access to resources, a decrease of spiritual and moral values, etc. Financial education of children and youth is considered to be one of the ways to solve the current social issues.

Resolution of the problem requires starting educative work with the youngest – primary school students. The urgency of this concern is evidenced in a number of normative, conceptual documents for public schools in the EU and other countries that share European integration aspirations. The entrepreneurship competences have been identified as the core ones in the recommendations of the European Parliament and the Council of Europe. Formation of financial literacy in primary school students is the initial stage of the process of reformation in order to improve the economic culture of citizens in society, promoting a prosperous happy life.

Financial education has been paid considerable attention in the schools of the European Union, in particular, the Netherlands has launched the International Program "Aflatoun", which aims to develop financial literacy in children. The word "Aflatoun" is translated from Arabic as "researcher" (Lusardi, 2015). The key topics of the basic financial education (e.g. saving, investment, budgeting, financial risks and being a smart consumer) have been included in school curricula in primary and secondary education in Spain following the recommendations of the OECD, the European Commission and other international organizations. A number of courses like «Aula virtual" (Ikawa, 2016) have been developed to provide primary school teachers with the necessary knowledge, skills and qualifications to feel confident teaching financial literacy in their classes, no matter what their prior expertise in the subject.

The European integration processes encouraged the Ukrainian educators to follow the introduction of financial education in foreign countries and implement the positive experience in the educational sector of Ukraine. According to the statistics data in the research paper by Kikinedzhi (2015: 58), the Ukrainian society consists predominantly of poor families – about 70%, middle class covers about 25–29% and, respectively, the rich – up to 5%. Furthermore, according to the study "Financial Literacy, Financial Inclusion and Financial Well-Being in Ukraine" (2019) conducted within the USAID Financial Sector Transformation Project, the Ukrainians have the lowest level of financial literacy compared to other countries – 11.6 out of 21 points. The current state of formation of financial literacy is considered to be a solid reason for the profound exploration of the scientific sources on financial education, in search of approaches to improve the effectiveness of the designed program.

The problem of financial literacy of children and youth has been the subject of numerous studies. It has been the object of scientific research by Andriichuk (2021), Potrich, Vieira and Mendes-Da-Silva (2016), Vieira, Moreira Júnior and Potrich (2020), Bongini, Colombo and Iwanicz-Drozdowska (2015), Knehans-Olejnik (2014), Swiecka (2018), Dare et al. (2020) and others. The relevance of financial education, its economic and social significance have been revealed in the studies by De Beckker, De Witte and Van Campenhout (2020), González Castro, Enríquez-Diaz and García, (2021), Sánchez Santos (2020) and others. The scientific investigations by Amagir et al. (2018), Carpena et al. (2017), Hastings, Madrian and Skimmyhorn (2013), Kaiser and Menkhoff (2020), Lusardi and Mitchell (2011) resulted in literature reviews, programs and research data analysis related to financial education.

Polish scholar Swiecka (2018) argued about the continuous feature of financial education as a necessary condition of its effectiveness. Also, emphasis has been made on the necessity of teacher training and high quality of textbooks (Swiecka, 2018: 15). Similarly, De Beckker et al. (2019) paid attention in their research to the role of teachers in the process of financial education. The implementation of national strategy on the level of secondary school education, which exists in many countries, would enhance the effects of financial education. According to Tezel (2015), this strategy involves the organization and systematization of activities in the field of financial education, as well as lifelong learning (Tezel, 2015: 16). The younger generation is considered to face greater financial risks and more complex financial products than their parents. In addition, young people get acquainted with financial services at young age via mobile phones, bank accounts, credit cards. Therefore, financial education should be provided at least in primary school age.

Additionally, the concern for early financial education has been stated in studies by Batty et al. (2020), Grohmann, Kouwenberg and Menkhoff (2015), Jayaraman, Jambunathan and Adesanya (2021), Scheinholtz, Holden and Kalish (2011) and others. Panos and Wilson (2020) argued about the rapid implementation of the modern financial technologies in our everyday lives (e.g. mobile payments, robot counselling, application-based investment platforms, online banking, etc.) and strongly recommended to develop financial literacy from an early age, after all, differences in financial knowledge acquired at an early stage of life can determine a significant part of financial and other spheres of well-being in adult life.

The number of countries that are involved in the implementation of the financial literacy programs is growing every year, in particular, according to study by Andriichuk (2021), in Europe, there are more than 180 similar programs. The analyses of the international experience of teaching financial literacy in primary school revealed the importance of inclusion of financial literacy into the educational process in primary school on the example of Czech Republic, USA, Great Britain, the Netherlands, Turkey and other countries. Introduction of financial literacy courses in the primary and secondary school curricula in the Czech Republic was considered to be one of the possible ways of prevention of unhealthy debt burdens for adults, avoidance of potential bankruptcy of individuals or households due to lack of financial awareness, inability to assess financial risks, create or use one's own financial reserves (Andriychuk, 2021: 84). The importance of entrepreneurial education is argued by Pech, Řehoř and Slabová (2021) to be increasing in the Czech Republic nowadays. Preparation of students to start their own business is considered significant due to changes in the market and environment. The researchers admit that new intentions from the Czech Republic's state politics positively influence and support early business, that consequently can motivate more beginning young entrepreneurs.

The interconnection between the low level of financial literacy and the emergence of debt has been revealed in the works of Artavanis and Karra (2020), Carlander and Hauff (2019) and others. High level of financial literacy, as argued by De Beckker, De Witte and Van Campenhout (2021), Xiao and O'Neill (2016) and others, contributes to the increase in quality financial activity.

Furthermore, a strong link between the financial education of a child and its behaviour being grown-up has been proven in a number of scientific studies (Alekam, Salleh and Mokhtar, 2018; Batty, Collins and Odders-White, 2015; Fernandes, Lynch and Netemeyer, 2014; Gerth et al., 2021; Kaiser et al., 2021; Mandell and Klein, 2009 and others). Along those lines, Kalwij et al. (2019) reflected the results of an experiment on the impact of a 45-minute financial education program on children's financial literacy and savings behaviour in Dutch primary schools. Dare et al. (2020) has also focused on the impact of a large-scale national financial education program on the knowledge and skills of primary school students about responsible spending and effective implementation transactions. Teaching methodology has been explored in a study by Amagir et al. (2018), who considered "learning by doing" to be a promising method of teaching financial literacy to children and adolescents in primary and secondary school. Additionally, Batty, Collins and Odders-White (2015) reported the effectiveness of children's financial education in shaping a positive attitude towards personal finance and the ability to save. This aspect has been reflected in works by Babiarz and Robb (2014), Barbic (2020), Bucciol and Veronesi (2013), De Witte, Holz and De Beckker (2020),

Hastings and Mitchell (2020), Kalwij et al. (2019), Te'eni-Harari (2016), Tonsing and Ghoh (2019), Yeh (2020), Lieber (2016) and others. Multiple researches re-emphasized the interconnection between financial literacy and the ability to save.

Among the forms, methods, and means of formation of students' financial literacy, Plekhanova et al. (2020) stressed the key ways of prompromoting the formation of financial literacy in high school students: family, school, and personal experience of earning, that factors were considered to facilitate children to learn the value of money, get matured, construct their social image in future.

The importance of the parents' role in the process of financial education has been proven in the works by Gudmunson and Danes (2011), Hanson and Olson (2018), Maldonado, De Witte and Declercq (2022), Moreno-Herrero, Salas-Velasco and Sánchez-Campillo (2018), Riitsalu and Põder (2016). The significant influence of non-formal parental education (providing pocket money and discussing money issues) has been substantiated by Coda Moscarola and Kalwij (2021). Ming and Jais (2021) studied parents' perceptions on the importance of financial education for children in the context of the COVID-19 pandemic. Grinstein-Weiss et al. (2011, 2012), Kardash, Coleman-Tempel and Ecker-Lyster (2021), Oggero and Rossi (2016), Spader and Yeo (2011) and others found out to what extent the parents' financial education affects the children's achievements in different areas (education, finance).

We came across several thought-provoking studies of gender aspects of financial education that had been revealed in works by Tinghög et al. (2021), Bucher-Koenen et al. (2016), Grohmann et al. (2021), Mahdavi and Horton (2014), Mittelstaedt and Wiepcke (2014), Aguiar-Díaz and Zagalaz (2021) and others. Overall, the generalized findings of the analyzed studies, in particular, Migheli and Coda Moscarola (2017), encouraged the authors of the research to reflect on gender neutrality in financial education programs.

The research findings of De Beckker, De Witte and Van Campenhout (2020) drew the attention of scholars to the influence of the national culture phenomenon on financial literacy. Therefore, it is important to consider cultural dimensions into future international studies of financial literacy. Besides, the issue of international aspects of financial literacy has been explored by Cupák et al. (2021) – the role of individual characteristics and institutions has been determined across countries.

At the same time, there are no works that substantiate the innovative method of financial literacy with an emphasis on the integration of three current issues of the educational process of primary schools: financial education, media education (economic aspects of media education, creating media on money and advertising), education for sustainable development (economical disposal of resources, development of spirituality and moral guide).

The analysis of the scientific works has shown the necessity to develop innovative ways of the formation of financial literacy of primary school students, implementing the content integrated approach to education and to address the current social problems in Ukraine.

The **objective** of the research is to substantiate the innovative methodology of formation of financial literacy in primary school students on the basis of the comprehensive analysis of the content, forms, methods of financial education, media education and education for sustainable development; to test the efficiency of the designed methodology empirically.

Research **hypothesis** implies that the process of formation of financial literacy in primary school students will be effective if it is integrated into the educational process of education for success in life (media education, financial education and education for sustainable development).

Financial literacy

The content of the concept of financial literacy is usually defined by researchers as a set of knowledge and skills to construct a reasonable attitude towards personal finances and contribute to rational decision-making relatively to the economic sphere of human activity. However, there are different variations of the definition.

To begin with Mundy's (2012) interpretation of financial literacy as knowledge, understanding, skills and confidence, the focus is given to the ability to make reasonable financial decisions and act according to specific circumstances. Development of financial literacy in Mundy's opinion aims at having influence on people's patterns of behaviour, not only providing them with knowledge, skills and abilities. A deep understanding of the structure of financial competencies has been described in works by Swiecka (2018). Financial competencies have been structured into knowledge in the field of personal finances (the principles of spending money, saving and budgeting) and financial skills (account creation, payment by mobile phone, cash payments through an ATM, etc.). Hence, the structure of financial competencies implies certain knowledge and skills, besides, Swiecka (2018) divided the competencies into *hard* and *soft* ones. The hard ones include knowledge in the field of loans, forms of savings, the ability to create a digital account, card payments and other. Soft skills are related to psychophysical characteristics and social skills (Swiecka, 2018: 4).

Besides, financial literacy, according to the research analysis, includes high motivation for its development, awareness of the feasibility of self-improvement in the financial sphere, the need to help those in need, because charity encourages higher earnings, as well as reasonable disposition of the earned money.

Thus, taking into account these aspects, financial literacy is defined as a set of knowledge and skills to manage individual funds in profitable ways, ensure financial independence and participate in charity events.

However, the meaning of *"financial literacy of a primary school student"* differs from the definition of *"financial literacy of a high school student or an adult"*. The peculiarities of formation of financial literacy of an elementary school student have been reflected in the program results of study, where in particular it is stated that students are expected to know how to plan a budget, rules of saving; think about wise management of pocket money, etc. Actually, elementary school students are already aware of the connections between

career achievement and hard work; schooling, opportunities for success, overcoming difficulties in life, material prosperity. The authors of this study interpret the notion of financial literacy in primary school students on the basis of the profound analysis of the scientific sources, conceptual documents, educational standards, as a set of knowledge, skills, values, defined in the program documents for primary school, which construct the patterns of behaviour determined with reasonable attitude to personal money, ability to use means of payment, economical approach to consumption, critical use of media for self-development in the field of finance, in regard with the prospects of self-education to achieve in future financial independence. This definition, as it includes the value aspect, suggests the use of the terms *"financial literacy"* and *"financial competence"* as synonymous.

Taking into account the approaches to understanding the structure and content of the concept of financial literacy in the previously discussed studies the authors of the current research have identified the following components of financial literacy: *goal-motivational* (motivation for financial education, value beliefs), *cognitive* (set of knowledge, awareness of media on finance and their critical analysis), *praxeological* (set of skills, behaviour of reasonable attitude to personal money, economical approach to consumption, creation of media products), *productive and analytical* (determination of prospects for self-education to achieve financial independence in the future). In addition, according to the classification by Swiecka (2018), in the structure of financial literacy we distinguish between *hard* and *soft competencies* (a special place among soft competencies is occupied by motivation for media education, the ability to reflect) as displayed at the Figure 1.

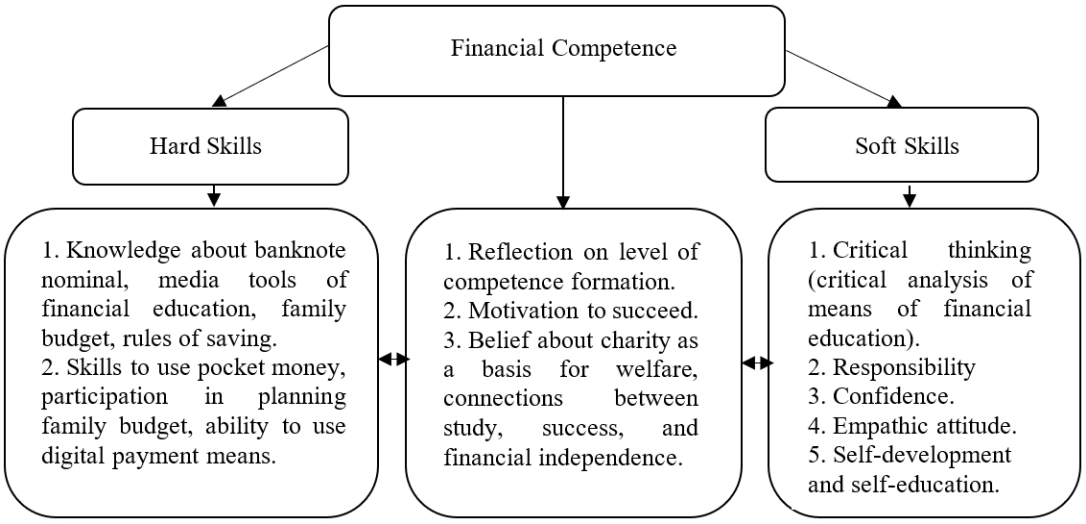

Figure 1: Structure of financial literacy, 2020–2021 (source: own research)

The formation of financial literacy is considered to be in close relationship with the formation of media literacy (economic aspects of media, critical analysis of advertising products, earning money with the help of creation of media products, reasonable attitude to finances) and sustainability competencies (social, economic and environmental aspects: saving natural resources, responsibility for one's own actions, identifying ways to overcome poverty as a combination of education, work, charity). The process of integration of financial education with media education and education for sustainable development is defined by the authors of the study as education for success in life. It is presented in the Figure 2.

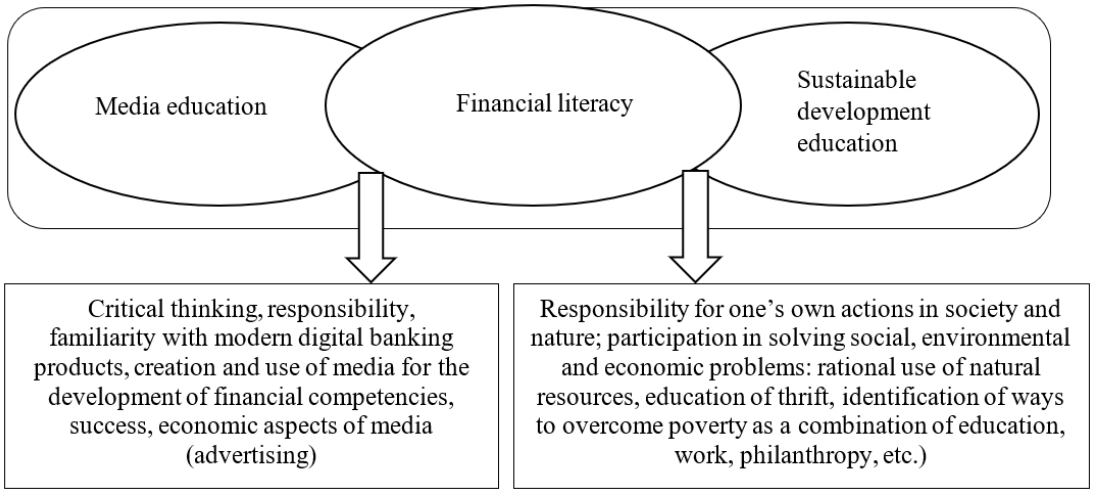

Figure 2: Education for success in life, 2020–2021 (source: own research)

MATERIALS AND METHODS

Research participants

The experimental survey involved 209 pupils of 3 secondary general education establishments from three administrative regions of Ukraine – Ternopil, L'viv and Zakarpattya. The experimental study lasted from 2020 until 2021 academic year. The participants were divided into control group (CG) and experimental group (EG).

Research stages

The initial stage of the research implied the discovery and theoretical study of the issue. A number of methods have been used: *search and bibliographic*, which was used to search and systematize the references, namely the printed sources, the materials of the Internet on the problems of economic education and financial education of children and the youth; *interpretive-analytical*, *comparative-pedagogical* analysis of scientific, educational-methodical works and information resources. The obtained theoretical data allowed us to define the task of the experimental investigation.

The ascertaining stage of the research presupposed the assessment of the levels of financial literacy formation in primary school children by means of the *analysis of the products of children's activity* (school project "How to overcome poverty?"), *interviews* and *expert assessment method* (experts were the authors of the study, primary school teachers) and the *questionnaire*.

The questionnaire form presented 12 questions correlated with the 12 indicators of financial literacy. Every confirmative answer scored 1 point to a respondent, therefore, according to the interpretation scale, a high level of financial literacy corresponded to 10–12 points; sufficient level – to 7–9 points; satisfactory level– to 4–6 points; low level – to 0–3 points.

The applied questionnaire included the following items to define the level of financial literacy in primary school children:

1. *Is it necessary to provide financial education in the preschool and primary school establishments?*
2. *Do you agree that a rich person both earns more money and makes more charity? (donates to the poor)?*
3. *Do you understand the notion of financial literacy?*
4. *Are you interested in books, web-sites, TV programs on topic of money and ways how to spend them properly?*
5. *Do you know any ways to save money?*
6. *Do you understand what is family budget and how to plan it?*
7. *Do you take part in planning of family budget?*
8. *Do you have any experience of shopping, other ways of spending money?*
9. *Have you ever scrimped and saved?*
10. *Do you have a bank card? How often do you use it?*
11. *Can you be called a financially literate student?*
12. *Have you ever considered that it is necessary to start doing something already at primary school in order to become a happy and wealthy person in an adult life?*

The questions were designed in order to reflect the development of the indicators and criteria of financial literacy in primary school children. Due to the analysis of the scientific sources, exploration of the structure of financial literacy, interpretation of the results of interviews with teachers and parents there have been established specific criteria to every structural component. In particular, the *target-motivational component* corresponds to the *inductive-valuable criterion*; *cognitive* – to *informational-semantic*; *praxeological* – to *procedural-personal*, and finally, *evaluative-reflexive* – to *productive-analytical*. The structure, criteria of financial literacy and the appropriate indicators are presented in the Table 1.

The main structural components	Criteria	Indicators
Target-motivational	Inductive-valuable	1. Ability to realize the need to properly manage money; to acquire financial literacy. 2. Ability to find connections between financial education and financial behaviour, wealth and charity; financial education, diligence and success in life. (Explains the importance of knowledge of financial education, hard work and thrift for success).
Cognitive	Informational-semantic	1. Ability to explain what financial literacy is. 2. Knowledge of the rules of saving. 3. Knowledge how to plan a budget. Considers how to properly manage pocket money. 4. Knowledge of traditional and innovative media of financial education, their content.
Praxeological	Procedural-personal	1. Skills of participation in family budget planning. 2. Skills to save resources (thrift, love of nature). 3. Experience in competent handling of pocket money, makes small purchases. 4. Skills to use modern means of payment and disposes of them.
Productive-analytical	Evaluative-reflexive	1. Ability to assess their level of financial literacy. 2. Ability to discuss opportunities (to define prospects for the future).

Table 1: Criteria and indicators of levels of formation of financial literacy in primary school students, 2021 (source: own calculation)

The model of the methodology of formation of financial literacy in primary school children

The designed model of the methodology of formation of financial literacy is based on the integration of media education, financial education and education for sustainable development (education for success in life). Besides, the authors' attention was paid to the innovations, explored in the earlier studies (Tereshchuk et al., 2018; Chaikovska et al., 2021) and the traditional effective ways of work with primary school students, in particular, reading thematic literature for children and discussing the main points.

The experimental methodology is an open system based on *education for success in life* (integration of media education, financial education and education for sustainable development); *pedagogy of success* and *pedagogy of heart*. It combines *goals, content* (structure of financial literacy, theoretical and methodological principles of its formation); *algorithm* of arranged activities for students, parents and teachers on the basis of partnership pedagogy; *forms, methods, means of formation* of financial literacy; *diagnostic tools* and *result*. The peculiarities of the methodology are, in addition to education for life success, the relationship between the problems of study, work, success and prosperity; earnings and charity; pedagogy of success and pedagogy of the heart; cooperation, mutual support of people in achieving financial success. Emphasis is also placed on restoring school traditions: reading educative literature for children on topics of money and financial management; individual creation of media products on education for success in life. Taking into account the recommendations of the Japanese teacher Suzuki and Kyoko (1982), who developed a philosophy of educating people of different ages and abilities, the experimental methodology provides that reading books and creating elementary media products is supposed to be a common hobby of the whole family.

A number of existing ESD school methodologies in Ukraine can not meet the needs of primary school students because they are restricted to a 45-minute school course. The distinctive features of the designed methodology, in contrast to others, include participation in the international financial literacy programs, e.g. *"Aflatoun"*, integrated learning, group work, e.g. project *"Children – millionaires"*, inspiring case studies and success stories.

Thus, the purpose of the experimental methodology is the multifaceted formation of financial literacy in primary school students. Realization of the purpose implies the organization of work (under condition of partnership of pupils, teachers and parents) according to the structure of financial literacy defined in the programmed results of study. The content, based on pedagogics of the heart and pedagogics of success in life, is supposed to comprise the core theoretical and methodological framework for financial literacy formation.

The algorithm of actions consists of the *target-motivational* stage (definition of the purposes and motivation for their realization), *cognitive* (acquisition of knowledge on subjects of monetary units, ways, rules of savings), *ethical-pragmatic* (management of the family budget during integrated lessons, holidays, project activity) and *productive* (making small purchases, economical use of resources at home and school, reflection on the level of formation of financial competencies and determining the prospects for self-development and self-improvement).

The innovative *form* of study in the experimental method is the production of media works "Interview with Aflatoun" aimed at common reflections on ways of overcoming poverty. Possible options may include successful study, hard work, high earnings, frugality in the use of resources at home and charity, which involves warm and kind attitude towards people in need. Possible questions to Aflatoun include: *"How can a student make money?"*, *"Do you really need to study hard in order to earn high in the future?"*, *"Is there a connection between earnings and charity?"*.

Besides, reader conference has been proved to be an effective *form* of group work. At forums students had opportunity to discuss books "A Dog Called Money or the ABC of Money" by Schäfer (2019), "Economics. What Adults won't Tell you" by Janiszewski (2019); meanwhile, parents were recommended to read a manual "Open Family Studios: "Financial Wisdom of Family Pedagogy" by Kikinedzhi et al. (2015). "Praxeological Tales" by Kuzma (2019). A number of successful students and entrepreneurs were invited to such conferences, drawing attention of students to the necessity to read books, improve themselves, and invest in education. Meetings with bright students of Ternopil Volodymyr Hnatiuk National Pedagogical University, e.g. the developer of thematic cartoons of educational character about life success, were an effective form of work in experimental groups. A contest for the best fairy tale on life success among the participants of experimental study resulted in selection of a plot for a new cartoon.

One of the effective *methods* of education was exercise "*Which advertisement can be trusted?"* Children were offered advertisements of various brands of juice (they had to decide which one to choose), chips and potatoes, and so on. In addition, they had to choose from a list of food packages those that need to be bought to cook healthy meals (the choice was made in favour of buckwheat, butter, bread, fruit, children rejected packages with popular pop drink, candy, instant noodles and chips). A number of separate meetings was hold to discuss with students their level of financial literacy before and after the experiment.

The components of the experimental methodology also include a set of *diagnostic tools* – criteria and indicators of the levels of financial competence and the *result* – formation of financial literacy at high and sufficient levels. The model of methods of formation of financial literacy of pupils of primary school age is presented at the Figure 3.

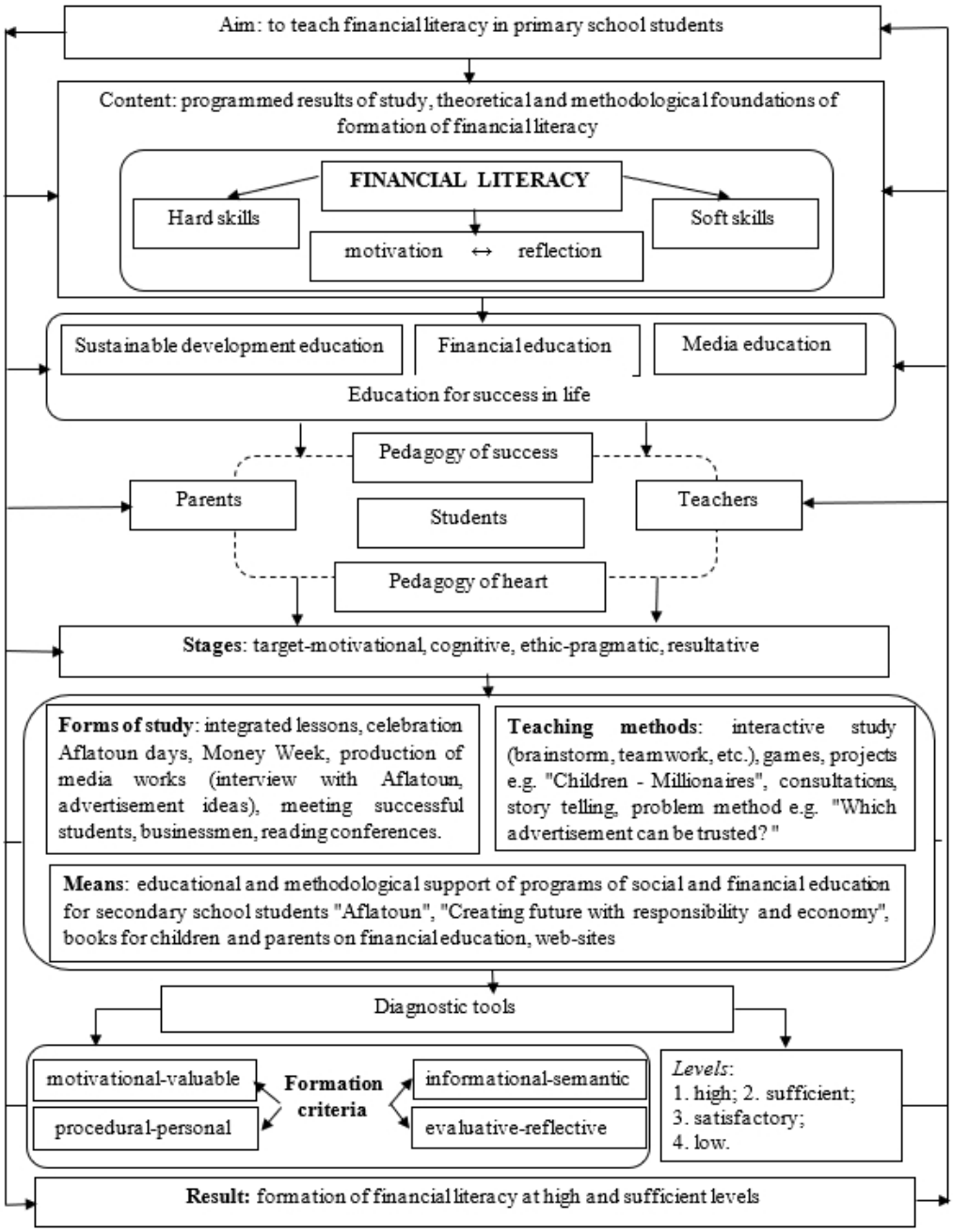

Figure 3: The model of methodology of formation of financial literacy in primary school students, 2020–2021(source: own research)

Research procedure

The experimental survey aimed at assessment of the levels of formation of financial literacy in primary school students and degree of influence of the authors' methodology on the dynamics of its indicators' change. The methods of the mathematical statistics were applied to identify the qualitative and quantitative parameters of the obtained data and to establish the differences between the results demonstrated in CG and EG.

At the main stage of the research, the experimental study has been conducted in EG with the application of the innovative methodologies. Meanwhile, the students in CG were taught in the traditional way.

At the final stage of the experiment, the conclusions were made after the survey had been conducted repeatedly in order to test the effectiveness of the applied methodology; the qualitative and quantitative analysis was made; the degree of efficiency of the teaching approaches used in formation of financial literacy in primary school children was estimated. The validity of the conclusions about the efficiency of the experimental study is proved by means of the comparative analysis of the questionnaire results obtained in CG and EG at the ascertaining stage of the research and from the second survey at the final stage.

The progress in the development of every criterion of the financial literacy formation was tracked by means of the Student's *t*-test in order to confirm the significance of the changes that took place in CG and EG. The statistics calculations were performed by means of the package of computer software of universal spreadsheet application of data processing IBM SPSS Statistics 21.

RESULTS

At the initial stage of the experiment no significant differences had been reported in the indicators of CG and EG respondents. Besides, the findings of the survey at the ascertaining stage of the research revealed that majority of pupils have satisfactory (37.5% in CG and 36.36% in EG) and low level (31.25% in CG and 33.33% in EG). A high level of formation of financial literacy had been estimated only in 6.25% in CG and 3.04% in EG.

Results of the experimental survey on the methodology of formation of financial literacy in primary school children are presented in the Table 2.

Level	Control group		Experimental group	
	initial stage	final stage	initial stage	final stage
high	6/ 6.25%	6/ 6.25%	3/ 3.04%	22/ 21.22%
sufficient	26/ 25%	30/ 28.13%	29/ 27.27%	39/ 36.36%
satisfactory	39/ 37.5%	35/ 34.38%	39/ 36.36%	32/ 30.30%
low	32/ 31.25%	32/ 31.25%	35/ 33.33%	13/ 12.12%

Table 2: Comparative analysis of the data obtained in CG and EG at the initial and final stages of survey, 2020–2021 (source: own calculations)

The research findings evidenced the significance and necessity of introduction into school environment the author's methodology, that has been incorporated in the experimental classes. The validity of conclusions on the efficiency of the theoretically substantiated methodology and the practical experiment is based on the comparative analysis of data obtained in CG and EG at the initial and final surveys.

The final stage of the experimental research has revealed the increase of high (in 18.8%) and sufficient (in 8.66%) levels of financial literacy in the EG. Besides, there has been estimated the decrease in the number of pupils with low (in 21.21%) and satisfactory levels of financial literacy. There has not been reported any significant changes in the indicators of the financial literacy formation in CG at the final stage of the experimental research.

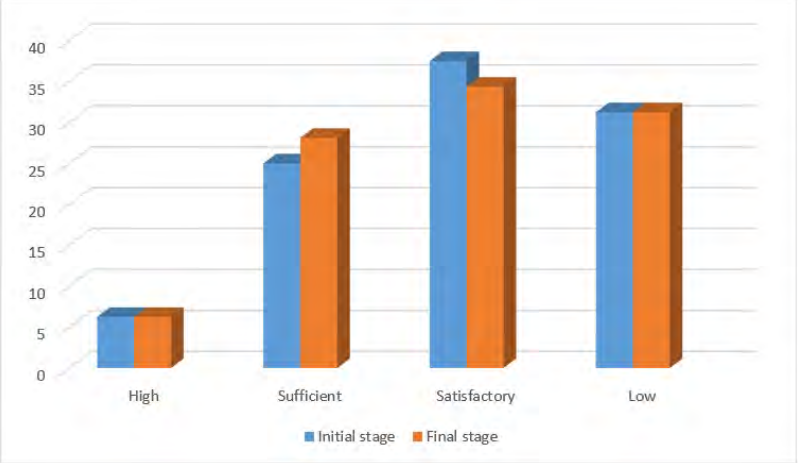

Figure 4: Comparison of the indicators of financial literacy in the control group at the initial and final stages of the experimental survey, 2020–2021(source: own research)

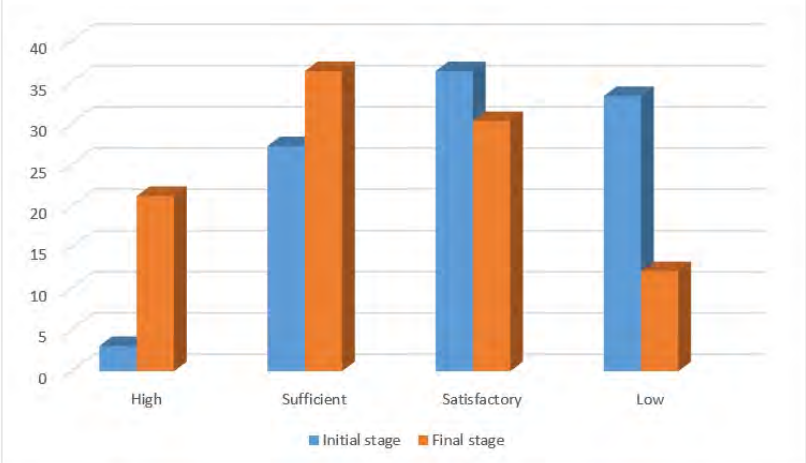

Figure 5: Comparison of the indicators of financial literacy in the experimental group at the initial and final stages of the experimental survey, 2020–2021(source: own research)

The detailed analysis of the indicators and criteria of the financial literacy formation (*motivational-valuable, informational-semantic, procedural-personal and evaluative-reflexive*) has evidenced the noteworthy differences in the EG. It has been proved with help of the indicators of the Student's *t*-test, after the experimental study in EG, as compared with CG, all the criteria underwent significant changes: *motivational-valuable* (MV) ($t = 4.373$), *informational-semantic* (INS) ($t = 8.866$), *procedural-personal* (PP) ($t = 5.603$) and *evaluative-reflexive* (ER) ($t = 9.243$). The discussed statistics data is available at the Table 3 and Table 4.

Indicators	Final stage survey	*N*	Mean	Standard deviation	Standard Error Mean
MV	CG	103	37.62	30.892	3.044
	EG	106	55.19	27.106	2.633
INS	CG	103	47.33	19.776	1.949
	EG	106	70.75	18.411	1.788
PP	CG	103	35.44	25.371	2.500
	EG	106	54.95	24.981	2.426
ER	CG	103	16.99	20.476	2.018
	EG	106	48.82	28.532	2.771

Table 3: Statistics of criteria of financial literacy formation in CG and EG after the experimental study, 2020–2021 (source: own calculations)

		Levene's test of equal variances		*t*-test for Equality of Means						
		F	Sig.	*t*	df.	Significance (2-tailed)	SD	SE M	95% confidence interval of the differences	
									lower	upper
MV	Equal variance assumed	3.059	.082	**4.373**	207	< .001	17.567	4.017	25.487	9.648
	Equal variance not assumed			4.365	201.920	< .001	17.567	4.025	25.503	9.632
INS	Equal variance assumed	.171	.680	**8.866**	207	< .001	23.425	2.642	28.633	18.216
	Equal variance not assumed			8.857	204.943	< .001	23.425	2.645	28.639	18.210
PP	Equal variance assumed	.002	.963	**5.603**	207	< .001	19.516	3.483	26.383	12.649
	Equal variance not assumed			5.602	206.594	< .001	19.516	3.484	26.384	12.648
ER	Equal variance assumed	5.793	.517	**9.243**	207	< .001	31.830	3.444	38.620	25.041
	Equal variance not assumed			9.286	190.666	< .001	31.830	3.428	38.592	25.069

Table 4: Criteria for the independent samples of CG and EG. 2020–2021 (source: own calculations)

The effectiveness of the experimental study has been evidenced by the statistical values of the indicators of the experimental group (EG) before and after the experiment. In particular, statistically significant changes have been observed for all the indicators: *motivational-valuable* ($t = 5.476$), *informational-semantic* ($t = 10.402$), *procedural-personal* ($t = 5.983$) and *evaluative-reflexive* ($t = 9.675$). Information is presented in the Table 5: and Table 6).

Thus, statistical analysis of the results of the study confirmed the reliability of the results.

Indicators	Survey in EG	*N*	Mean	Standard deviation	Standard Error Mean
MV_e	initial stage	106	33.73	29.889	2.903
	final stage	106	55.19	27.106	2.633
INS_e	initial stage	106	43.63	19.537	1.898
	final stage	106	70.75	18.411	1.788
PP_e	initial stage	106	33.96	26.092	2.534
	final stage	106	54.95	24.981	2.426
ER_e	initial stage	106	15.80	20.507	1.992
	final stage	106	48.82	28.532	2.771

Table 5: Statistics of criteria of the financial literacy formation in EG before and after the experimental study, 2020–2021 (source: own calculations)

		Levene's test of equal variances		*t*-test for Equality of Means						
		F	Sig.	*t*	df.	Significance (2-tailed)	SD	SE M	95% confidence interval of the differences	
									lower	upper
MV_e	Equal variance assumed	2.551	.112	**5.476**	210	< .001	21.462	3.919	29.188	13.736
	Equal variance not assumed			5.476	208.025	< .001	21.462	3.919	26.189	13.736
INS_e	Equal variance assumed	1.180	.279	**10.402**	210	< .001	27.123	2.607	32.263	21.983
	Equal variance not assumed			10.402	209.264	< .001	27.123	2.607	32.263	21.983
PP_e	Equal variance assumed	.089	.766	**5.983**	210	< .001	20.991	3.509	27.907	14.074
	Equal variance not assumed			5.983	209.603	< .001	20.991	3.509	27.907	14.074
ER_e	Equal variance assumed	5.833	.16	**9.675**	210	< .001	33.019	3.413	39.747	26.291
	Equal variance not assumed			9.675	190.632	< .001	33.019	3.413	39.751	26.287

Table 6: Criteria for the independent samples of EG before and after the experimental study, 2020–2021 (source: own calculations)

DISCUSSION

The procedure of improvement of the level of financial literacy in primary school students implies a long-term work with students, parents and teachers. The application of a small-scaled experimental course may not be sufficiently conducive to resolution of the problem. We believe that the introduction of a special subject "Financial Literacy" is an extensive way to implement financial education. A more effective way is to implement the methodology based on the integrated approach.

At the initial stage of the experimental work, it was found out that students were not sufficiently familiar with the term of *"financial literacy"*, despite the fact that it is one of the key competencies in primary school. The findings of our research suggested that the majority of students (almost 60%) did not use any educative media resources on financial literacy. One of the most urgent problems we came across in the course of our scientific research was pupils' low motivation for financial education, intention to participate in family budget planning. The survey reported the insufficient level of this criteria among the respondents of our investigation. At the same time, such character traits as responsibility, independence and critical thinking were named as necessary ones for a person with financial literacy.

We were interested in the fact that students owning a bank card turned out to be respondents with sufficient and satisfactory levels of financial literacy. Therefore, having a bank card does not necessarily mean having a high level of financial literacy.

During the analysis of the data from the questionnaires, there was a need for additional conversations with students, whose answers were contradictory or incomplete. For example, they wrote that they used media that contributed development of reasonable attitude to money, but they did not specify which media. Popular topic of discussions held with students was *"How to Overcome Poverty?"* However, students had a tendency to choose the variant with financial or material support, e.g. offer used clothes, and so on, as the only way to overcome poverty. Their point of view was predisposed to the idea that the rich ought to share with the poor. It raises the question of whether the level of development of a society where a child receives education influences the formation of financial literacy. Group of scientists believe that the peculiarities of the country (Grohmann et al., 2021), national culture (De Beckker, De Witte, Van Campenhout, 2020) affect the formation of financial literacy. However, such differences in the cultural features of social environment of a student are worth in-depth scientific research in order to be addressed when implementing foreign programs of financial education.

Only few participants of the research admitted that they read educative books for children on the subject of money and appropriate ways to earn, spend, save, lend or borrow. In primary school this problem is considered to have little effect on everyday life of a personality, however, in future, the particularly low interest in resources (educative literature, web-sites) on financial literacy may result in risky transactions with money, poverty as a social problem. We concluded that in the age of digital technologies, increasing (digital) financial integration and threats arising from cases of (online) financial fraud, financial education is necessary for the modern young generation. The idea is supported by findings of work by Panos and Wilson (2020), who developed the issue of financial responsibility in the financial technologies era. As an integral part of our methodology, media education addresses the challenges of digital financial integration.

The introduction of the author's approach in the experimental class helped to increase the level of all criteria of financial literacy. All the indicators increased through the integration of media education, financial education and education for sustainable development, resulting in education for success in life. The experience of integration of media education and education for sustainable development (Chaikovska et al., 2021) allows the authors of the study to view the current research as the next step in the experimental technology in the context of integration in education.

The most significant growth has been reported in the indicators

of *informational-semantic* criterion due to focus on the theoretical and practical aspects of financial literacy formation in the experimental learning. Children were explained the definition of financial literacy in regard to its role in achieving success in life. Much attention was paid the detailed study of family budget distribution, recommended ways of saving, some features of lending and borrowing. In this part, our results corroborate earlier findings of Bucciol and Veronesi (2013), Tonsing and Ghoh (2019), Lučić, Barbic and Erceg (2020), etc. proving the idea that the ability to save affects the level of financial literacy. And this is, perhaps, the most important thing for future life – to learn to manage one's financial resources. However, due to their young age and lack of experience with financial operations, primary school students need the proper guidance of parents, and recommendations of financial education teachers, e.g. savings should not limit child's needs. The ability to save should not turn into avarice. That is why the methodological basis of the experimental technology includes the partnership of parents, teachers and students on the basis of a pedagogy of heart and pedagogy of success. The previous studies have reflected positive results of such a partnership (Tereshchuk et al., 2018). We came to the conclusion that the role of parents in the formation of financial literacy is undoubtedly important, as it has been evidenced in studies by Grinstein-Weiss et al. (2011), Hanson and Olson (2018), Moreno-Herrero, Salas-Velasco and Sánchez-Campillo (2018), Coda Moscarola and Kalwij (2021), etc. It suggests a new direction of further research – to develop a methodology providing financial literacy of parents as agents of influence on their children's financial awareness.

Besides, regarding the young age of primary school students, in our study, we believe in the feasibility of the early financial education, which has also been highlighted in the works by Scheinholtz, Holden and Kalish (2011), Grohmann, Kouwenberg and Menkhoff (2015), Jayaraman, Jambunathan and Adesanya (2021), etc. The suggestion to start the educative work with children of the pre-school age to provide higher efficiency in primary school deserves the attention of scientists and methodologists.

In the course of the research, the opinion of whether the child's gender affects the level of financial literacy and the ways of its formation was left disputable. We did not notice such a pattern of behavior. And this idea coincides with the studies of Grohmann et al. (2021). At the same time, it is contradictory to the findings of Mittelstaedt and Wiepcke (2014), who noticed gender differences, also Bucher-Koenen et al. (2016), who argued in their study that males tend to be more financially literate. However, we believe that nowadays young generation is able to change the lowered expectations to female students. We agree with Migheli and Coda Moscarola (2017), who admit the need in gender-neutral programs and environment.

Besides, significant growth has been admitted in the indicators of the *evaluation-reflexive* criterion. Students were encouraged to reflect on their level of financial literacy, realizing that it affects their future financial security. The level of financial awareness affects financial behaviour: it has been proved in a number of works (Batty, Collins and Odders-White, 2015; Kalwij et al., 2019; Lusardi, 2015; Tezel, 2015 and others).

The combination of education for sustainable development with financial and media education into education for success in life is considered as a key factor in personal self-development of a primary school student. The eclectic approach contributes to reinforcement and optimisation of the educative influence of every separate element in their unity on pupils. It gives primary school students an opportunity to achieve in adult life harmony of success, happiness, and sufficient material security; as a way to keep in balance spiritual and moral values. Clearly, the development of a citizen' personality contributes to the development of a state. The findings of the research revealed the positive dynamics of the levels of financial literacy in primary school children. In the experimental groups, the number of representatives with high level of financial literacy has increased, meanwhile the number of students with low level has significantly decreased. However, it is necessary to scientifically substantiate the postulate that the level of financial literacy is not only the result of financial education but also the development of soft-skills, which are genetically determined, as well as family traditions of money management, family values.

Finally, students of the experimental class have been reported to have the tendency to donate, to link charity with success, this aspect of study relates to our effort to humanize the society of the 21-st century that is becoming increasingly pragmatic. Therefore, the formation of financial literacy is seen not only as a way to achieve the material well-being of every citizen, but also it leads to the economic prosperity of the state and the establishment of spiritual and moral values in it.

The possible limitations of the research methodology are caused with a comparatively small sample of participants (n=209), on the other hand, the whole Western region of Ukraine has been represented in the study due to the involvement of schools from three different administrative regions in the pedagogical experiment. Besides, the participants of our research are mostly city dwellers without representatives of countryside schools. However, due to the significant expansion of distance learning opportunities, these issues will be taken to account in selection of the research sample of the further explorations of financial literacy formation.

CONCLUSIONS

The formation of financial literacy is a complex, multifaceted problem; its solution requires a combination of traditional and innovative ways. One of them is the method of formation of financial literacy as an open system, which is based on education for life success (integration of media education, financial education and education for sustainable development); pedagogy of success and pedagogy of heart. The key components of the developed methodology include *aim*, *content components* (structure of financial literacy, theoretical and methodological principles of its formation, the effects of educational programs); *algorithm* of arranged activity of students, parents and teachers on the basis of partnership pedagogy*; procedural components* (e.g. integrated lessons, celebrations of Aflatoun days, Money Week, production of media works, interviews with Aflatoun, advertising products, meetings with successful pupils, students, entrepreneurs,

reading conferences), *methods* (interactive learning, brainstorm, work in groups, games, projects, conversations, story-telling, problem method, e.g. "Which advertisement can be trusted?"), *means of formation* of financial competencies (educational and methodological support of programs on socio-financial education and upbringing for students of secondary schools "Creating future with responsibly and economy", "Aflatoun", books for children and parents on financial education, websites), *diagnostic tools* (criteria and levels) of formation of financial literacy and the expected *result*.

The main findings of the experimental methodology demonstrate a significant increase in the number of the primary school students with the high level of financial literacy – from 3.03% to 21.22% in the EG. Respondents with low level of formation of financial literacy demonstrated positive dynamics in the growth of their indicators after the experimental study: their proportion dropped from 33.33% to 12.12%. The percentage of representatives with the sufficient level of financial literacy formation has increased: from 27.27% to 36.36%.

The prospects for further research imply the identification of cultural features and gender differences in the formation of financial competencies; development of the methodology to provide financial literacy of parents as agents of influence on their children's financial awareness; efficiency of forms and methods of education for success in life.

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Full research paper

CZECH PRESCHOOL TEACHERS' CONTRASTING BELIEFS ABOUT INQUIRY-BASED ACTIVITIES

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ABSTRACT

Using a self-reporting measure, the study examined IBA-related beliefs of Czech preschool teachers (n = 1,004). In addition, it explored the beliefs of teachers who strongly agreed (n = 564) and those who strongly disagreed (n = 67) with the implementation of IBA in preschool classes. The findings show that teachers within the full sample, as well as those within the contrasting subsamples, hold considerably strong beliefs about the potential of IBA for children´s cognitive development. At the same time, teachers are aware of the challenges associated with implementing IBA. Teachers who strongly favour IBA have significantly stronger beliefs in the benefits that IBA bring to children and also have stronger beliefs about the knowledge and skills teachers need for IBA planning and implementation than has the group that strongly rejects IBA. In contrast, teachers who strongly reject IBA have stronger beliefs that IBA cause problems in preschool classes. The group of teachers who strongly favour IBA have higher levels of education and fewer years of practice than the contrasting group. They are mostly younger teachers who received a modern professional education and who are more open to newer instructional strategies such as IBA.

KEYWORDS

Inquiry-based activities, preschool, teachers' beliefs

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Highlights

- *The study describes inquiry-based activities (IBA) as a means to engage children to motivate and learn.*
- *Preschool teachers hold considerably strong beliefs about the positive potentials of IBA for children's cognitive development.*
- *However, some teachers strongly oppose introduction of IBA in preschools and believe less favourably about IBA benefits for children.*
- *They also rate their IBA-related competence lower than teachers who strongly favour introduction of IBA in preschool classes.*

INTRODUCTION

Science teaching in early childhood classes is an important educational domain because it lays the foundations for science achievement in later grades. However, in spite of its importance, it is less researched compared to that of science education in primary and secondary schools (Greenfield et al., 2009; Leuchter, Saalbach and Hardy, 2014). Even less frequent is a line of research focusing on what beliefs preschool teachers hold about the developmental potentials of science education mediated through inquiry-based activities (IBA). This knowledge deficiency prevents teacher educators from employing efficient approaches towards preparing preservice teachers as well as influencing in-service professionals to adopt modern instructional strategies such as IBA in preschool classes.

IBA are generally accepted as a prominent way to draw pupils into the culture of science. By participating in IBA, pupils are enculturated in scientific practices and traditions and learn to appreciate scientific values (Abrams et al., 2008; Cobern and Aikenhead, 1997; Lee, 2003). IBA are a pathway for pupils to understand science concepts and develop scientific reasoning. Though in preschool classes such high aims cannot be achieved, teachers can implement inquiry to develop children's attitudes toward science by activities based on observation and object manipulation, thus drawing on children's natural curiosity, imagination and enthusiasm

to learn about the world around them (Eshach and Fried, 2005; Howitt, Morris and Colvill, 2007; Watters et al., 2000). The challenge for preschool teachers is to fuel this curiosity and enthusiasm through the provision of appropriate learning experiences and an engaging preschool classroom environment. By implementing inquiry in preschool, teachers lay the foundations of children's abilities and skills needed for teaching science in higher schooling levels (Chesloff, 2013; Merino et al., 2014; Morrison, 2012; Tao Oliver and Venville, 2012).

Even though many studies describe the implementation of IBA in preschool classrooms (Edson, 2013; Edwards and Loveridge, 2011; Hamlin and Wisneski, 2012; Smith and Trundle, 2014), there is little knowledge of how teachers' beliefs influenced adoption of these activities. Identifying and understanding such beliefs, and the teacher characteristics with which they are associated, enable a fuller understanding of the preschool teacher as a professional. The implementation of IBA is challenging for teachers because they must draw on a sizeable repertoire of practices and combinations thereof. What remains undetermined are the levels of IBA teacher acceptance in the preschool context and the IBA-associated beliefs of preschool teachers.

This study offers two research perspectives on preschool teachers' IBA beliefs. The first perspective considers teachers to be a population with rather homogenous levels of beliefs, attitudes, knowledge and skills. Such a perspective enables an appropriate generalisation of research findings for the entire teacher population. We adopted this perspective in an analysis of the IBA-related beliefs of a large sample of Czech preschool teachers and inspected their demographic characteristics associated with their beliefs, these being gender, level of education and years of practice. The subsequent findings served as comparison data for later analyses.

The other research perspective considers teachers as a heterogenous population because they studied in diverse teacher-training institutions and work under varied conditions, and their beliefs were influenced by specific professional, social and cultural conditions; consequently, they have diverse belief profiles (Park et al., 2017; Jamil, Linder and Stegelin, 2018; Rubie-Davies, Flint and McDonald, 2012). Therefore, in addition to exploring the IBA-related beliefs of a full teacher sample, we examined beliefs and belief-related characteristics of two subsamples extracted from the whole: teachers who strongly favour and teachers who strongly reject the implementation of IBA in preschool classes. Besides their IBA-related belief profiles, we examined their demographic characteristics. This research strategy was motivated by the assumption that analysing the beliefs of contrasting teacher subsamples would provide more elaborate insights into teachers' IBA-related beliefs than an examination of the full sample.

The text has the following structure. First, we explain the context of the Czech preschool. Then we introduce the theoretical concepts of IBA and teacher beliefs. In the research section, we present the research aims, teacher samples and the research instrument used. The results section reports about the IBA-related beliefs of the full teacher sample and two subsamples. The final sections of the study deal with discussion and implications.

The Czech Preschool Context

In the Czech Republic, preschool offers an education programme to children from two to six years of age. Most of the children attend a full-day programme. Under the current legislation, preschool attendance is obligatory for children in the pre-primary year, i.e., children who are 5 years old. Preschool education is based on a personalistic theory and is focused on developing a child into a holistic person. Under the Education Act, the preschool programme promotes the development of a child's personality, contributes to their emotional and physical development, supports personal satisfaction and well-being, and teaches the child to understand societal norms and values. The preschool curriculum is divided into five content areas: the child and their body, the child and their mind, the child and others, the child and society, the child and the world (Ministry of Education, Youth and Sports, 2018). To follow an integrative educational approach, which is the core idea of the didactic model in Czech preschools, these areas are interconnected. It is a strongly held belief that pre-primary education creates foundational prerequisites for children's continued learning. In the upper years of preschool, increased importance is placed on supporting the knowledge and skills required for the successful transition to primary education. Thus, preschool teachers pave the way for children's success in their first years of primary school.

Preschool teachers plan and organise children's activities with varying teacher involvement. They provide guidance, support and scaffolding to children's learning, but they also enable children-choice play. Teachers employ a range of educational strategies, in both large and small group instruction. Preschools provide a variety of materials and resources for children to manipulate and use, both in learning and play activities. The preschool physical environment is usually segmented into circles or corners to enable learning in a specific domain, e.g., science, pre-literacy, visual arts or music. Instructional activities are managed by teachers, with emphasis on the needs of individual children.

Basic inquiry activities, such as observation, measurement or sorting, are typically used in the content area of the child and the world. The goal of this area is acquiring the knowledge and skills needed to learn about the surroundings and creating a responsible attitude towards the environment. Activities such as interpreting phenomena, identifying variables, or experimenting are less common in Czech preschool classrooms. Many teachers describe, clarify or explain phenomena rather than let children actively engage in their explorations.

The basic preschool teacher qualification requirement is the completion of pedagogical vocational schooling. Such schooling provides the professional theories and skills necessary to perform the responsibilities of a preschool teacher, including planning and organising activities, adjusting them to children's needs, and efficiently communicating with parents and the community. A growing number of teachers in the Czech Republic have successfully completed bachelor's or master's programmes in preschool education, which provide broader theoretical foundations than vocational schools in pedagogy, psychology and sociology, in addition to the provision of teaching practice.

Inquiry-Based Activities

Inquiry-based activities are educational practices that aim to stimulate children's curiosity about the world around them and provide opportunities for active learning (Eshach and Fried, 2005; Hollingsworth and Vandermaas-Peeler, 2017). IBA are an array of classroom practices that promote pupils' learning through guided and, increasingly, independent investigations of questions and problems, often for which there is no single answer (Lee et al. 2004). IBA are intentional educational practices during which pupils verbalise a problem, assess, plan and experiment. Subsequently, they draw conclusions and thus expand their knowledge (Stuchlíková, 2010). If organised efficiently, IBA bring valuable learning benefits. Children can develop cognitive skills like observing, investigating, questioning, predicting, planning and recording the obtained evidence. They learn to understand concepts and processes at a developmentally appropriate level and develop a favourable attitude towards science and scientific inquiry (Bell et al., 2010; Dostál, 2015; Osborne and Dillon, 2008; Hubáčková et al., 2014; Minner, Levy and Century, 2010; Pavlovičová, 2012). The focus of IBA is that children make sense of the phenomena they explore and with which they work (Crawford, 2007).

IBA are based on the educational principle that learning is most effective when children are active participants in the learning process when the learning proceeds from experiences to explanations, and when teachers are well prepared to support children in the learning process (Anderson, 2002; Hackling, 2007). The teacher's focus in class is more on facilitation and monitoring the children's learning rather than on stringent structural managing of children's actions. Instead of supplying children with new knowledge, teachers trigger children's interests so that they might self-discover knowledge.

Though IBA can be used in all educational domains, they are most frequently favoured in teaching science and in learning about physical phenomena (Bell et al., 2010; Crawford, 2007; Dostál, 2015; Minner, Levy and Century, 2010; Osborne and Dillon, 2008). Researchers suggest that science education should begin in early childhood (Eshach and Fried, 2005; Watters et al., 2000), so as to build foundations for children's interest in science (Aldemir and Kermani, 2014) and to provide scientific literacy (Osborne and Dillon, 2008). Science is apt for early learning because it involves hands-on activities, using resources and instruments like lenses, scales or magnets to explore the physical world. If IBA are implemented effectively, they facilitate the developing of children's problem-solving, communication and collaborative skills and foster children's self-confidence and independence. However, there are obstacles that prevent teachers using IBA in preschool classrooms or prevent using them adequately. A major difficulty in adopting IBA in preschool teaching, which has been of concern for decades, is that many teachers either lack confidence or have weak beliefs concerning IBA (Byrne, Rietdijk and Cheek, 2016; Murphy, Neil and Beggs, 2007).

Beliefs

Beliefs are psychologically-held understandings, premises, or propositions about the world that are felt to be true (Richardson, 1996) and are a component of a person's self-regulatory system. In the educational area, teachers' beliefs are reflected in their interaction with the school, pupils, and colleagues (Stuchlíková, 2003; Woolfolk Hoy, Hoy and Davis, 2009; Vítečková, 2018). They regulate teachers' thinking, motivation, and behaviour as well as mediate their skill development and teaching (Pajares, 1992). Teachers' beliefs are frequently described as "filters" that guide the perception and interpretation of classroom situations (Fives and Buehl, 2012) and through which new knowledge and experiences are interpreted (Handal and Herrington, 2003). Teachers' beliefs are also related to their attitude to teaching, goal orientation, wellbeing or burnout (Natovová and Chýlová, 2014; Yildizli, 2019).

Teacher beliefs influence teaching in a variety of complex ways. First, they function as a foundation for classroom decision-making. The decisions teachers make in planning and organising classroom environments, interactions with children, and decisions about classroom practices are, in part, based on their beliefs (Vartuli, 2005). Teachers' instructional decisions, in turn, influence learning opportunities provided to children (Rubie-Davies, Flint and McDonald, 2012). Teachers' beliefs about the nature of education influence their teaching through content selection, teaching style, and the type of learning opportunities provided to pupils. Thus, exploring teachers' beliefs is an important research aim because they help us understand their practices (Maggioni and Parkinson, 2008; Richardson, 2003; Smith and Croom, 2000).

Beliefs must be distinguished from knowledge. Beliefs are more experience-based, while pedagogical knowledge is more theory-based (Mansour, 2009). However, the teacher must possess pedagogical knowledge – in addition to classroom experience – in order to generate professional beliefs. Beliefs are situated, while knowledge is more abstract. Beliefs are more evaluative and affective than knowledge. The relationship between teacher beliefs and teacher pedagogical knowledge is interactive; they affect each other. Managing the demands of the teacher profession requires both specific knowledge and skills, and beliefs in their own abilities to be resilient and persistent in the face of teaching challenges.

Teachers' beliefs are of utmost importance in teachers' practices. Beliefs affect the way and extent the teacher addresses the demands of the teaching process (Pajares, 1992; Richardson, 2003; Woolfolk Hoy, Hoy and Davis, 2009). Teachers with strong beliefs have a firm intention to engage their proficiency to attain educational goals that are prescribed by the curriculum. This study examines Czech teacher beliefs about implementing IBA in preschool classrooms. By using a valid self-rating instrument, it explores how strong preschool teachers' beliefs are about their potential to plan and implement IBA, what benefits they think IBA bring to children and to themselves, but also how they view the problems and obstacles that arise during the implementation of IBA. Uncovering how strong preschool teachers' beliefs are in IBA and with which teaching factors IBA is associated will expand the understanding of this important teacher characteristic.

RESEARCH AIMS

The study aimed to examine IBA-related beliefs of a sample of preschool teachers in the Czech Republic in three belief

components, which are described in the methods section. In addition, the aim was to examine two teacher subsamples: those who strongly agreed and those who strongly disagreed with the implementation of IBA in preschool classes. Though many Czech preschool teachers endorse IBA and enthusiastically use them in classes, some reject the idea of implementing such activities with preschool age children and are reluctant to carry them out. Exploring contrasting groups of teachers was intended to increase insight into the teachers' IBA-related beliefs. Because teacher beliefs have been shown to be associated with teacher characteristics, we also explored the relationships between teacher IBA-related beliefs and teacher demographics. The study asks these questions:

1. What is the beliefs level of teachers in the full sample about planning and implementing IBA in preschool classes?
2. How is this level associated with teachers' demographic characteristics?
3. What is the beliefs profile of teachers who either strongly favour or strongly reject IBA implementation in preschool classrooms?
4. Which demographic characteristics distinguish these teachers?

Two hypotheses were stated that relate to research questions 1 and 2.

H1: There are no statistically significant differences among the three components of teachers' IBA-related belief ratings.

H2: There are no statistically significant differences in IBA-related belief ratings between the teachers who strongly agreed and those who strongly disagreed with the implementation of IBA in preschool classes.

SAMPLES

Full Sample

A total of 1,004 preschool teachers from all fourteen regions of the Czech Republic participated in the study. The sample represents 3.2% of all teachers that actively taught in Czech preschools in 2020 (Ministry of Education, Youth and Sports, 2021). The teachers were addressed at their particular preschools, told of the purpose of the study, and informed about privacy protection through answer anonymisation. The gender composition of the sample is heavily disbalanced - 980 teachers (97.8%) are female[1]. Teachers provided information on their highest attained level of professional education. The majority of teachers (67%) completed pedagogical vocational schools, 21% earned a bachelor's degree, and 12% had master's degrees in preschool education. The average number of years of teaching experience within the sample was 17.6 (SD = 13.1), with a range of 0 to 46 years. The teachers taught in preschools in both rural and urban areas of the Czech Republic, in locality sizes ranging from 500 to 100,000+ inhabitants. Though the sample is not technically representative, it well reflects the demographics of Czech preschool teachers and thus is satisfactory for exploratory purposes.

Subsamples

Two subsamples were extracted from the full sample: teachers who strongly agreed or teachers who strongly disagreed with the implementation of IBA in preschools. The selection criterium was their response on the questionnaire statement "IBA *do* belong in preschool". Thus, two contrasting teacher groups were constituted, the "pro-IBA group" of 564 teachers (56.2% of the total sample) and the "anti-IBA group" of 67 teachers (6.7% of the total sample). The demographic characteristics of both groups are displayed in Table 1.

		pro-IBA group	anti-IBA group
Gender	Female	514 (96.8%)	67 (100%)
	Male	17 (3.1%)	0
Education	Vocational	332 (63.1%)	52 (77.6%)
	Bc.	119 (22.6%)	13 (19.4%)
	Mgr.	75 (14.3%)	2 (3.0%)
Years of experience	0–3	106 (19.7%)	5 (7.6%)
	4–10	130 (24.1%)	14 (21.2%)
	11–30	189 (35.1%)	33 (50.0%)
	31–46	114 (21.2%)	14 (21.2%)

Note: pro-IBA = teachers who strongly agreed with using IBA in preschool; anti-IBA = teachers who strongly disagreed with using IBA in preschool.

Table 1: The demography of teachers who strongly agreed or disagreed with using IBA in preschool

METHODS

The teachers filled in the Czech version of *Preschool Teachers' IBA-related Beliefs Questionnaire* (DPBA, initials for the Czech title *Dotazník přesvědčení o badatelských aktivitách v mateřské* škole). Because the researchers were not sure if all teachers were aware what inquiry is and what is not, the first section the questionnaire provided two examples:

The teacher shows children two transparent glasses with daffodils. One has a white daffodil and the other a blue daffodil. The teacher tells the children, "I poured ink into a glass of blue daffodil. This is what happened." THIS IS NOT INQUIRY!

The teacher starts conversation with children about what the plant needs so that it does not wither. Children pour water into the glass.… One child notices a flask with ink on the table and asks, "What will happen after we pour ink in the glass?" The teacher says, "Let's explore it", and she pours ink in the glass. Children observe what is happening. After a while, the narcissus turns blue. Children discuss why this happened. THIS IS inquiry!

1 The gender proportion roughly corresponds to the Czech preschools census of 2021, in which 98,7% teachers are female (Ministry of Education, Youth and Sports, 2021).

The questionnaire consists of 22 items distributed into three components: Benefits, Teacher Concerns and Teacher Competence. The Benefits component includes items describing the teacher's beliefs about the child's learning outcomes due to IBA, and also about the satisfaction and enjoyment these activities bring to the teacher (12 items). The Teacher Concerns component includes items that express beliefs about the difficulties or complications awaiting the teacher when using IBA in classes (4 items). The Teacher Competence component contains items related to the teacher's belief in what professional knowledge and skills are needed for these activities (6 items). Teachers responded on a scale ranging from *strongly disagree* (1) to *strongly agree* (5). Higher values equate to stronger beliefs. Examples of items include the following:

- IBA foster the child's observation skills.
- The performance of IBA by children brings joy and satisfaction to the teacher.
- IBA take more time than traditional activities.
- The teacher has knowledge about how to explain doing experiments to children.

The questionnaire development and validation are described in the study of (Gavora and Wiegerová, 2019). Here we present only a short description.

The three questionnaire components have reliability as follows: Benefits 0.904; Teacher Concerns 0.733; Teacher Competence 0.847 (McDonald's omega). The slightly lower reliability coefficient for the Teacher Concerns component reflects the small number of items (only 4). The reliability of the entire questionnaire is 0.875. The three factors explain 47.7% of the common variance. A confirmatory factor analysis with a model of three "latent" factors, i.e., Benefits, Teacher Concerns and Teacher Competence, provided satisfactory indices: RMR = 0.079; AGFI = 0.922; CFI = 0.937; TLI = 0.962 and RMSEA = 0.054.[2] The wording of items, the item means and the standard deviations of the questionnaire components are presented in Table 2.[3] In addition to filling in the belief items, teachers provided information about gender, highest education completed, years of experience and the size of the locality of their preschool.

RESULTS

Results are presented in two parts. In the first part, descriptive statistics are provided about the IBA-related beliefs of the full teacher sample. These beliefs are further associated with teacher demographic characteristics. In the second part, descriptive statistics are provided about the two teacher subsamples as described above, and again, their IBA belief scores are related to their demographics.

IBA-Related Beliefs of the Full Teacher Sample

Table 2 shows the descriptive statistics of teachers' beliefs in the three belief components. The average score on the Benefits component is much above the midpoint of the five-point scale used (M = 4.05, SD = 0.67), signifying that teachers seem to be comfortable using IBA to support children's learning. They strongly believe that IBA support children's cognitive learning, developing specific knowledge, observation skills, comprehension, language and communication ability as well as their relationship to science. Teachers also understand the personal benefits, like joy, satisfaction and self-confidence that IBA implementation bring to them. Moreover, teachers rated high the belief that IBA are a way of preparing preschool children for primary school science. The lowest scores were earned by the item stating that IBA are the best way to educate children, probably because of the general nature of the item.

The Teacher Concerns component results indicate that teachers seem to feel discomfort with using IBA in their classes. The component's average score is above the midpoint of the scale used (M = 3.72, SD = 0.79), as are the averages of all the items, indicating teachers are uncomfortable when implementing IBA. Teachers demonstrated significant concerns about planning and organising IBA, the increased teaching time required for IBA, and about the classroom disorder IBA cause.

The Teacher Competence component describes teachers' beliefs about the knowledge and skills necessary for planning and organising IBA. Also, this component produced averages above the scale midpoint (M = 3.50, SD = 0.81). Three highly rated items specifically relate to doing experiments with children, an activity that is the core feature of science learning. These items concern explaining principles of experiments to children, organising experiments, and finding resources that support planning in-class experiments. Other items refer to knowledge about organising IBA and about children's learning through IBA. The component included an item related to teacher feelings about classroom disorder when performing IBA, which was rated the lowest.

To compare the relative strength of beliefs in the three IBA belief components, we submitted each component pair to a Wilcoxon rank test. The results show that teachers rated beliefs in the Benefit component significantly higher than those in the Concerns component (Z = -10.356, $p < 0.001$) and higher than in the Teacher Competence component (Z = -18.840, $p < 0.001$). They also rated beliefs in the Concerns component higher than those in the Teacher Competence component (Z = -4.804; $p < 0.001$). Thus, the H1 stating that there are no statistically significant differences among the three components of teachers' IBA-related belief ratings was rejected. The ratings of the three belief components show a distinct pattern. The Benefit component was rated the highest, followed by the Concerns component and then by the Teacher Competence component.

Table 3 presents IBA-related belief scores by gender.

2 RMR = root mean square residual; AGFI = adjusted goodness of fit; CFI = comparative fit index; TLI = Tucker Lewis index; RMSEA = root mean square error approximation.

3 The Czech version of the DPBA will be provided on request.

	Questionnaire components and component items	M	SD	Omega
Item	**Benefits**	4.05	0.67	0.904
24	IBA foster the child's thinking.	4.36	0.87	
27	IBA make children familiar with science phenomena.	4.26	0.85	
5	IBA foster the child's relationship to science.	4.25	0.96	
18	IBA foster the child's observation skills.	4.25	0.90	
34	IBA help children comprehend physical phenomena.	4.15	0.95	
9	Hands-on activities are the best way of learning.	4.15	0.95	
3	IBA (e.g., with life materials) foster the child's language and communication skills.	4.10	0.96	
6	Doing IBA by children brings joy and satisfaction to the teacher.	4.08	0.94	
12	IBA is a way of preparing preschool children for science in primary grades.	4.01	1.00	
16	Successful IBA implementation increases the teacher's self-confidence	3.78	0.98	
21	IBA are an efficient way to engage inattentive children.	3.75	1.01	
17	IBA is the best way to educate children.	3.49	1.00	
	Teacher Concerns	3.79	0.79	0.733
28	Implementing IBA is more difficult than organizing traditional activities.	4.00	1.02	
4	IBA take more time than traditional activities.	3.91	1.07	
7	Preparation for IBA is demanding for the teacher.	3.63	1.10	
20	IBA make a mess in class.	3.34	1.08	
	Teacher Competence	3.50	0.81	0.847
22	The teacher has knowledge about how to explain doing experiments to children.	3.76	1.03	
26	The teacher can manage organizing children in experiments.	3.62	1.00	
30	The teacher has adequate professional knowledge for organizing IBA.	3.49	1.09	
32	The teacher can easily find ideas for planning experiments in resources.	3.49	1.09	
10	The teacher has sufficient knowledge about inquiry-based learning.	3.49	1.08	
31	The teacher does not worry about seeming disorder in class during IBA.	3.18	1.13	

Note: N = 1,004 preschool teachers. IBA = inquiry-based activities. Beliefs scale ranges from strongly disagree (1) to strongly agree (5); Omega = McDonald's reliability coefficients. Items translated from Czech.

Table 2: DPBA components with means, standard deviations and McDonald's reliability coefficients

The Kruskal-Wallis H test demonstrates a statistically significant difference in IBA-related beliefs between female and male teachers only in the Teacher Concerns component ($H(2) = 5.21$, $df = 1$, $p = 0.02$). Female teachers gave somewhat higher ratings than male teachers to benefits that IBA bring to children as well as to the teacher. They also rated higher problems accompanying planning and implementing IBA in preschool classes. However, the result is arbitrary because of the small number of male teachers in the sample.

	Benefits		Teacher Concerns		Teacher Competences	
Teacher gender	Female	Male	Female	Male	Female	Male
n	980	24	980	24	980	24
M	4.05	3.87	3.73	3.39	3.50	3.48
Md	4.17	3.92	3.75	3.50	3.67	3.67
SD	0.66	0.84	0.79	0.72	0.81	0.79
Min	1	1.08	1	2.25	1	1.33
Max	5	4.92	5	4.75	5	5

Note: Beliefs scale range from strongly disagree (1) to strongly agree (5)

Table 3: Descriptive statistics of the three IBA-related belief components by gender

Because we assumed that level of education might influence teachers' views of IBA, and consequently their IBA-related beliefs, we computed the belief scores in each of the three teacher education levels: vocational school, bachelor's degree and master's degree. Table 4 presents the descriptive data. The education level groups exhibited similar patterns of IBA-related belief scores as the full sample. In each of the education level groups, the highest average score went to the Benefit component, followed by the Teacher Concern component and then the Teacher Competence component. The differences in

IBA-related belief ratings among education levels in the Benefit component, as computed by the Kruskal-Wallis test, are small and are nonsignificant (H(3) = 5.61, df = 2, p = 0.06). Similarly, there were non-significant differences among education levels in the Teacher Concerns component (H(3) = 3.51, df = 2, p = 0.22) and among education levels in the Teacher Concerns component (H(3) = 4.62, df = 2, p = 0.10).

	Benefits			Teacher Concerns			Teacher Competence		
Education	Vocational	Bc	Mgr	Vocational	Bc	Mgr	Vocational	Bc	Mgr
n	645	198	114	645	198	114	645	198	114
M	4.03	4.02	4.13	3.76	3.73	3.53	3.52	3.38	3.60
Md	4.08	4.17	4.29	3.75	3.75	3.75	3.67	3.50	3.50
SD	0.65	0.72	0.74	0.75	0.80	0.93	0.79	0.89	0.81
Min	1.08	1	1.33	1	1.5	1	1	1	1.5
Max	5	5	5	5	5	5	5	5	5

Note: The beliefs scale ranges from strongly disagree (1) to strongly agree (5).

Table 4: Descriptive statistics of the three IBA-related belief components by teachers' education levels

Further, we examined how teachers' IBA-related beliefs are associated with years of teaching experience. Experience was divided into four categories: 0–3 years, 4–10 years, 11–30 years and 31–46 years. Descriptive statistics are presented in Table 5. The Kruskal-Wallis H test shows that there is a statistically significant difference in IBA-related beliefs between the experience categories in the Teacher Concerns component (H(4) = 49.5, df = 3, p < 0.001). The Bonferroni post hoc test shows a significant difference between the shortest experience (0–3 years) and 11–30 years of experience, as well as between 4–10 years of experience and 11–30 and 31–46 years of experience, respectively. Thus, teachers with less experience see fewer problems with planning and implementing IBA in preschool classes, or they do not worry about these problems. Furthermore, there was a statistically significant difference among teacher experience in the Teacher Competence component (H(4) = 13.74, df = 3, p < 0.001). The Bonferroni post hoc test shows a significant difference between the two longest experiences. Teachers who taught for more than 31 years showed higher beliefs on Teacher Competence than teachers with experiences between 11 and 30 years.

	Benefits				Teacher Concerns				Teacher Competence			
Years of experience	1–3	4–10	11–30	31–46	1–3	4–10	11–30	31–46	1–3	4–10	11–30	31–46
n	173	231	342	225	173	231	342	225	173	231	342	225
M	4.12	3.96	4.06	4.05	3.49	3.53	3.84	3.93	3.54	3.49	3.39	3.64
Md	4.08	4.00	4.25	4.08	3.50	3.50	4.0	4.0	3.50	3.50	3.58	3.67
SD	0.55	0.73	0.70	0.61	0.82	0.81	0.76	0.70	0.74	0.72	0.88	0.83
Min	1.83	1	1.08	1.83	1	1	1	1	1	1.50	1	1
Max	5	5	5	5	5	5	5	5	5	5	5	5

Note: The beliefs scale ranges from strongly disagree (1) to strongly agree (5).

Table 5: Descriptive statistics of the three IBA-related beliefs components by years of teacher experience.

Teachers who Strongly Favour or Strongly Reject IBA

The previous analyses produced data on the IBA-related beliefs of the full teacher sample. However, because we wanted to achieve a more structured picture of teachers' beliefs, in the further analyses, we concentrated on the contrasting teacher groups that were extracted from the full sample, i.e., the pro-IBA group and the anti-IBA group.

The scores of both groups on the three belief components are presented in Table 6. Results show that the two groups' scores on belief components varied. As the Kruskal-Wallis test confirmed, the pro-IBA group scored significantly higher than the anti-IBA group on the Benefits component (H(2) = 111.49; df = 1; p < 0.001) and also on the Teacher Competence component (H(2) = 12.98; df = 1; p < 0.001). Contrarily, the anti-IBA group scored significantly higher than the pro-IBA group on the Teacher Concerns component (H(2) = 12.32; df = 1; p < 0.001), thus expecting more problems and difficulties in planning and carrying out IBA in preschool classes than the other group. It can therefore be concluded that the two teacher subsamples are strongly differentiated in all three belief component ratings. Therefore, H2 stating that there are no statistically significant differences in IBA-related belief ratings between the teachers who strongly agreed and those who strongly disagreed with the implementation of IBA in preschool classes was rejected on Teacher Competence and Teacher Benefit scores, but it was failed to reject on Teacher Concerns scores.

More detailed information about the two contrasting groups was obtained by comparing their demographic characteristics. Table 1 presents the comparison data. The gender distribution between the two teacher groups was strongly imbalanced: 514 females and 17 males in the pro-IBA group and no males in the anti-IBA group. This imbalance reflects the typical disproportion of teacher genders in Czech preschools. As concerns the education level, the pro-IBA group has a somewhat

	pro-IBA group						anti-IBA group					
Belief Components	***n***	***M***	***Md***	***SD***	***Min.***	***Max.***	***n***	***M***	***Md***	***SD***	***Min.***	***Max.***
Benefits	564	4.36	4.42	0.44	2.67	5.00	67	3.19	3.42	0.88	1.00	4.67
Teacher Concerns	564	3.61	3.63	0.82	1.00	5.00	67	3.95	4.00	0.87	1.50	5.00
Teacher Competence	564	3.66	3.67	0.76	1.00	5.00	67	3.11	3.50	1.11	1.17	5.00

Note: pro-IBA = teachers who strongly agree with using IBA in preschool; anti-IBA = teachers who strongly disagree with using IBA in preschool. The Beliefs scale ranges from strongly disagree (1) to strongly agree (5).

Table 6: Beliefs of teachers who strongly agreed or disagreed with using IBA in preschool

higher proportion of teachers with a bachelor's degree (22.6%) than the anti-IBA group (19.4%), as well as a higher proportion of teachers holding master's degrees (14.3% compared with 3%). A Chi-squared test shows that the difference in education levels between the two groups of teachers is statistically significant: χ^2 (2, N = 598) = 8.02, p = 0.018. Thus, it may be concluded that it is the level of education that differentiates teachers who favour or reject IBA in preschool.

With regard to teaching experience, the pro-IBA group considerably differs from the anti-IBA group in two practice categories. This group has a larger proportion of teachers with shorter teaching experience (0-10 years) than the opposite group, and a smaller proportion of those with 11-30 years of teaching experience (Table 1). A Chi-squared test confirmed that the years of teaching experience is a factor that differentiates the pro-IBA group from the anti-IBA group of teachers in this sample (χ^2 (3, N = 605) = 8,47, p = 0.037).

DISCUSSION

Findings about the Full Sample of Teachers

The present study expands the current understanding of teachers' implementation of IBA in preschool classes by examining three belief components: Benefits, Teacher Concerns and Teacher Competence. Teachers rated highest their beliefs in benefits that IBA bring. They are convinced that IBA provide appropriate opportunities to support science learning by stimulating children's cognitive abilities and developing favourable attitudes towards science. They also believe that IBA engage non-attentive children through hands-on tasks. If preschool teachers believe that IBA are a stimulating tool for children's development, they are inclined to implement instructional activities of higher quality and of a larger amount (Kluczniok, Anders, and Ebert, 2011). In contrast to other studies on teacher beliefs about science in early childhood education (Maier, Greenfeld and Bulotsky-Shearer, 2013; Pendergast, Lieberman-Beltz and Vail, 2017), in this study the benefits component also included IBA-related benefits to *teachers.* Teachers noted personal benefits they acquire when using IBA, such as enjoyment, satisfaction and increase in self-confidence.

The Teacher Concerns component had the second highest beliefs scores, which reflect the problems teachers incur when planning IBA, employing the activities or managing the class. They also worry about the "mess" the children make when they experiment with objects and substances. This study supports the evidence that though doing science with children brings teachers enjoyment, many of them perceive associated difficulties or threats (Banko et al., 2013; Cho, Kim and Choi, 2003; Maier Greenfeld and Bulotsky-Shearer, 2013; Pendergast Lieberman-Beltz and Vail, 2017). Research documents tensions teachers must negotiate between existing beliefs and difficulties they encounter in their science teaching (e.g., Capps and Crawford, 2013; Crawford, 2000; Crawford, 2007).

Though Benefits and Teacher Concerns embody contrasting beliefs, they well represent the intricacy of teachers' believing and thinking. The relatively high scores on these opposite components indicate the disparate character of teachers' beliefs about IBA. However, contrasting beliefs do not refute the theory that teacher beliefs constitute a system (Kagan, 1992; Mansour, 2009; Schommer-Aikins, 2004). Rather, they demonstrate the dialectical unity of the polarised attributes that are integrated within a person's belief system.

Teacher Competence scores were somewhat lower than on the other two components but are above the midpoint of the scale, indicating teachers in this sample are quite confident that knowledge and skills are needed for planning and conducting IBA in preschool classes.

Two demographic characteristics were associated with IBA-related beliefs. Regarding the education levels, the differences in IBA-related beliefs are small and insignificant. This is an unexpected finding because higher education levels generally bring more advanced teacher competencies and might lead to stronger teacher beliefs. However, level of education is a robust variable that does not reveal the content of the teacher training curricula and the extent to which it covered IBA.

The literature confirms (Pajares, 1992; Pendergast, Garvis and Keogh, 2011) that teacher beliefs are associated with teachers' years of practice. Findings from this sample show that novice teachers (0 – 3 years of experience) scored the lowest among the experience categories on the Teacher Concerns component. We find this result realistic. They view fewer problems with planning and implementing IBA in preschool classes than mid-career teachers, or they do not worry about these problems. Novice teachers generally underwent more up-to-date teacher training that more thoroughly prepared them for IBA implementation.

Findings about the Subsamples of Teachers

While the results of the full teacher sample provided an overall picture of teachers' IBA-related beliefs, with some unexpected findings, they conceal details about teachers with specific attributes. We examined IBA-related beliefs of two radically differing teacher groups: those who strongly favour and those who reject the implementation of IBA in preschool classes and inspected their demographic characteristics. We ascertained that almost three-quarters of the full teacher sample strongly support the idea of implementing IBA in preschool classes. On the other hand, only 6.7% hold an opposite attitude. This is not a surprise. Refusal or reluctance of IBA adoption, or more

generally, of science in preschool classes, exists in many school districts (Erden and Sönmez, 2011; Greenfield et al., 2009; Yoon and Onchwari, 2006). A range of reasons might contribute to negative attitudes towards IBA. IBA might be considered developmentally inappropriate for young children or difficult to implement in preschool, especially with younger classes (Maier, Greenfeld and Bulotsky-Shearer, 2013; Pendergast Lieberman-Beltz and Vail, 2017). Teachers might lack scientific knowledge or confidence to organise IBA, such as observations or experiments with children (Erden and Sönmez, 2011; Fleer, 2009; Jiménez-Tejada et al., 2016; Spektor-Levy, Baruch and Mevarech, 2013). Or teachers might believe that the preschool's main focus is to support socio-emotional aspects of children rather than teaching them science (Blömeke, Dunekacke and Jenßen, 2017).

Teachers who favoured preschool IBA adoption obtained higher levels of education than those who reject IBA. On the other hand, they have statistically fewer years of experience. These teachers received more recent pre-service training with greater emphasis on constructivist pedagogy than their older colleagues. This probably shaped their attitudes towards the adoption of current instructional strategies, such as IBA, in preschool education. IBA are, for them, personally significant because they are in line with modern educational trends that preschool teachers are expected to follow. Younger teachers might also consider IBA important as a way to contrast their pedagogy to that of older colleagues. They might manifest an intergenerational gap by considering different educational strategies than those of older teachers. We assume that implementing IBA allows children more freedom to make choices in the learning process, explore their own ideas, work collaboratively with peers or ask more questions than when engaging in more traditional modes of instruction (Wenning, 2005). This assumption, however, must be proved by examining their classroom behaviour.

Older teachers might reject preschool IBA adoption for a number of reasons. They are more set in their ways and are more frequently inclined to resist changes (Hargraves, 2005). They may be sceptical towards the adoption of new initiatives, like IBA, because they have long been employing traditional instructional strategies that they found to be efficient. They may also preserve nostalgic memories of their teaching (Goodson, Moore and Hargreaves, 2006) that they are not willing to abandon.

CONCLUSIONS AND RESEARCH IMPLICATIONS

The results of this study confirm that though it is important to examine a particular teacher attribute, such as IBA-related beliefs, within a broad sample, it is also relevant to explore segments of teachers with varying degrees of the particular attribute in order to create more structured data. The study also recognises the importance of analysing teacher demographics in association with teacher beliefs.

Three strong areas are suggested for prospective research. Because preschool teachers educate young children, it seems to be important to examine their conceptions of the child and childhood. Teachers make many fundamental belief-based instructional decisions that are determined by their viewing of children's cognitive, social and emotional potentials (Fleer, 2009; Kowalski, Pretti-Frontczak and Johnson, 2001; Lee and Ginsburg, 2007). Specifically, it would be valuable to explore teachers' views of children's autonomy, as manifested by children's agentic behaviours (Mayall, 2002). Teachers who align their pedagogical philosophy with children's agency allow children to initiate and perform purposeful actions in order to achieve certain goals.

Another suggested line of future research is to explore the relationship of teachers' IBA-related beliefs with their teaching self-efficacy (Voet and De Wever, 2019; Walan and Rundgren, 2014; Woolfolk Hoy, Hoy and Davis, 2009), which is a belief about one's abilities to plan and successfully execute actions to achieve desired outcomes (Bandura, 1977). A teacher with high self-efficacy would be more willing to engage, persist longer and face challenges than a teacher who doubts their own knowledge and abilities. A highly efficacious teacher would approach IBA as a challenge to be taken and not as a threat to be avoided.

Finally, another important extension of this research would be to relate teachers' beliefs in IBA to their instructional behaviours. Classroom observations might reveal how teachers with varying degrees of beliefs actually adopt IBA and how they align their beliefs with their instructional strategies and teaching methods. This knowledge would also provide concurrent validity of the beliefs questionnaire used. Because of the large sample size and the sample selection method, the findings of this study well represent IBA-related beliefs of Czech preschool teachers. The authors believe the study provides valuable data for cross-country comparisons in order to gain a wider perspective on the IBA-related beliefs of preschool teachers.

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Full research paper

PERSONALITY DEVELOPMENT AS A KEY ASPECT OF TEACHER LEARNING: A PILOT STUDY OF THE TRAINING PROGRAMME EFFECTS WITHIN THE CLIMA CONCEPT

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ABSTRACT

The modern teacher must respond to the needs of society in the context of Education 4.0. It seems suitable to adapt this trend to teaching children at an early age. The paper examines the usefulness of professional education for kindergarten and primary school teachers focused on personality development, emotional intelligence, and other social areas with an emphasis on creating a favourable classroom climate. The pilot study aims to discover which specific areas of this new education approach contributed to the teaching practice. The training effects were evaluated using questionnaires collected from 27 participants before and after the programme in 2018 and 2019. The data obtained from the closed questions were analysed using statistical methods, while open-ended questions were processed by content analysis. An ANOVA test demonstrated the effect in all monitored areas. In verbal answers, the participants appreciated the acquired skills in the field of communication and emotional intelligence. The results suggest that a training programme using elements from management appears to be beneficial to current teaching practice.

KEYWORDS

CLIMA concept, emotional intelligence, leadership, personal development, teacher education

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Highlights

- *The CLIMA concept (including Culture of learning, Leadership, Inclusion, Mentoring, and Activating forms of learning) brings an interdisciplinary approach to teacher training.*
- *The participants in the CLIMA training programme perceived the benefits to be especially in the field of communication and emotional intelligence.*
- *The programme had a greater effect on the classroom climate than on the teaching staff climate.*

INTRODUCTION

The current significant changes in society, the perception of the world and the use of technology are vastly different from a few decades ago and strongly influence how children are educated. Thus, Education 4.0 is a response to new trends in educational needs (Hussin, 2018). In addition to professional skills, teachers need to develop competencies for the educational process. In particular, these are new approaches in the areas of motivation, teamwork, effective communication, inclusion, counselling, coaching and mentoring.

The Organisation for Economic Co-operation and Development (OECD, 2018) states that the present day is characterised by constant changes in the social and cultural spheres. The entire labour market is also changing, mainly because of the need for different skills for existing and new occupations (World Economic Forum, 2018). People must learn and prepare for new roles all their lives (Marr, 2019). In this context, teachers must adapt to the change not only in terms of educational content but its transfer (OECD, 2019). Therefore, in this paper, we asked the question: *How can a training programme focused*

on developing selected aspects of personality contribute to the modern pedagogical process?

To continuously develop high-quality education, the Ministry of Education Youth and Sports in the Czech Republic (MEYS-CZ) established the *Operational Programme: Research, Development and Education* (OP RDE) for 2014–2020, aiming to contribute to education so that the labour force is educated, motivated and creative (MEYS-CZ, 2015c). The view of the MEYS-CZ is that the acquisition of appropriate soft skills should contribute to positive changes in the education of pupils and children and, also, to teachers' private lives because the professional and private lives of each person are inextricably linked.

Education climate

In recent decades, pedagogical research has focused on the educational environment of the school classroom, also known as the 'education climate'. Understanding the educational environment/climate and effectively regulating it consistently with educational objectives is an important factor in facilitating teaching (Özyildirim, 2021). Průcha (2020) defines this concept as a set of psychosocial factors, which can also be described as the relationships between pupils and teachers and between the pupils themselves. These phenomena are examined based on the perception of the educational process, not just on the perception of an independent observer. In this way, the perception of the subjects of the education process is utilised as opposed to typical observation by an independent researcher (observational approach) where these phenomena remain hidden. These findings were also confirmed by the Dutch scholars Creemers and Reezigt (1999) in the elementary school environment and by Vnoučková, Urbancová and Smolová (2017) in university education.

In Czech schools, only some measurements of the classroom climate were taken using the MCI questionnaire (My Class Inventory). For example, Bek (2007), as cited in Průcha (2020), primarily focused his research on how the education climate is evaluated by pupils. A risk of the development of conflicting behaviour can be detected as early as in preschool children. Therefore, it is necessary to pay attention to the classroom climate, even in kindergarten. If not detected in time, it can result in fewer close relationships with the teachers (Buyse et al., 2008). The study by Birbili (2019) focuses on the early stages of children's education as these are critical to their development. A critical approach requires pre-school education, which is also reflected in the perception of teachers of useful knowledge for children (in further education).

The culture and climate in every school and every department is unique. Therefore, loyalty to the organisation is more important than the rivalry of cultures (McGrath and Bates, 2017). In addition to the education of the labour force, Penny (2015) also links the current continuous process of changes to cooperation. Carpenter (2015), like the MEYS-CZ (2015b), claims that a shared positive culture at a school contributes to raising awareness, introducing and maintaining the school curricula, and the effective management of specific cases in education and professional development.

Teachers' personality development

Personality includes a unique combination of psychological and social characteristics that affect the behaviour, thoughts, opinions, attitudes, and feelings of an individual in various situations as well as at different times (e.g., Göncz, 2017; Kim, Jörg, and Klassen, 2019). Psychological theories about personality help to explain the importance of a teacher's personality in the educational process (Göncz, 2017). In addition, personality can change over time (Bleidorn et al., 2021). The development of a teacher's personality affects his/her teaching effectiveness and is beneficial both for the pupils and the whole education system (Kim, Jörg, and Klassen, 2019).

Hargreaves and Preece (2014) state that the development of a teacher's personality can be considered crucial given the fact that teaching reflects his/her personality traits, which can be substantially corrected in the teacher training programme. An administrative environment should be set up to create a teacher's personal development programme, and this ultimately takes an ambivalent attitude to personal growth in professional development (Luckcock, 2007). However, there are not many opportunities for the professional education of teachers with such a focus (Pennington, 1994). Similarly, Hockicková and Žilová (2015) state that to date, the lack of professional education specifically persists in teacher training, where the combination of theoretical and practical knowledge and experience is important.

In particular, "teachers' pedagogical optimism" plays a key role in the conceptual approach of the MEYS-CZ (2015a). Pedagogical optimism means that pupils' success is influenced by the fact that teachers consider school results to be important, that they can positively influence teaching and the lives of all pupils, and that they trust pupils and parents because they have a common goal (Hoy, Tarter and Hoy, 2006).

CLIMA concept

Livingston and Flores (2017) call for new skills, new ways of thinking and innovative approaches to view the interaction of teaching and learning. It is advisable that the evolving form of education absorbs new scientific knowledge that present-day teachers were not acquainted with during their studies, e.g., about effective trends in education that are consistent with how the human brain reacts to different stimuli (MEYS-CZ, 2020).

In the OP RDE (MEYS-CZ, 2015c), the newly promoted approach, the so-called CLIMA concept, focuses on the development of five areas: Culture of learning, Leadership, Inclusion, Mentoring and Activating forms of learning, which stands for the acronym in the concept title. Attention should be focused in further teacher education on the individual sections that comprise the acronym CLIMA (MEYS-CZ, 2015b). These are presented in more detail below in separate paragraphs and focus on how they relate to the development of personality and climate in the classroom. Education according to the CLIMA acronym represents the teaching of interconnected soft skills.

The *culture of learning* has been discussed globally since the 1980s. Damen (1987) refers to it as a separate dimension to teaching. The role of the culture of learning also lies in its ability to promote and increase the quality of teaching (Shepard,

2000). Therefore, it is an important aspect in the application of teaching methods (Janík, 2013; van Breda-Verduijn and Heijboer, 2016). The culture of learning influences the psychological aspects of employees and their involvement in their company's intentions and, therefore, its effectiveness (Islam, Khan and Bukhari, 2016). Ball and Ladson-Billings (2020) provide concrete examples of how understanding cultural practices can contribute to better training programmes. School culture significantly affects the relationship between teaching leadership and teachers' job engagement (Zahed-Babelan et al., 2019).

Leadership also increases the efficiency of communication in teaching because it achieves more open and honest communication (Graham, 2018; Shields, 2017; Stejskalová et al., 2021). Teaching leadership also eliminates gender disparities and balances gender roles in the competitive and turbulent environment of this world (Kairys, 2018). Leadership also supports interpersonal relationships and interdisciplinary (e.g., Margolis et al., 2017; Miles and Scott, 2019). With education development in the 21st century, leadership is being incorporated into teachers' professional qualifications (Santi, 2020). Cooper (2020) explains the complexities of connecting the role of the teacher and the role of the leader in teaching and views this problem as the dual identity of the teacher.

The aim of *inclusion* is undoubtedly to establish a fairer approach to education for all groups of children, pupils, and students. A prerequisite for inclusion as open education for all is the willingness to cooperate (Florian and Beaton, 2018). The issue of inclusion is one of the biggest challenges in contemporary education. Students with specific needs must be understood and the appropriate conditions for their education must be set (Tharp et al., 2018). The inclusion success depends on the teaching approach and teaching skills, as well as the school climate and school culture (Woodcock and Woolfson, 2019).

Mentoring is a process of life guidance, leading and support and takes place in schools, communities, and religious environments. Mentoring is one of the most effective approaches to achieving workplace optimisation (MacLennan, 2017) that requires an approach different from previous generations and should include various forms of communication (Waljee, Chopra and Saint, 2020). Spooner-Lane (2017) shows, that like inclusion, mentoring is still not a precisely defined term, especially in primary education (although as highlighted, it is a key element and is not only for novice teachers). Orland-Barak and Wang (2021) analyse four basic approaches to mentoring kindergarten teachers from the perspective of expecting new directions in education.

There are many *activating forms of learning,* e.g., the core elements: active, collaborative, cooperative and problem-based learning (Prince, 2004). However, the basic pillar can be the involvement of a pupil or student in the process of problem-solving using an appropriate communication method (Sivan et al., 1991) to awaken their critical thinking. Teamwork competencies can be considered as activating methods based on cooperation (Nančovska Šerbec, Strnad and Rugelj, 2009) or an activating method of learning (Hošková-Mayerová and Rosická, 2015). Fischer and Hänze (2019) indicate that activating forms of teaching and acceptance by pupils may also be associated with sympathy for the teacher. Fidan and Tuncel (2019) found that the integration of the activating form using augmented reality into the teaching of physics improved the students' learning outcomes together with a positive attitude towards the subject being taught.

Pilot study based on new training programme and research questions

Tatto (2021) states that training programmes must seek ways to consistently provide teachers with the opportunities to learn the professional knowledge and skills that will allow them to be effective. Liu (2020) shows that turnaround school improvement requires more various comprehensive approaches, focusing on the interpersonal dimensions of leadership.

This pilot study presents the results of a nine-week training programme (26 teaching hours) reflecting the CLIMA concept. This training programme for primary school and kindergarten teachers was first implemented in the Czech Republic in 2018. Through the acronym CLIMA, it aimed to select useful skills from the broadly focused goal of the Czech National Development Programme and thus contribute to the development of the teacher's personality and, at the same time, to improving the classroom climate.

The programme paid increased attention to the learning culture, leadership, mentoring and active/activating forms of learning related to the classroom climate. The main goal of the programme lecturers at the Faculty of Management of the Prague University of Economics and Business was to use an interdisciplinary approach to familiarise the participants with new knowledge in habit formation, the reaction of the brain to selected stimuli, emotion management, communication, teamwork, leadership, procrastination, etc., i.e., to develop personality, emotional intelligence and a positive classroom climate.

The combination of CLIMA content, classroom climate and the level of the pedagogical process is a new and yet unpublished view of education. The paper intends to follow up the ideas of Darling-Hammond (2017), who states that teaching concepts that present greater challenges will probably be accomplished better if we can teach each other what matters and what works in different contexts. Therefore, the objective of this pilot study is to present and discuss the results from the new training programme reflecting the CLIMA concept and in line with the introductory question focusing on the topics that appeared useful to the teachers and contributed to improving their teaching methods.

In particular, the pilot study aims to answer the following research questions (RQ):

- RQ1: How do the programme participants perceive the change in their teaching methods and the classroom or teamwork climate after completing the educational programme?
- RQ2: How did the training programme affect the teachers' skills from the programme participants' point of view?
- RQ3: In which educational areas did the influence of the training programme differ between kindergarten and primary school teachers?
- RQ4: What new skills do the participants in the training programme consider to be the most beneficial?

The Materials and Methods section describes how the data were obtained and evaluated to answer the research questions asked. It also briefly introduces a sample of respondents – participants in the training programme, who were kindergarten and primary school teachers. The Results section offers comparative analyses of respondents' answers before and after completing the programme. It also presents the programme benefits perceived by their participants. In the next section, the results are discussed and compared with the results of other studies. The main findings are summarised in the Conclusions section, including the limitations of the study and the direction of possible further research.

MATERIALS AND METHODS

The pilot study is based on a two-round questionnaire survey, which was part of the nine-week training programme for teachers at primary schools and kindergartens in 2018 and 2019. The participants evaluated the effects of education from the period preceding the CLIMA training programme and subsequently after completing the training programme. To maintain the anonymity of respondents, but to link the responses from both questionnaires, each respondent used their own easy-to-remember identification symbol.

Sample

Both questionnaires were completed by 27 (11 kindergarten teachers and 16 primary school teachers) out of 31 participants (13 kindergarten teachers and 18 primary school teachers) on the training programme. The programme participants were all women, and their breakdown by the length of practice in years (four categories) is shown in Table 1.

Participants	Type of School	Practice Length [Years]				Total
		[0, 3)	[3, 10)	[10, 20)	[20, ∞)	
Sample	Kindergarten	0	3	2	6	11
	Primary School	4	4	4	4	16
	Total	4	7	6	10	27
All	Kindergarten	0	3	3	7	13
	Primary School	4	4	5	5	18
	Total	4	7	8	12	31

Table 1: The distribution of the training programme participants (kindergarten and primary school teachers) by practice length, 2019, (source: own research)

The small number of respondents is because the training programme is designed for a maximum of sixteen participants due to the individual approach. Therefore, the programme is not intended for frontal teaching, and it is also quite extensive. To date, it has only been implemented twice. Nevertheless, the return rate of both questionnaires was 87.1%.

Questionnaire design

Both the questionnaires completed before and at the end of the training programme had a common part focused on six specific educational areas:

(1) *Behaviour* – Pupil behaviour and classroom management;
(2) *Teamwork* – Teamwork support;
(3) *Communication* – Communication skills development;
(4) *Emotion* – Development of emotional intelligence;
(5) *Atmosphere* – Creating a pleasant atmosphere in the workplace;
(6) *Personality* – Development of their own personalities and the personalities of the pupils.

When determining the benefits and usefulness of the training programme, we were inspired by the form of a selected part of the design of the questions from the Teaching and Learning International Survey – TALIS (Czech School Inspectorate, 2014, 2019). The TALIS was conducted in more than 40 OECD countries and focused on lower secondary schools and the corresponding sixth and eighth grades at grammar schools. This concerned the part focusing on professional education, where the first area *Pupil behaviour ('student behaviour' in TALIS) and classroom management* is directly monitored. The other five areas were selected in accordance with the contents of the training programme and the research objective. The respondents evaluated the positive effect of each area on their teaching using one item with a four-point ordinal scale (0 – none, 1 – little, 2 – medium, 3 – large effect). This scale was chosen the same as in the TALIS 2013 (Czech School Inspectorate, 2014).

The second questionnaire was more extensive than the first. In addition, it contained questions focused on a perceived change in the classroom climate and the teaching staff after completing the training programme. The respondents again rated these two questions (items) on the four-point ordinal scale (0 – none, 1 – little, 2 – medium, 3 – large effect). Further, it included open-ended questions, where for each of the six educational areas, the respondents wrote what they had already used in their practice, what they found interesting and, where applicable, what they would use in the near future. In addition, the respondents had the opportunity to enter their own evaluation commentary on the training.

Data analysis

The data from the scaled items in both questionnaires were first processed using descriptive statistics. Subsequently, the ANOVA model with blocks, which considered the interconnection of the questionnaires from the same respondents, and a two-sample *t*-test were used to evaluate the first three research questions RQ1–RQ3. The chosen statistical

parametric methods are robust to the violated normality assumption and are also applicable to ordinal data, even in the case of lower sample sizes (Heeren and d'Agostino, 1987; Stiger et al., 1998; Zimmerman and Zumbo, 1993; Norman, 2010). The statistical tests are supplemented by the related effect size characteristics (Lakens, 2013).

Free answers from the open-ended questions of the second questionnaire distributed at the end of the training programme were used to evaluate the last research question RQ4. The participants' responses were processed using content analysis (White and Marsh, 2006). This approach made it possible to evaluate the transfer of acquired skills into teaching practice. To increase the validity of the results in terms of triangulation, all the statements were classified independently by two experts into thematic units. Slight differences in classification were subsequently made up together. Finally, a frequency analysis of the topics was performed. In addition, selected full-text responses were used to supplement the results obtained from the statistical analysis.

RESULTS

This section is divided into three parts. The first part addresses RQ1, the second addresses RQ2 and RQ3 and the third gives the basis for the response to RQ4. One-word names of the monitored educational areas are used in this section.

Perceived effects of the training programme on the classroom or work team climate

Table 2 shows the relative frequencies and average values of the respondents' answers to the perceived change in the climate in their working environment. A positive effect was perceived in the classroom by 88.5% of respondents. However, the average effect is rated between low and medium levels. Distinguishing the type of school where the respondent teaches, we arrived at the following frequencies of the perceived positive effect: 80% of respondents teaching in kindergartens and 93.8% of respondents teaching in primary schools. Thus, the average effect was perceived as higher among primary school participants and reached the level of 1.69.

Environment	Type of School	Positive Effect [%]				Average Effect
		0 – none	1– little	2 – medium	3 – large	
Classroom	Kindergarten	20.0	40.0	40.0	0.0	1.20
	Primary School	6.2	25.0	62.5	6.3	1.69
	Total	11.5	30.8	53.9	3.8	1.50
Work team	Kindergarten	60.0	30.0	10.0	0.0	0.50
	Primary School	56.3	12.5	31.2	0.0	0.75
	Total	57.7	19.2	23.1	0.0	0.65

Table 2: The perceived positive effect of the training programme on the climate in the classroom and the work team, 2019, (source: own research)

The effect of the training programme on the climate in the work team was less pronounced. On average, it was 0.85 points lower than in the class (0.65 vs 1.50). A positive effect was perceived in the work team by a minority (42.3%) of respondents, more specifically by 40% of respondents teaching in kindergartens and by 43.7% of respondents teaching in primary schools. The average effect ranges from 0.50 to 0.75, i.e., below the level with little positive effect.

Perceived effects of the training programme on areas of teachers' skills

Based on the responses from the programme participants in both questionnaires, Table 3 shows the average values of the perceived effects for each area in the respondents' own teaching, including the differentiation of the type of school where the respondent teaches. It also shows a change in the evaluation of the areas before and after completing the programme. This change can be considered as a benefit of the training programme. The data suggests that the programme has helped most of the participants in the use of emotional intelligence (*Emotion*). Specifically, at the beginning of the training programme, the respondents assessed the effect of emotions in teaching at an average of 0.48 points (i.e., between none and little effect) while after the programme, at an average of 1.78 points (i.e., closer to the middle effect). The overall average change based on the respondents' answers thus reached the level of 1.30 points.

A change (1.22) almost as big as in emotional intelligence was also reported by the training programme participants in the area of *Personality* (development of their personalities and those of the pupils). Note that at the end of the course, the positive effect of this area in the respondents' teaching was perceived on average as the highest with 2.15 points among the examined areas. This was the main reason that the concept of the programme was created. The training programme lecturers had studied a large amount of new scientific knowledge, which claims that changing one's personality will cause a change in the behaviour of the other members of the team, especially when the team leader, i.e., the teacher, changes their personality. The following was stated by one of the primary school teachers (with 3 to 9 years of experience) in the questionnaire: *"Each session had something that influenced my actions, thinking and view of the pupils. I passed this on, and the relationships are improving. The training has improved and facilitated my life and work, I can cope with procrastination, relationships, ask the right questions, turn a problem into a no problem, etc."*

On the contrary, the smallest average increase in effect (0.81) was in *Teamwork*. This was caused, inter alia, because the programme only introduced the topic in the last session, so the participants did not have the opportunity to acquire practical skills by practising the recommended techniques. However, one of the participants teaching at primary school (experience length 3 to 9 years) wrote: *"What I found most interesting was how a team works, how to change it, establish a sense of*

security, get the right people on your side, listen also to the angry ones, and discuss a difficult and rejected topic before meeting with those who would most likely oppose a solution."

Moreover, the spider graphs in Figure 1 show the differences in the utilisation of each area of teaching in kindergarten and primary schools.

Type of School	Kindergarten			Primary School			Total		
Evaluation Area	Before	After	Change	Before	After	Change	Before	After	Change
Behaviour	0.64	1.55	0.91	0.94	1.75	0.81	0.81	1.67	0.85
Teamwork	1.09	1.55	0.45	0.56	1.62	1.06	0.78	1.59	0.81
Communication	1.82	2.09	0.27	0.62	2.00	1.38	1.11	2.04	0.93
Emotion	0.82	1.82	1.00	0.25	1.75	1.50	0.48	1.78	1.30
Atmosphere	0.91	1.64	0.73	0.31	1.44	1.12	0.56	1.52	0.96
Personality	1.09	2.18	1.09	0.81	2.12	1.31	0.93	2.15	1.22

Table 3: Average evaluation of the effects of the areas before and after the training programme and the changes (after - before), 2019, (source: own research)

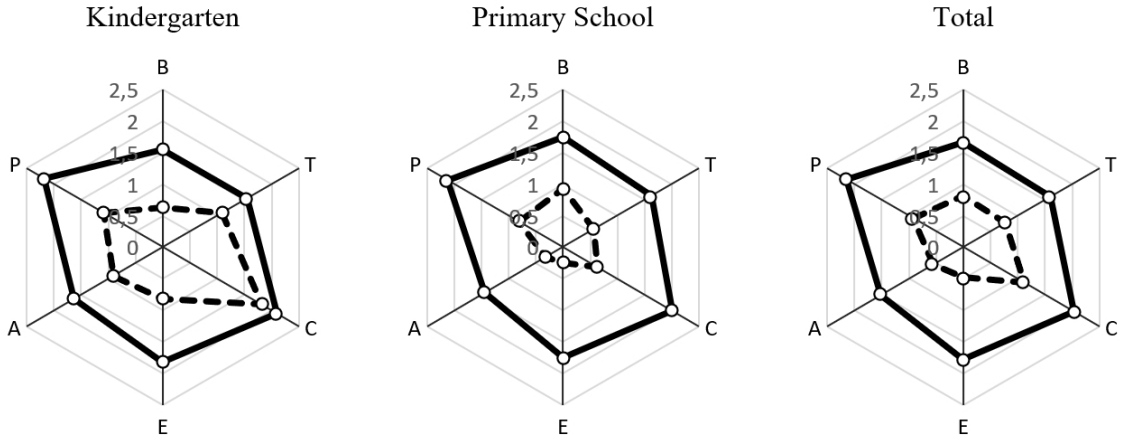

Figure 1: Average ranking of the evaluation areas (B – Behaviour, T – Teamwork, C – Communication, E – Emotion, A – Atmosphere, P – Personality), 2019, (source: own research)

A linear model with ANOVA parameterisation and blocks was used to estimate and test the significance of the change in the mean effect. Specifically, two dichotomous variables identifying the state concerning the training programme (before, after) and the respondent's workplace (kindergarten, primary school) entered the model, while the blocks characterised the same respondent. The mean effect, in this case, was the mean of the mean effects in the kindergarten and primary school teaching.

Table 4 presents the basic results for answering RQ2. Based on the model used, the increase in the mean effect of *Emotion* in teaching was estimated as the highest at 1.25 points with *Teamwork* as the lowest at 0.76 points. The second-highest programme benefit is for the area of personality development (the estimated increase is 1.20 points). The changes in the mean effect are statistically significant for all the six educational areas (see low *p*-values in Table 4). Fisher's η^2 ranges from 0.16 to 0.34.

Area	Mean Change	95% Conf. Int.	*p*-value	Fisher's η^2
Behaviour	0.86	(0.28, 1.44)	0.005	0.16
Teamwork	0.76	(0.26, 1.25)	0.004	0.17
Communication	0.82	(0.41, 1.23)	< 0.001	0.25
Emotion	1.25	(0.78, 1.72)	< 0.001	0.34
Atmosphere	0.93	(0.46, 1.40)	< 0.001	0.19
Personality	1.20	(0.70, 1.70)	< 0.001	0.24

Table 4: Estimates of the mean changes in the effects of the areas on teaching based on a linear model with the related *t*-tests and Fisher's η^2, 2019, (source: own research)

Table 5 presents the results of a comparison of the differences in the change in the effect of each area between kindergarten and primary school teachers (RQ3) using a two-sample *t*-test applied to the "change data" (i.e., 27 "after – before" values). A statistically significant difference in a change in effect was found in only one case, *Communication* (p = 0.011). The difference in a change in effect was 1.10 higher for primary schools than for the kindergartens, which is due to the "better starting position" of the participants from the kindergartens before the programme (see Table 3, Figure 1). Note that

Cohen's *d* of 1.08 also demonstrates a large change difference in this case. In the remaining five areas, the data did not show a statistically significant difference concerning the type of school.

Area	Change Diff.	95% Conf. Int.	*p*-value	Cohen's *d*
Behaviour	-0.10	(-1.25, 1.06)	0.865	-0.07
Teamwork	0.61	(-0.38, 1.60)	0.218	0.50
Communication	1.10	(0.28, 1.92)	0.011	1.08
Emotion	0.50	(-0.44, 1.44)	0.284	0.43
Atmosphere	0.40	(-0.54, 1.34)	0.392	0.34
Personality	0.22	(-0.78, 1.22)	0.652	0.18

Table 5: Comparison of the change difference in the effects of the areas on teaching between kindergarten and primary school based on a two-sample *t*-test and Cohen's *d* applied to "change data", 2019, (source: own research)

Perceived acquired skills based on the training programme

As part of the open-ended questions in the questionnaire, we addressed the fact that in different social education areas, the course participants mentioned the same skills that they were interested in and that they used. For example, "New Communication Skills" appeared in both "Communication" and "Personality". For this reason, we grouped individual skills into the frequency table, regardless of the social area in which they were mentioned. Then, based on an expert approach, we grouped them into educational and social areas. This procedure aimed to discover which topics (skills) interested the participants most often, regardless of the other contexts in which they were mentioned. The results are shown in Table 6.

Based on the number of responses, the participants were most interested in *Communication* (almost 38%). Of the specific skills, then these were "new communication skills" (59% within the area) and story communication (20% within the area). As part of their new communication skills, they mentioned, for example, conducting an interview using open-ended questions. As part of communicating through the story, a new and useful approach for the participants was how to manage the story in their minds, i.e., how to be able to realistically display the experienced reality and reduce the distortion of the perception caused by past experiences.

The second most important area was *Emotional Intelligence* (25%). In this area, the participants most often mentioned *Positive Thinking* as a new skill, including recording positive experiences in the flow diary (39% within the area). They also reported the use of *Mirroring of Positive Emotions* (29% within the area) very often. The reflection of emotions in the discussion and the questionnaire survey also appeared to be a useful tool used in new communication skills and this skill was frequently mentioned by the course participants at the same time. They found it useful that when approached by an angry parent or an unhappy child, their emotions were so strong that it was often very difficult to negotiate. One possible way is to manage the reflection of positive emotions more strongly than the negative ones that are transmitted. One of the assumptions that this can be done is also positive thinking.

The area of *Personality Development* was mentioned by almost 20% of the participants. The most frequently mentioned new skills were *Support for a change in one's behaviour* (39% within the area) and *Focus only on what I can influence* (35% within the area). The two skills are closely linked and the participants in the discussion said that it was easier and more pleasant for them to deal with what they could influence. Focusing frequently on this will improve the atmosphere in the classroom.

The area of *Teamwork (leadership*) also appears to be important, showing 17% of responses. The participants considered the search for suitable common solutions and common intention to be the most important skill (68% within the area). They were also interested in finding new solutions to the situation instead of looking for the cause (30% within the area). Finally, the area of *Activation methods of teaching* did not interest the participants very much and was mentioned in less than one per cent of the answers.

The innovative training programme was relatively well evaluated by the participants. In the overall summary of the programme, one of the participants teaching in kindergartens (experience length 10 to 19 years) wrote: "*As far as I am concerned, I can write that the title of the training programme using the CLIMA approach is very apt and my participation in it exceeded my expectations. My life is really comfortable, and I feel better and more confident. Thank you.*" Another participant teaching at primary school (experience length 3 to 9 years) stated the following: "*Thanks to the programme, I don't take over the duties of others – I only do what I am really supposed to do (and what I can change). Not putting things off for later (dealing with them as soon as possible but not in emotions). Not forgetting about myself and thinking about myself – what I want, and I look for a solution. Realising how nice something will be "after" if I attempt to change it. I look for a NO-problem and with it a motivation to change. So far, I am unable to "anchor" myself, i.e., to calm down quickly when strong emotions occur".*

Acquired Skills	*N*	PT [%]	PA [%]
Communication	**104**	**37.6**	**100.0**
New communication skills (such as listening and using open-ended questions)	61	22.1	58.6
Communication through a story	21	7.6	20.2
Successful key interview techniques	8	2.9	7.7
Finding and communicating with collaborating solvers	7	2.5	6.7
Identifying and communicating with opponents (doubters, weak links)	6	2.2	5.8
Perception of body language in communication	1	0.3	1.0
Emotional Intelligence	**69**	**24.9**	**100.0**
Positive thinking (including recording positive experiences in the flow diary)	27	9.8	39.1
Using the mirroring of positive emotions	20	7.2	29.0
Development of emotional intelligence	13	4.7	18.9
Creating security	9	3.2	13.0
Personality Development	**54**	**19.6**	**100.0**
Support for change in one's behaviour	21	7.6	38.9
Focus only on what I can influence	19	6.9	35.2
Creating a new habit	6	2.2	11.1
Self-confidence	5	1.8	9.2
Setting and following rules, such as a new habit	3	1.1	5.6
Teamwork and Leadership	**47**	**17.1**	**100.0**
Finding suitable common solutions, common intentions	32	11.6	68.1
Finding new solutions to the situation instead of finding the causes	14	5.1	29.8
Using the principles of leadership	1	0.4	2.1
Activation Methods of Teaching	**2**	**0.8**	**100.0**
Situation simulation	1	0.4	50.0
Activation methods of learning	1	0.4	50.0
Total	**276**	**100.0**	**100.0**

Table 6: A detailed look at the individual skills acquired with a different arrangement of educational social areas (*N* – number of answers, PT – proportion of total answers, PA – proportion of answers within the area), 2019, (source: own research)

DISCUSSION

The main aim of this paper was to evaluate the effect of the new educational approach based on areas (subjects) of the CLIMA acronym and to find how specific areas of this new form of education contributed to the participants' teaching practice. The results from the questionnaires collected from 27 participants confirmed that the positive effect of all the areas supported by the training programme under examination has significantly increased. The educational approach based on areas (subjects) of the CLIMA acronym can be considered useful and successful. Moreover, the results confirm that not only faculties of education can offer interesting and effective training programmes for teachers and thus suitably supplement the portfolio of their training programmes. In the Czech Republic, there is no educational entity that would train teachers in the field of national policy. Insulander, Brehmer and Ryve (2019) presented the teachers' agency in professional development programmes focusing on the national policy initiative in Sweden. However, this initiative was limited to the professional development of mathematics teachers, so it was not a holistic (comprehensive) development as in the case of this study of CLIMA.

By comparing some selected results of TALIS 2018 (Czech School Inspectorate, 2019), the training programme can help the Czech Republic move closer to the European average in the area of active learning, such as the possibility to practice the application of new procedures and knowledge in the classroom (the Czech Republic: 73%, the EU average: 84%) and the possibility of collaborative learning (the Czech Republic: 30%, the EU average: 72%). It has also contributed to sharing experience and development of mentoring. It has also contributed to sharing experience, improving knowledge and the development of mentoring (Suchánková and Hrbáčková, 2017). In the Czech Republic, 59% of school principals do not have access to a mentoring programme (Czech School Inspectorate, 2019). This is significantly more than the average figure for EU countries (35%).

The second important finding is that the greatest benefit of improvement in the further professional and personal life of teachers was in *Personality* (i.e., the development of their personalities and those of their pupils). In particular, the participants appreciated techniques to encourage a change in their behaviour and the realisation that they should focus only on what they can influence themselves. This confirmed the main idea and objective of the training programme, which was based on the following new knowledge: a change in the behaviour of the leader (in this case, the teacher) will also trigger a change in the behaviour of the team members (in this case, the pupils). According to Hargreaves and Preece (2014), personality development can be significantly corrected in a teacher training programme. A study by Ghaith (2003) proves that establishing cooperation helps with a better perception of the classroom climate and, at the same time, a better performance (success). From an individual point of view, this can lead to a feeling of "happiness".

Further, based on the responses of the programme participants, a significant positive change in terms of the effect of that area in teaching has been identified in emotional intelligence. Specifically, at the beginning of the training programme, the respondents assessed the effect of emotions in teaching at an average of 0.48 points while after the programme, at an average of 1.78 points. This may be because emotional intelligence had not been supported much in previous education and that there has recently been a lot of new scientific knowledge focused on how to develop this area. Emotional intelligence is a key element to managing the "emotions" of other (groups) through self-understanding (Serrat, 2017). The programme participants reported that what helped them most in this area was newly acquired communication skills in terms of how to communicate with themselves: not to deal with or think about things and situations they cannot influence but rather channel energy into what they can influence. They were also extremely interested in the issue of mirroring positive emotions and positive thinking. In the respondents' view, good workplace relationships and the art of listening are also important.

Specifically, the participants reported that they had begun to use the technique of mirroring positive emotions and positive thinking in practice. They also stressed in their evaluations that they had realised the importance of good relationships in the workplace and the art of listening. Self-efficacy in classroom management can be increased through self-understanding (Weber, Prilop and Kleinknecht, 2019). Emotional experience affects the effectiveness of teaching (the ability to achieve the desired results), which can be further improved in practice based on the acquired knowledge and training (Williams, 2009).

A positive setting of the climate in the classroom should be the basis. In addition, it can resolve or even prevent any conflict from occurring (Elliott and Morris, 1991). Therefore, a positive climate in the classroom acts as prevention. The results of the pilot study indicated a positive effect of the training programme on the classroom climate. We are aware that classroom climate should be verified by observing non-participants; however, the view of teachers as observers on how the climate among pupils has changed is interesting.

In contrast, the effect of the training programme on the climate in the work team was quite low. On average, it was 0.85 points lower than in the class. This result could be expected for two reasons. The first is that a maximum of two teachers from each school took part, who then had to transfer limited knowledge to their colleagues who did not attend the training. The second reason is that the content of the training programme was only to a small extent focused on building the climate in the team of teachers and was more focused on building the climate in the classroom.

An important point is *Teamwork* (support of teamwork), which can be described as Leadership based on how it is taught at the faculty of management, where the training programme was implemented. In this area, we recorded the smallest average increase in the effect of education in the teaching practice of the participants. Based on this pilot study, the training programme lecturers realised that this is a difficult and complicated area for teachers. This part would deserve at least one more session with the participants and ideally, a follow-up training programme focused solely on this issue (with a duration of approximately three weeks with two lessons each). In this area, we identify with Fairman and Mackenzie (2012), who state that the role of leadership is crucial in the professional (further) education of teachers. When teachers encountered conflict, they found that they needed to build interpersonal relationships, and they lacked the proper skills to do so.

On the contrary, what is completely different is the promotion of leadership among school principals, who are largely influenced by the school's culture established in the past and their predecessors (they transfer their knowledge to the new leadership of the school – distributed leadership) (Torrance, 2015). The introduction of leadership in education is seen as reform (Earley and Greany, 2017), as it is a change in the whole school policy and an increase in teaching standards (entitlement to it). However, an additional outcome is a higher standard of a pupil's or student's curriculum vitae. Higher quality student outcomes are recorded in all stages of study, including doctoral (Tolstikov-Mast et al., 2018).

Of equal importance is the knowledge that joint education for kindergarten and primary school teachers has proven to be successful. It is useful to see the developmental process of a child in a wider age context. The development of the teacher community was also addressed by Alles, Seidel and Gröschner (2019), who emphasise the need for further education of teachers in their practice. In seminars with a facilitator, they can develop discussions about their individual teaching styles and different alternative scenarios. This leads to the professional development of teachers. The exchange of the experience of teachers from kindergartens and primary schools who participate in the elementary phase of the institutional educational process of individuals in contemporary society can help increase efficiency.

CONCLUSIONS

The development of the climate in the classroom and the team of teachers using the CLIMA concept can be described as a new pedagogical approach. The CLIMA training programme brings the interdisciplinary approach, for example, among psychology, management and pedagogy and other disciplines. It is based on new scientific knowledge about how the human brain works so increases education with greater spontaneity, perception, listening and a sense of happiness – both for educators and children.

The pilot study shows that the direct effect of all the supported social areas (*Behaviour, Teamwork, Communication, Emotion, Atmosphere, Personality*) has increased significantly. Based on the responses of the programme participants, a significant positive change in emotional intelligence was identified in terms of the effect of this area in teaching. Another important finding is that after the training programme, the greatest perceived benefit in further professional and personal life was measured in *Personality*.

Another relevant point is teamwork (teamwork support), which can be described as leadership based on how it is taught at the faculty of management. From this point of view, other faculties than those of education can offer interesting and

effective training programmes for teachers. Thus, they suitably supplement the portfolio of their training programme while contributing to expanding the portfolio of modern teachers. In summary, the training programme using the CLIMA approach can help the Czech Republic move closer to the European average in the field of active learning, such as the opportunity to practice the application of new procedures and knowledge in the classroom.

Our pilot study has several limitations. It focuses on one specific training programme conducted by the managerial faculty. As this is a new training programme, the results are based on only two implementations of the entire training programme in one school year. Therefore, the number of respondents is relatively low although we still arrived at statistically significant and particularly stimulating results. Further, our study was based on a questionnaire survey using a rough four-point scale, where each variable was represented by only one item. Although no qualitative research was conducted, for example, through in-depth interviews, the open-ended questions in the questionnaire provided more detailed results than those offered by the scale used.

It should also be noted that the feedback on the training programme was provided immediately after completion. Therefore, in further research, it is appropriate to focus on long-term monitoring of the training programme impact to identify which skills acquired in the training programme the participants still use in their pedagogical practice or life, for example, one year apart. Based on the pilot study results, the programme content needs to be extended primarily to activating methods in the classroom and teamwork. This is a challenge for the further development of the innovative CLIMA training programme, which is still of interest.

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META-ANALYSIS STUDY: THE RELATIONSHIP BETWEEN REFLECTIVE THINKING AND LEARNING ACHIEVEMENT

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ABSTRACT

Reflective thinking is a must-have skill to connect the knowledge obtained with previous knowledge and can be seen from learning achievement. This study aims to prove and determine the relationship between reflective thinking and learning achievement and its effect size. This study used a quantitative meta-analysis method. Reflective thinking is the independent variable and learning achievement is the dependent variable. The data sources were obtained from online database searches on Google Scholar and international journal platforms from 2012 to 2021. Based on the search, 22 research publications met the predetermined criteria through a strict screening. Quantitative meta-analysis with correlation meta-analysis type was used to analyze the data. The software used was JASP 0.8 4.0. The results showed that this research Ho is rejected. It can be concluded that there was a significant relationship between reflective thinking and student achievement ($z = 8.139$; $p < 0.001$; 95%CI [0.400; 0.654]). The effect of reflective thinking on student achievement was in the medium category ($r_{RE} = 0.527$). The findings are consistent with those of previous research on reflective thinking skills and learning achievement.

KEYWORDS

Learning achievement, meta-analysis study, reflective thinking

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Highlights

- *The assessment of 22 studies about reflective thinking.*
- *There is a positive relationship between reflective thinking and learning achievement around the world.*
- *The relationship between reflective thinking and learning achievement reflective thinking on student achievement was in the medium category.*
- *The evaluation of important aspects of education through comprehensive meta-analysis study.*

INTRODUCTION

Developing students' higher-order thinking skills (HOTS) is a complex multidimensional educational challenge. This thinking skill is part of the general skills that must be trained to students in all subjects to improve their performance and reduce their weaknesses (Arif, 2019). According to Qasrawi and Beni Abdelrahman (2020), cognitive processes of analysis, evaluation, and creation in Bloom's taxonomy are grouped into HOTS while knowledge, understanding, and application are grouped into LOTS. Yen and Halili (2015) state that thinking skills, especially HOTS, are the main benchmark in achieving learning objectives. Included in HOTS are critical thinking, logical thinking, reflective thinking, metacognition, and creative thinking. One of HOTS is reflective thinking (Setiawan et al., 2021; Dwyer, Hogan and Stewart, 2014).

Reflective thinking is a thinking activity that can make students try to connect the knowledge they have acquired to solve new problems related to their old knowledge (Choy and Oo, 2011). Khalid et al. (2020) state that reflective thinking is the ability to manage information or data to respond internally and explain what has been done. Some one who thinks reflectively will also realize their own mistakes and correct them and communicate ideas with symbols or images (abstract), instead of direct objects (concrete) (Chamdani, Salimi and Fajari, 2022). Reflective thinking is part of the critical thinking process, which refers to the process of analyzing and making judgments about what has happened. Reflective thinking is the most important skill in encouraging learning during complex problem-solving situations because it allows students to step

back and think about how to solve the problem and how a set of problem-solving strategies is accomplished to achieve their goals (Shavit and Moshe, 2019; Orakcı, 2021).

According to Dewey (Ozudogru, 2021), reflective thinking means being active, continuous, persistent, and carefully considering everything that is believed to be true or the format of knowledge with supporting reasons leading to a conclusion. Boody, Hamilton, and Schon (Ozudogru, 2021) explain the characteristics of reflective thinking as follows: (1) reflection as retrospective analysis or recall (ability to judge oneself), (2) reflection as a problem-solving process (awareness of how one learns), (3) self-critical reflection (developing self-improvement continuously), and (4) reflection on self-confidence and success.

Students who have a reflective style tend to spend more time responding and reflecting on the accuracy of answers. Reflective individuals are very slow and careful in responding but tend to give correct answers (Kholid et al., 2020). Reflective students are more likely to perform tasks such as remembering structured information, reading by understanding and interpreting texts, solving problems, and making decisions. They may also determine their own learning goals and concentrate on relevant information. They usually have high work standards (Choy and Oo, 2011; Kablan and Gunen, 2021).

Empowering reflective thinking skills is the task of all levels of education. Belief in reflective thinking plays an important role because it is closely related to how students can evaluate themselves. Reflective thinking can also be used to encourage thinking processes during problem-solving. With reflective thinking, students can predict the correct answer immediately so that they can explore problems by identifying the concepts involved, using various strategies, building ideas, drawing conclusions, re-examining solutions, and developing alternative strategies (Mirzaei, Phang and Kashefi, 2014a; Kablan and Gunen, 2021).

In addition, Qasrawi and Beni Abdelrahman (2020) state that HOTS is closely related to thinking skills following the cognitive, affective, and psychomotor domains as an integral part of the teaching and learning process. Therefore, reflective thinking skills, one of HOTS, influence learning achievement in terms of cognitive, affective, and psychomotor aspects. Several studies mention that reflective thinking contributes to learning achievement, including the research of Farahian, Avarzamani, and Rajabi (2020), Akpur (2020), Pham et al. (2020), Hsia and Hwang (2020), Aslam et al. (2021), Safari, Davaribina, and Khoshnevis (2020), etc.

Studies related to reflective thinking and its relationship to learning achievement tend to be carried out partially or only part in certain situations, so that it is difficult to see as a whole. For instance: Pham et al. (2020) examine reflective thinking skills and learning achievement only for ELF students in the context of academic writing. Then, Aslam et al. (2021) examines reflective thinking skills and specific learning achievement only for the students of teacher education. Furthermore, Hsia and Hwang (2020) examine reflective thinking skills, dance learning achievement, self-efficacy and task load, especially in flipped learning conditions. Studies that are not comprehensive and explicitly focused on the effect of reflective thinking skills and learning achievement have several shortcomings, such as: the research results are often biased and only applied to certain situations so that these are difficult to apply to other situations. One alternative to thoroughly analyze the relationship between reflective thinking and learning achievement is by using a meta-analysis study. Meta-analysis is systematic and quantitative research using the existing studies used by other researchers to obtain accurate conclusions (Briggs, 2005; Basu, 2017). Malički et al. (2021: 3) state, 'Meta-analysis is a form of research using data from other existing studies (secondary data)'. Therefore, it is a quantitative research method by analyzing quantitative data from the results of previous studies to reject or fail to reject their hypotheses. This type of research method is increasingly popular to summarize research results (Yusuf and Fajari, 2022). Meta-analysis is widely used in the study of research theory. In addition, it can be a source of foundation in policymaking (Borenstein et al., 2009; King and He, 2006).

In the meta-analysis, the data processed are used to make statistical conclusions. The data can be expressed by various measures that are calculated or searched in advance by formulas in various mathematical equations, which are closely related to the research objectives of the meta-analysis carried out (Pereira et al., 2019; Turner, Bird and Higgins, 2013). This size is known as the effect size. Meta-analysis includes content analysis that encodes the characteristics of a study, such as age, research location, or other domains in a scientific field. Effect sizes with the same characteristics are grouped and compared (Mueller et al., 2018).

Meta-analysis has some advantages, including (1) meta-analysis procedures apply useful disciplines in summarizing research findings; (2) meta-analysis is conducted in a more sophisticated manner than conventional review procedures, which tend to rely on qualitative summaries or "vote-counting"; (3) meta-analysis can find influences or relationships that are obscured in other approaches to summarizing research; (4) meta-analysis provides an organized way of dealing with information from a large number of research findings under review (Briggs, 2005; Borenstein et al., 2009; Basu, 2017).

Based on the explanation above, reflective thinking skills are very important for every student at all levels of education. To make an overview of the relationship between reflective thinking and learning achievement around the world, a meta-analysis study is needed. This is the first meta-analysis study that tests the universality of this relationship among participants from different countries. Therefore, this study aims to prove and determine the effect size of the relationship between reflective thinking and learning achievement through a quantitative meta-analysis approach.

MATERIALS AND METHODS

Research Design

The quantitative meta-analysis method was used in this study. Quantitative meta-analysis is a statistical technique that combines two or more similar studies to obtain a quantitative mix of data (Mueller et al., 2018). Viewed from the process, meta-analysis is a retrospective observational study where

the researcher recapitulates the data without performing experimental manipulation. The recapitulated data were obtained from research publications related to the relationship between reflective thinking skills and learning achievement at the tertiary level.

Eligibility Criteria

The research publications were selected by several criteria with the aim that the results of this extensive analysis can be more centralized. The studies to be included depend on the purpose of the meta-analysis (Tawfik et al., 2019). Therefore, the meta-analysis study hypothesis is very helpful in determining the inclusion and exclusion criteria that should be used from the outset to identify relevant studies (Higgins et al., 2019). The criteria for selecting the research publications studied are (1) publications that can be searched in search databases of online international journals such as Google Scholar, Springer, Eric, Proquest, SAGE, ERIC, et al.; (2) publications from various countries; (3) publications written in English; (4) publications with Scopus, Web of Science, SINTA indexes; (4) publications with sample students; (5) publications from 2011 to 2021; (6) publications that have a value of (r), (t) or (F) which explains the relationship between reflective thinking skills and learning achievement; and (8) the samples studied ≥ 10.

Data Coding

Malički et al. (2021: 2) state that coding in meta-analysis is 'the most important requirement to facilitate data collection and analysis'. Therefore, the instrument in this meta-analysis was a coding category sheet. The coding describes the characteristics of the publications used, such as the year of publication, country of origin of the study, publication sample (N), correlation value (r_{xy}), t-value, F-value, and remarks containing accreditation/reputation information of the journal. The distribution of publications is presented in Table 1.

Authors	Year	Sample	*N*	*r*	*t*	*F*	Remarks
Tuncer and Ozeren	2012	University students	356	0.353	7.109		Elsevier
Hsieh and Chen	2012	Management students	13	0.507	1.950		Web of Science (ESCI)
Ambrose and Ker	2013	Medical students	1000	0.480			Scopus Q1
Alatas	2014	Physics students	156	0.651			Science and Technology Index (SINTA 2)
Afshar and Hamzavi	2014	ELF students	223	0.610			Web of Science (ESCI)
Chang and Lin	2014	Student	104	0.196	2.020		Scopus Q1
Yilmaz and Keser	2015	Open students	103	0.138	1.400		Scopus Q1
Laio and Wang	2016	Medical students	86	0.463	4.7994	23.034	Scopus Q1
Elaldi	2016	Medical students	64	0.337	2.815		
Ghanizadeh and Jahedizadeh	2017	Student	196	0.435	6.7298	45.290	Scopus Q2
Kalantari and Kolahi	2017	ELF students	158	0.318			Scopus Q1
Asakereh and Yousofi	2018	ELF students	132	0.810			Scopus Q2
Hosseini, Maktabi, and Manijeh	2018	Student	899	0.660			Scopus Q2
Ramdani and Badriah	2018	Biology students	137	0.371			Science and Technology Index (SINTA 3)
Zulu and Haupt	2018	Graduate students	100	0.774			Proceeding
Chen, Hwang and Chang	2019	Graduate students	19	0.629	3.340		Scopus Q1
Turan and Koc	2019	University students	640	0.071	1.815		Web of Science (ESCI)
Farahian, Avarzamani, and Rajabi	2020	ELF students	69	0.520			Scopus Q1
Akpur	2020	ELF students	227	0.074	1.120		Scopus Q1
Pham, Trinh and Thi	2020	Student	40	0.667			Scopus Q2
Hsia and Hwang	2020	Dance students	129	0.375	4.5717	20.900	Scopus Q1
Aslam et al.	2021	University students	400	0.670			Scopus Q2

Table 1: Comparison of 22 studies based on *N, r, t,* and *F* values, 2011–2021 (source: own calculation)

Data Analysis

The data analysis in this study was carried out through the following steps: (1) analysis of the characteristics of the research sample; (2) data coding; (3) conversion of the values of t and F to the value of r correlation with the formula below;

$$F = t^2 \quad (1)$$

$$t = \sqrt{F} \quad (2)$$

$$r = \frac{t}{\sqrt{t^2 + N - 2}} \quad (3)$$

(4) heterogeneity test of effect size; (5) calculation of the summary effect or mean effect size; (6) creating forest plots and funnel plots; (7) hypothesis testing; (8) checking publication bias. The data were analyzed using correlation meta-analysis. At the hypothesis testing stage, the p-value obtained was used to test the following hypothesis.

H_o: There is no significant relationship between the reflective thinking and learning achievement
Ha: There is a significant relationship between the reflective thinking and learning achievement
Effect size can be categorized into the values of 0–1 based on Cohen's effect size criteria (Cohen et al., 2020). The software used in this research was JASP 0.8.4 because it can be installed on various computer operating systems, has Cohen's criteria options, provides assumption testing, and has many helpful features for those who want to learn the analysis and interpretation of statistical results. The Cohen's effect size criteria are presented in Table 2.

Value	Criteria
< 0 + / -.1	Weak effect
< 0 + / -.3	Modest effect
< 0 + / -.5	Moderate effect
< 0 + / -.8	Strong effect
≥ + / -.8	Very strong effect

Table 2: Cohen's Effect Size Criteria (Source: Cohen et al., 2020)

RESULTS

Based on the analysis of 22 publications with specific criteria, various values of *r, t,* and *F* were obtained for each study. Before performing the heterogeneity test, the researchers converted the *t*- or *F*-values of all research publications that have no *r*-value to *r*-value. The results of the heterogeneity test are presented in Table 3 and residual heterogeneity estimates are presented in Table 4.

	Q	*df*	*p*
Omnibus Test of Model Coefficients	66.248	1	< 0.001
Test of Residual Heterogeneity	41.734	21	< 0.001

Note. p-values are approximate.
Note. The model was estimated using the Restricted ML method.

Table 3: Heterogeneity test, 2011-2021 (source: own calculation)

	Estimate
τ^2	0.081
τ	0.284
I^2 (%)	94.707
H^2	18.892

Table 4: Residual heterogeneity estimates, 2011–2021 (source: own calculation)

The results of the heterogeneity test above showed that $Q = 411.734$ with $p < 0.001$; τ^2 or $\tau > 0$; I^2 (%) is close to 100%; it means that the 22 effect sizes of the analyzed studies were heterogeneous. Furthermore, an analysis of the estimation of the summary effect or mean effect size was carried out, and a publication bias test was performed using a random effect approach. The results of the analysis of the summary effect or mean effect size is presented in Table 5.

	Estimate	Standard Error	*z*	*p*	95% Confidence Interval	
					Lower	Upper
intercept	0.527	0.065	8.139	< 0.001	0.400	0.654

Note. Wald test

Table 5: Summary effect or mean effect size, 2011–2021 (source: own calculation)

The results of the analysis using the random effect model showed a significant positive correlation between reflective thinking and student achievement ($z = 8.139$; 95%CI [0.400; 0.654]). The *p*-value which shows < 0.001 proves that this research H_o is rejected. It can be concluded that there is a significant relationship between the reflective thinking and learning achievement The relationship between reflective thinking and student achievement was included in the moderate category ($r_{RE} = 0.527$).
Furthermore, the analysis results are presented using a visually attractive graphical method, referred to as forest plots. Forest plots allow us to know the estimated combined effect depicted by plots (dots) at certain intervals at the same time to make comparisons between studies clearer. A chart of the forest plots of the 22 analyzed studies is presented in Figure 1.
Based on the forest plot chart, the effect sizes of the analyzed studies vary from -0.06 to 1.30. Furthermore, the funnel plot was made. Begg's funnel plot is a scatter diagram used in meta-analysis to visually detect the possibility of publication bias (symmetrical or asymmetrical research sample). A funnel plot chart for the 22 studies analyzed is presented in Figure 2. The results of the funnel plot chart had no clear indication of publication bias because the model formed was symmetrical or asymmetrical, so further analysis using Egger's test was necessary. Egger's test results are shown in Table 6.

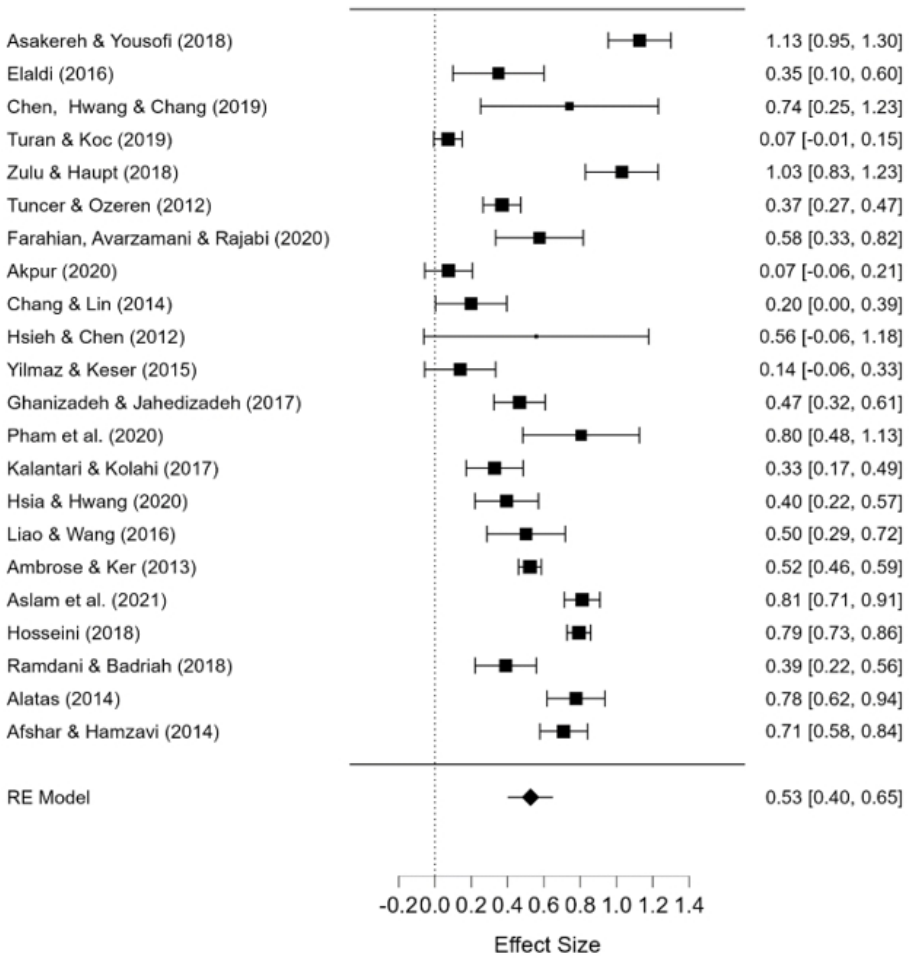

Figure 1: Meta-analysis forest plot, 2011-2021 (source: own calculation)

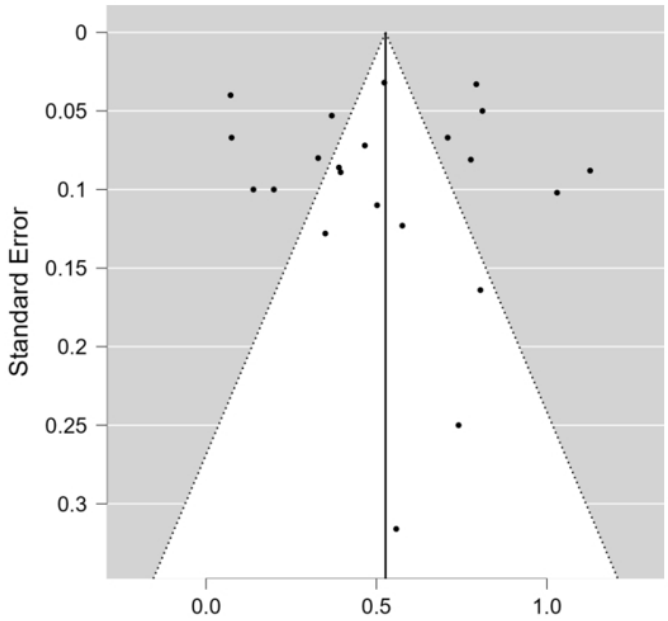

Figure 2: Funnel plot after Trim-Fill diagnosis, 2011-2021 (source: own calculation)

	z	*p*
sei	0.591	0.555

Note. Sei = predictor or standard error

Table 6: Regression test for funnel plot asymmetry (Egger's test), 2011-2021 (source: own calculation)

Table 6 shows $Z = 0.591$ with $p > 0.05$. This confirms that the funnel plot is symmetrical. Thus, there is no publication bias problem in this meta-analysis study.

DISCUSSION

Based on the 22 research results which were analyzed through this meta-analysis, there was a significant positive relationship between reflective thinking and learning achievement (p-value < 0.05). The more skilled students reflect the relationship between concepts, causal relationships, analogous relationships, or differences, the more skilled they are in making decisions, conclusions, and working on questions quickly and precisely for better learning achievements (Turan, Fidan and Yildiran, 2019; Isler, Yilmaz and Dogruyol, 2020).

Furthermore, based on the results of the effect size analysis, the 22 studies showed that the relationship between reflective thinking and student achievement was in the moderate category based on Cohen's effect criteria ($r_{RE} = 0.527$). Students' reflective thinking processes affect learning achievement by responding quickly to a problem and linking what is known and asked in the problem with their previous knowledge to reflect on and determine the right strategy to solve the problem with reasoning (Tsingos-Lucas et al., 2016; Aldahmash, Alshalhoub, and Naji, 2021). Students' reflective thinking processes can be seen from the confusion and doubt in solving a problem and obstacles that make students quickly investigate it with their knowledge (Turan, Fidan and Yildiran, 2019; Spears et al., 2021).

Reflective thinking allows students to learn to think about the best strategies in achieving learning objectives (Mirzaei, Phang and Kashefi, 2014b). In addition, reflective thinking can help them integrate their thinking skills by conducting assessments (Maksimović and Osmanovic, 2019). Reflective thinking is important for students to solve problems optimally (Spears et al., 2021). Therefore, it affects the way students decide on everything including cognitive, affective, and psychomotor activities in the components of learning achievement. This is supported by several studies stating the same theory, including Farahian, Avarzamani and Rajabi (2020), Akpur (2020), Pham et al. (2020), and Chen, Hwang, and Chang (2019).

Furthermore, Kholid et al. (2020) state that students should have reflective thinking skills in the learning process to solve problems of everyday life. With reflective thinking, someone can understand, criticize, assess, find alternative solutions, and evaluate the issues being studied. To improve students' reflective thinking skills, teachers can support them to hone their skills by using problem-based learning models, varied approaches, and open-ended essay questions (Killingsworth and Xue, 2015; Toman, 2017; Mirzaei, Phang and Kashefi, 2014b; Yilmaz, 2020).

In this study, no publication bias was found. Publication bias can be detected through analysis of the symmetrical shape of the funnel plot and Egger's test. They have the same conclusion. Analysis of publication bias is needed to determine the level of significance of the sources used, the quality of relevant research methods, accurate study conclusions, and different sample sizes which will affect minimally biased research conclusions (Nair, 2019; Joober et al. al., 2012). Therefore, the studies that were not included had the same results as those included as a sample in this meta-analysis.

CONCLUSION

From the results and discussion above, it is confirmed that reflective thinking skills affect learning achievement, which is indicated by the effect size of 22 publications which are proven to be heterogeneous and have a positive correlation value in the moderate effect category. Furthermore, publication bias does not exist, which means that the publications under review truly reflect the actual situation. The characteristics of the publications studied show the same sample, namely students, even though they are from various scientific fields. It is recommended that future researchers use similar themes by focusing on the sample of the research publications, such as elementary school, junior high school, high school, or non-formal education students. It is intended that there will be more theories on the relationship between reflective thinking skills and student achievement so that teachers will improve their teaching and consider this topic. The limitation of this research is that some publications are not reputable by Scopus, Web of Science, or SINTA. In fact, the better the reputation of the journal being studied is, the higher the quality of the data presented.

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IDENTIFICATION OF EFFECTIVENESS MEASUREMENTS AND BIAS PUBLICATION OF LITERATURE RESULTS STUDY: A COOPERATIVE LEARNING MODELS ON MATHEMATICS LEARNING OUTCOMES OF VOCATIONAL SCHOOL STUDENTS IN INDONESIA

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ABSTRACT

This meta-analysis intends to determine the impact of cooperative learning model research findings on the mathematics learning outcomes of Indonesian vocational high school students. Based on moderator variables, such as grade level and student sample size, identify efficacy and publication bias measures. Data from descriptive analysis, which included the mean, standard deviation, and sample size, were collected from 21 research projects based on applying the cooperative learning model in the experimental group and direct learning in the control class. Forest plot analysis was the data analysis method used. The results of the measure of the effectiveness of the cooperative learning model on mathematics learning outcomes in grades 10 and 11 were 0.87 and 0.92, with each effect size category being medium. While the effectiveness of the learning model is measured using a sample size of 1 to 30 students, and more than 30 students were 0.94 and 0.83, respectively, each has a medium effect size category. The results of other analyses show no publication bias. The findings of this study provided teachers with information on how to apply effective cooperative learning models to mathematical learning outcomes in 10th and 11th grade and the efficiency of learning with large class size.

KEYWORDS

Cooperative learning model, mathematics learning outcomes, meta-analysis, forest plot, publication bias

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Highlights

- *Cooperative learning has a moderate but significant effect on student mathematics learning results.*
- *The forest plot shows the meta-analysis sample's adequacy by identifying publication bias.*
- *This meta-analysis shows the application of effective cooperative learning to mathematics learning outcomes based on grade level and sample size.*

INTRODUCTION

Teachers' application in student-centred learning is a barrier for certain Indonesian teachers in giving students a thorough comprehension of the topic. Research by Bjork (2013) used a sample of teachers in Indonesia, as many as 100 high school teachers who participated in filling out a questionnaire related to the implementation of learning activities by teachers. The results showed that 53% of respondents in learning activities

by teachers to students used the lecture method. Direct learning activities include up to 20% of respondents while learning by involving students in discussions includes up to 5%. Furthermore, traditional learning approaches are used, which are teacher-centred and emphasise memorisation (Bjork, 2013). The teacher's learning process only emphasises students on memorising and learning focuses a lot on the material compared to evaluating and synthesising material according to its true meaning (Rodzalan and Saat, 2015; Wijaya et al., 2019). Teachers' learning activities are repetitive and yet dominated by the lecture technique. The teacher sees learning activities with the lecture method as easier conveying the material, although it generally makes students more passive and has difficulty thinking critically (Baguma et al., 2019; Mustofa and Yuwana, 2016). Another difficulty of teachers in South Sulawesi, one of the provinces in Indonesia, in carrying out the learning process by applying critical thinking learning is influenced by the lack of students' basic understanding of mathematics, interest, and motivation to learn mathematics (Ridwan et al., 2022).

Lesson designs, quality learning processes, and assessment and evaluation of learning outcomes are all significant because of the instructors, as mentioned above' learning phenomena. Compared with teacher-centred learning, one of the learning approaches significantly influences learning outcomes and the development of other aspects of students in cooperative learning. The cooperative learning model can improve learning outcomes, social skills, responses, and student learning activities (Ismail et al., 2019) and develop 21st-century collaboration, creativity, critical thinking, and communication (Lai and Viering, 2012). To develop these skills, educational institutions need to consider using innovative learning methods to increase student enthusiasm for learning and provide opportunities for active learning (Saavedra and Opfer, 2012). One of these innovative learning methods uses a cooperative learning model that requires students to work in groups to share ideas and materials to achieve a common goal of understanding the material.

The cooperative learning process involves students working in small heterogeneous groups conducting constructive discussions to help each other and provide understanding to other students (Johnson and Johnson 2014; Johnson, Johnson and Smith, 2014; Slavin, 1989). Studies on cooperative learning have shown that when students work together, they learn more than working alone (Johnson and Johnson, 2014; Slavin, 2014). In addition, research by Slavin (1989) by conducting learning on the same material content shows that the cooperative model is effective compared to conventional learning. The results of research using a meta-analysis approach also show that student-centred cooperative learning models are more effective than teacher-centred conventional learning (Agustini et al., 2021; Capar and Tarim, 2015; Kalaian and Kasim, 2014; Kumar, 2017; Kyndt et al., 2013). The measurable variables in the study consisted of learning outcomes and social and emotional skills.

Several researchers have conducted a meta-analysis evaluation of cooperative learning utilising moderator factors at all levels of education so far (Capar and Tarim, 2015; Hattie, 2009; Mansurah et al., 2021; Setiana et al., 2020; Sharan, 2010; Turgut and Turgut, 2018) as well as on student learning outcomes, with a focus on cognitive and emotional development (Parveen, Yousuf and Mustafa, 2017; Ridwan et al., 2021; Vega and Hederich, 2015). In comparison to the tertiary level, Hattie (2009) found that the cooperative learning approach for elementary and high school students was appropriate. Meanwhile, research by Capar and Tarim (2015) showed that cooperative learning is most effective at the tertiary level. Then, Mansurah et al.'s (2021) research showed that the cooperative model of the Two Stay Two Stray type at the high school level had a more significant effectiveness measure than the elementary and junior high school levels. Furthermore, compared to learning in elementary and junior high schools, the cooperative learning approach had the largest significant effect size of 0.445 on high school students' mathematics learning outcomes. However, other studies show that learning with cooperative models does not significantly affect mathematics learning outcomes based on each variable at the elementary school, junior high school, high school, and college level (Setiana et al., 2020; Turgut and Turgut, 2018).

Researchers are still utilising meta-analysis to discover measurements of the impact of cooperative learning models on vocational high school students' mathematics learning results. Identifying the learning effectiveness measure is based on the grade level variable of grades 10 and 11. Another variable is the sample size consisting of 1 to 30 and more than 30 students who become the research sample. In addition, another identification is the publication of bias against the research study sample used in the meta-analysis to see the adequacy of the research study sample to identify measures of the learning effectiveness of the cooperative model. The study literature search was conducted using Google Scholar and the criteria of a sample of research articles published in Google Scholar, SINTA (Science and Technology index), and GARUDA (Garda Reference Digital)-indexed publications. The samples for the research study were divided into two groups based on descriptive data analysis results based on cooperative learning models in the experimental class and traditional learning in the control class. The results of the descriptive data analysis consist of the sample size, standard deviation, and the average learning outcomes of mathematics for the two learning applications. Then, using the findings of a meta-analysis utilising forest plot analysis with a fixed-effect and a random-effect model, determine the effectiveness of the cooperative learning model. Meanwhile, the funnel plot approach, regression method, and rank correlation, as well as the Fail-Safe *N* method, were used to detect publication bias.

MATERIALS AND METHODS

Research Designs

This research employs a meta-analysis approach to uncover efficacy and publication bias measures in research studies on the impact of cooperative learning on mathematics learning outcomes among Indonesian vocational high school students. A meta-analysis is a statistical tool for synthesising a group of research studies that answer the same research issue (Borenstein et al., 2009; Glass, McGaw and Smith, 1981). The statistical

method synthesised this quantitative research by summarising and comparing research results. In contrast to other synthetic studies, meta-analysis focuses on study findings to develop conclusions based on effect sizes (Card, 2012). According to Field and Gillett (2010), meta-analysis procedures include (1) conducting a literature review to formulate a problem, (2) setting inclusion/exclusion criteria, (3) calculating effect sizes for each research study, (4) conducting a meta-analysis, (5) identifying moderator variables with further analysis, (6) conducting a publication bias analysis, and (7) writing down research study results.

Research Procedure

The stages of meta-analysis in this study consist of problem formulation by identifying the effectiveness of cooperative learning on the mathematics learning outcomes of vocational high school students. Identification consists of measures of effectiveness and publication of bias towards research studies that meet the criteria used as samples in the meta-analysis. Search research study literature using the keywords "(effectiveness or effect) of cooperative learning on mathematics learning outcomes of vocational high school students" through Google Scholar by considering the criteria for journals or seminars based on the Google Scholar, SINTA or GARUDA index. The grouping of research studies based on the criteria of independent variables consisted of cooperative learning in the experimental group and conventional learning in the control class. At the same time, the dependent variable is the mathematics learning outcomes of vocational high school students. Another criterion is a research study that employs a quasi-experimental research design. Then, the grouping results of research studies were evaluated based on the data from the descriptive analysis of the application of the two lessons consisting of the sample size, standard deviation, and mean. The criteria for grouping the literature study are given in the PRISMA diagram in Figure 1.

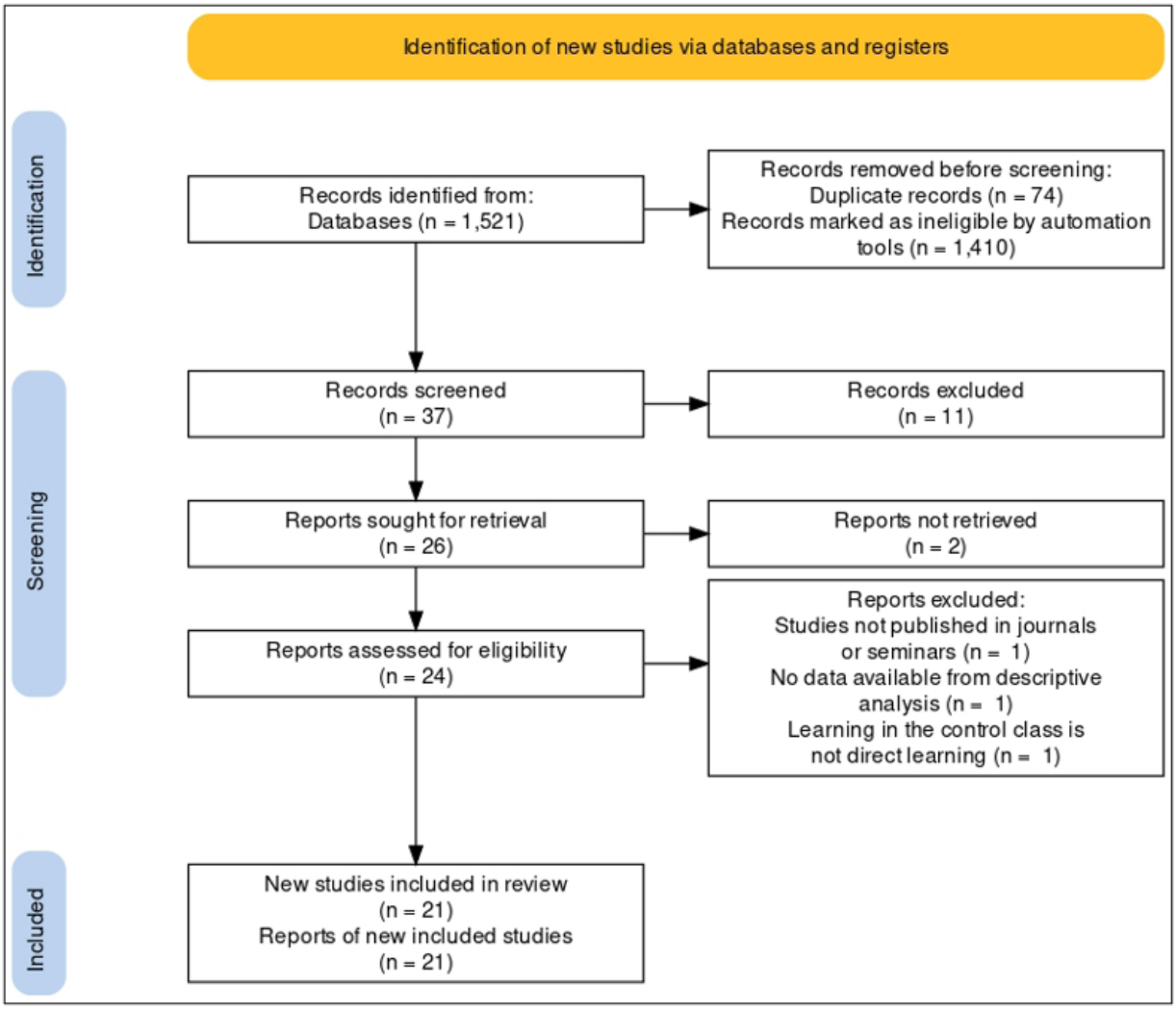

Figure 1: PRISMA diagram – the process of grouping research studies (Page et al. 2021)

For further information, go to http://www.prisma-statement.org/. The results of descriptive data analysis for the two groups of learning applications for each research study are then grouped and coded based on the author's name and year of research and the results of descriptive data analysis for the two groups of learning applications for each research study. The last stage is a meta-analysis based on moderating variables using descriptive analysis data for each research study that meets the criteria of heterogeneity test, forest plot analysis, funnel plot analysis, and publication bias analysis.

Data Analysis

The data analysis technique used in this research is meta-analysis using forest plot analysis and funnel plot analysis using Trim and Fill methods. The efficiency of the two learning models on the dependent variable was investigated using forest plot analysis. The effect size criteria are as follows on values of 0.00–0.20: weak, 0.21–0.50: small, 0.51–1.00: medium, and greater than 1.01: large (Cohen, Manion and Morrison, 2007). Identification of differences in effectiveness measures using the summary effect size estimation value based on the *p*-value obtained from the estimated value of *z* with $p = 2 \times \left[1 - \Phi\left(|z|\right)\right]$ where $\Phi\left(|z|\right)$ is the standard cumulative normal distribution. The value of $\Phi\left(|z|\right)$ can be calculated using Microsoft Excel with the function "=NORMSDIST(*z*)". Then, for the estimated value of z, it is obtained using the formula $z = \frac{M}{SE_M}$, where M and S_{EM} represent the value and standard error of the summary effect size, respectively. For example, given the following operational hypothesis:

H0 states that there is no difference in the size of the effectiveness of the cooperative and direct learning model on the mathematics learning outcomes of vocational high school students,

H1 states a difference in the effectiveness of the two learning models on the mathematics learning outcomes of vocational high school students.

For the hypothesis testing criteria above, if the *p*-value is less than 0.05, it rejects H0 so that there is a difference in the effectiveness of the two learning models (Retnawati et al., 2018). The funnel plot analysis was then utilised to discover publication bias in the meta-analysis' research articles. According to Card (2012), identifying biased publications can use the results of funnel plot analysis using the Trim and Fill method. If each effect size is distributed symmetrically in the funnel plot, there is no publication bias in the study (Borenstein et al., 2009; Cooper, 2016). The form of the funnel plot, on the other hand, indicates publication bias if it is asymmetrically distributed.

Other publications identified bias in this study using the regression method (Egger et al., 1997) and the rank correlation method (Begg and Mazumdar, 1994), and the Fail-Safe *N* (FSN) method (Rosenthal, 1979). Testing the null hypothesis based on a symmetric funnel plot using *p*-value criteria in the regression method and rank correlation. If the *p*-value is greater than or equal to 0.05, it means that the funnel plot is symmetrical so that there is no publication bias. The FSN value, which results from statistical calculations, serves as the basis for the Fail-Safe *N* method's criterion. If the FSN value is more significant than $5k + 10$ with k indicating the number of research studies observed, then the sample of these research studies is not indicated by publication bias (Mullen, Muellerleile and Bryant, 2001).

RESULTS

The literature study results obtained 21 research studies, consisting of 16 studies published in journals and five others in proceedings. The eleven research projects were then published in SINTA and GARUDA-indexed publications, while the others were published in Google Scholar-indexed journals and conferences. The moderator variables in this meta-analysis study are dependent on the grade level, and student sample size used. The cooperative learning model in grade 10 consists of 15 research studies, and the others are research studies with learning in grade 11. Then, 13 research studies are using a sample size of 1 to 30 students, while others use more than 30 students. Data analysis used a meta-analysis approach based on data from descriptive analysis consisting of the mean, standard deviation, and sample size based on grade level variables and the sample size used in the research study.

The preliminary analysis conducted a heterogeneity test to identify the variability of the research study sample used in the meta-analysis. Identification of variability aims to see the effect of the effect size based on sampling error or is also influenced by population variance. The heterogeneity condition in the meta-analysis approach refers to sampling error or variation in results between independent studies (Borenstein et al., 2009). The results of heterogeneity testing also provide information on determining the effect model used in the follow-up analysis consisting of a fixed-effect model or a random effect model. The analysis of heterogeneity testing in this study uses parameters based on the analysis of *Q*-statistical calculations with *p*-values given in Table 1.

Moderator	Variables	*Q*-Statistik		
		value	*df*	*p*-value
Grade	10	34.51	14	0.0017*
	11	11.03	5	0.0507
Sample Size	1 to 30	17.57	12	0.1294
	more than 30	27.02	7	0.0003*

*Note. *p-value <0.05*

Table 1: Results of heterogeneity test analysis

Table 1 shows the results of the heterogeneity test analysis of research studies based on numerical information data on the application of cooperative learning models in the experimental class and conventional in the control class to the mathematics learning outcomes of vocational high school students. The analysis of the heterogeneity test using the value of the *Q*-statistical parameter for the learning variable in class 10 and a sample size of more than 30 students each obtained a *Q* value > *df*. The corresponding *p*-value for *Q* = 34.51 (respectively 27.02) is 0.0017 (respectively 0.0003), each of which is less than 0.05. It shows that the sample data used in the meta-analysis satisfy heterogeneous conditions,

so the effect size is affected by sampling error and population variance. However, the research study's sample data met the homogeneity of other variables, with sampling error being the only factor. Furthermore, according to Ellis (2010), for the distribution of data that meets the heterogeneous assumption, it uses a random-effects model and vice versa. If it fulfils the homogeneous assumption, it uses a fixed-effects model. As a result of the heterogeneity test in Table 1, the learning variable in grade 10 was heterogeneous. In addition, the research study with a sample size of more than 30 students met the heterogeneity assumption. As a result, to determine the effect size of each research study and the summary effect size, the effect model employed for subsequent analysis is a random effect model. At the same time, the other variables use a fixed-effect model for further analysis based on forest plot analysis.

Forest plot research shows how cooperative and traditional learning strategies affect vocational high school students' mathematics learning outcomes. The forest plot shows the summary results of the meta-analysis in the form of visualisation (Borenstein et al., 2009; Card, 2012). The forest plot described for each research study result is illustrated as a forest that gathers to form a forest to provide a synthetic picture (San and Kis, 2018). The forest plot component consists of information on researcher data and year of study, effect sizes with lower and upper bounds for each research study, and summary effect size information with lower and upper bounds obtained using the random-effects model or fixed-effect model. The forest plot also provides weight information for each effect size and a summary effect. The effect size plots and standard errors for each research paper utilised in the meta-analysis using JASP software are displayed in Figures 2 and 3 due to the forest plot analysis.

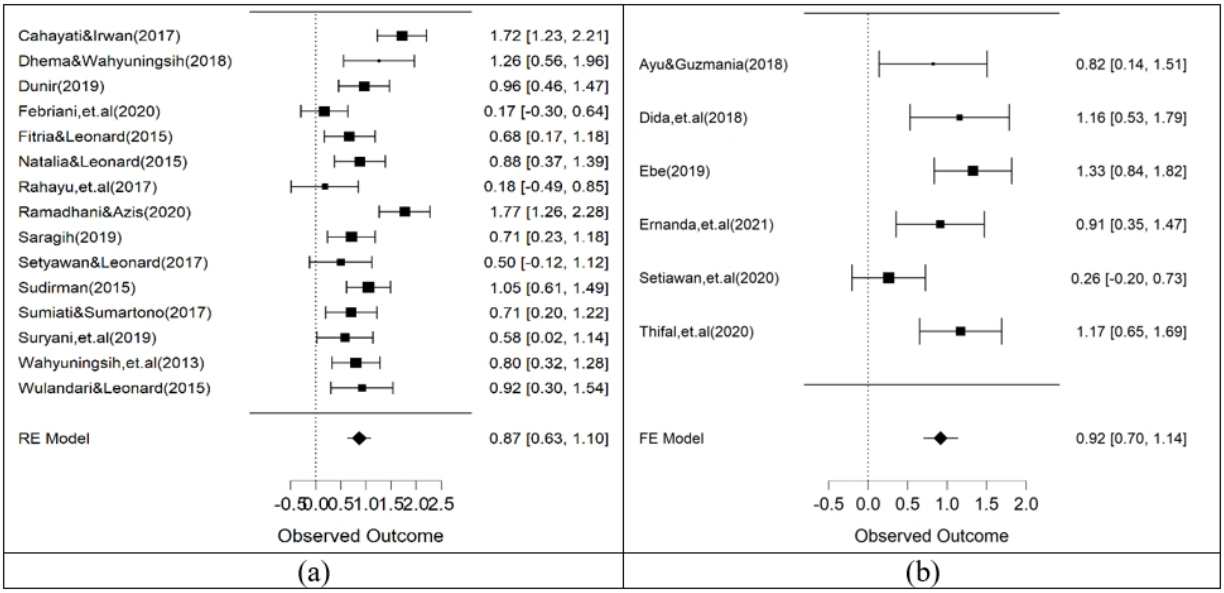

Figure 2: Forest plot of effect size data based on grade level (a) 10 (b) 11

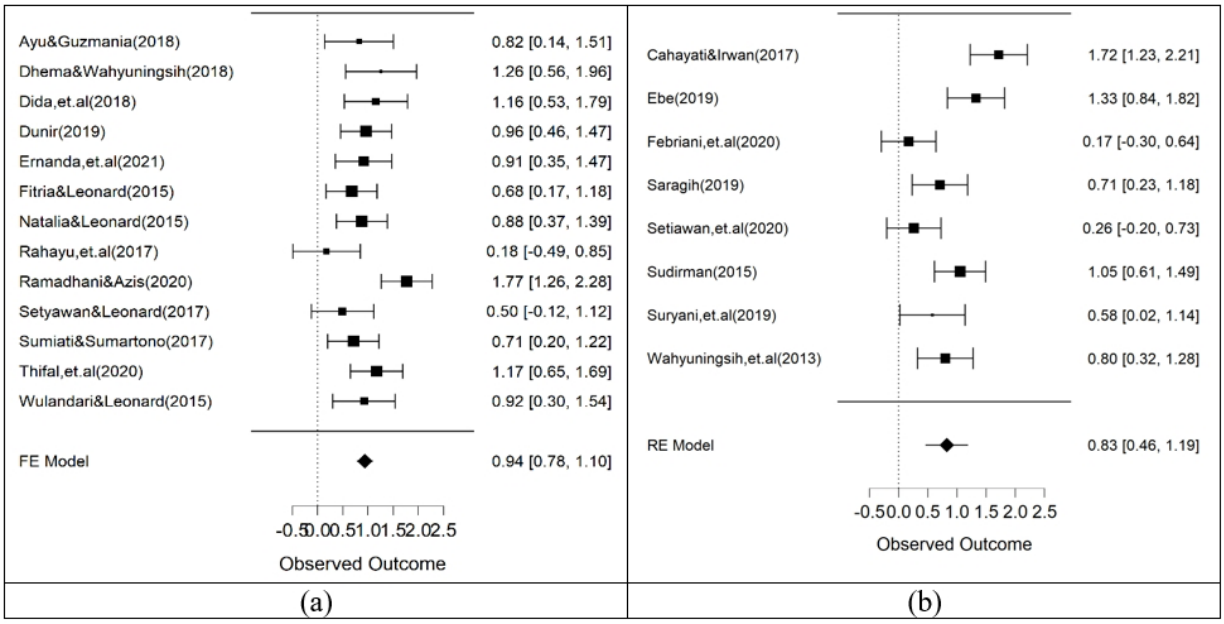

Figure 3: Forest plot of effect size data based on sample size (a) 1 to 30 (b) more than 30 students

Figures 2 and 3 show the results of the forest plot analysis using the random-effects model (Figures 2(a) and 3(b)) or the fixed-effects model (Figures 2(b) and 3(a)). The forest plot results consist of effect sizes with lower and upper bounds for each research study and summary effect sizes. The effect size depicts the effectiveness of cooperative learning on vocational high school students' mathematics learning outcomes. The effect size plots for each research study based on grade level and sample size variables show an effect size value greater than zero. It demonstrates that cooperative learning impacts vocational high school students' mathematics learning outcomes compared to traditional learning. The measure of the effectiveness of the summary of cooperative learning at the 10th-grade level is 0.87 [95%-CI: 0.63;1.10], therefore, according to Cohen, Manion and Morrison (2007), the effect size shows the medium category. According to the fixed effects model, learning in grade 11 is another moderator variable with a 0.92 [95%-CI: 0.70;1.14] effect size in the medium category. Meanwhile, cooperative learning based on the sample size variable uses 1 to 30 students and more than 30 students, respectively, the medium effect size is 0.94 [95%-CI: 0.78;1.10] and 0.83 [95%-CI: 0.46;1.19]. The forest plot results also suggest that cooperative learning positively impacts vocational high school students' mathematics learning outcomes compared to conventional learning.

The results of other forest plots in Figures 2 and 3 also show that for each study sample, the research used in the meta-analysis had a statistically significant effect or not on the summary effect size. For research studies that do not have a statistically significant effect, it can be identified based on a 95% confidence interval containing zero. Therefore, based on the class level variables and the sample size used in the research study, Febriani et al. (2020), Rahayu, Murni and Sakur (2017), Setiawan, Susilowati and Farahsanti (2020), and Setyawan and Leonard (2017) provide a statistically insignificant effect that pulls the summary effect size towards the zero line. It shows that the three research studies provide statistical information that learning using the cooperative model tends to be less effective in improving the mathematics learning outcomes of vocational high school students. Meanwhile, other research studies have effect sizes with non-zero confidence intervals to be consistent with each other and affect the summary effect size.

Based on grade level features and the sample size used in learning, the findings of the forest plot analysis may be used to uncover differences in the effectiveness of cooperative and traditional learning models on the mathematics learning outcomes of vocational high school students. Identifying these differences is based on calculating the estimated summary effect size value and the *z*-value with the *p*-value. The results of calculating the estimated value are given in Table 2.

Moderate Variables		EV	95%-CI	SE	*z*-value	*p*-value
Grade	10	0.87	[0.63; 1.10]	0.12	7.20	< 0.001*
	11	0.92	[0.70; 1.14]	0.11	8.12	< 0.001*
Sample Size	1 to 30	0.94	[0.78; 1.10]	0.08	11.73	< 0.001*
	more than 30	0.83	[0.46; 1.19]	0.19	4.46	< 0.001*

*Note. EV=Estimated Value; SE=Standard Error; *p-value<0.05*

Table 2: The results of the analysis of calculating the estimated value of the summary effect size

Table 2 shows the analysis of calculating the estimated summary effect size value based on moderator variables consisting of cooperative and conventional learning models at the grade level and the sample size used in research studies using fixed-effects and random-effects models. Based on the *p*-values for each grade level variable and sample size in Table 2, each obtained *p*-value < 0.001, which indicates rejecting H_0. It shows differences in the size of the effectiveness of learning with cooperative and conventional models on the mathematics learning outcomes of vocational high school students based on the level variable and the number of students in the class. Other results show that each moderator variable's summary effect estimation value does not contain zero at the 95% confidence interval. According to Springer, Stanne and Donovan (1999) and Israel and Richter (2011), the confidence interval for zero measurements showed insignificant results. It shows that the cooperative learning model based on grade level variables and sample size each significantly affects the mathematics learning outcomes of vocational high school students.

Following that, conditions for publication bias were found using the research studies involved in the meta-analysis. The condition of publication bias can refer to the possibility of finding the results of research studies that do not have a statistically significant effect or have a significant effect but are contrary to theory construction in general. The term "publication bias" refers to a situation in which each research study included in a published meta-analysis does not systematically represent the population studied (Rothstein, Sutton and Borenstein 2005). The analysis to identify publication bias in this study was based on visual funnel plot analysis using the Trim and Fill model, rank correlation and regression methods, and the Fail-Safe *N* method.

Trim and Fill models for funnel plots use an iterative technique to eliminate research studies with small sample sizes that significantly impact the funnel plot's positive side. The iterative procedure involves recalculating the effect size for each iteration to form a symmetric funnel plot. The funnel plots in Figures 4 and 5 using the Trim and Fill method use a fixed-effect model and a random effect model based on the analysis results of calculating effect sizes and standard errors for each research study used in the meta-analysis. Figure 3 depicts the funnel plot results based on the analysis of calculating effect sizes and standard errors for each research study based on mathematics learning outcomes of vocational high school students utilising cooperative and conventional models in grades 10 and 11. A visual study of effect size distribution

is conducted inside or outside the pyramid to discover any publications. The effect sizes are dispersed in the middle and top of the pyramid if there are research studies outside it. Publication bias is discovered when most research studies are dispersed towards the bottom of the funnel plot graph or only in one vertical line area (Borenstein et al., 2009).

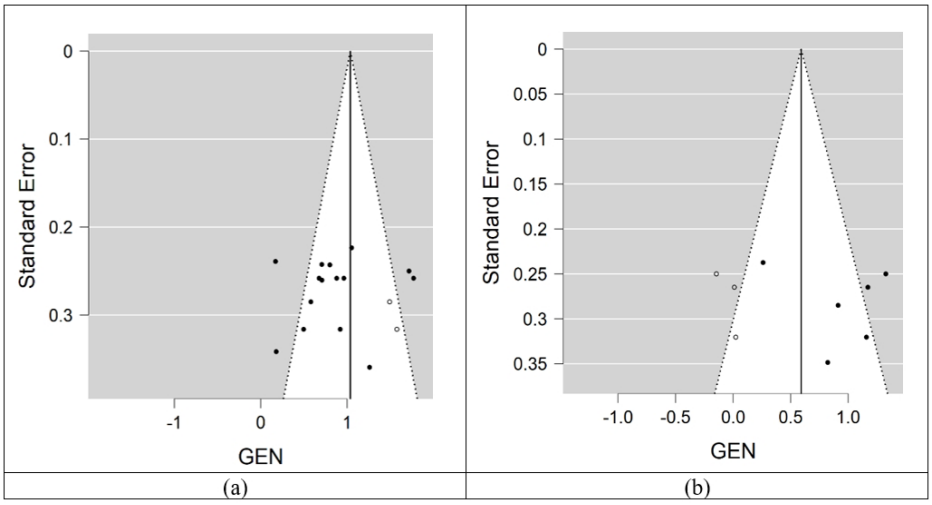

Figure 4: Funnel plot of effect size data based on grade level (a) 10 (b) 11

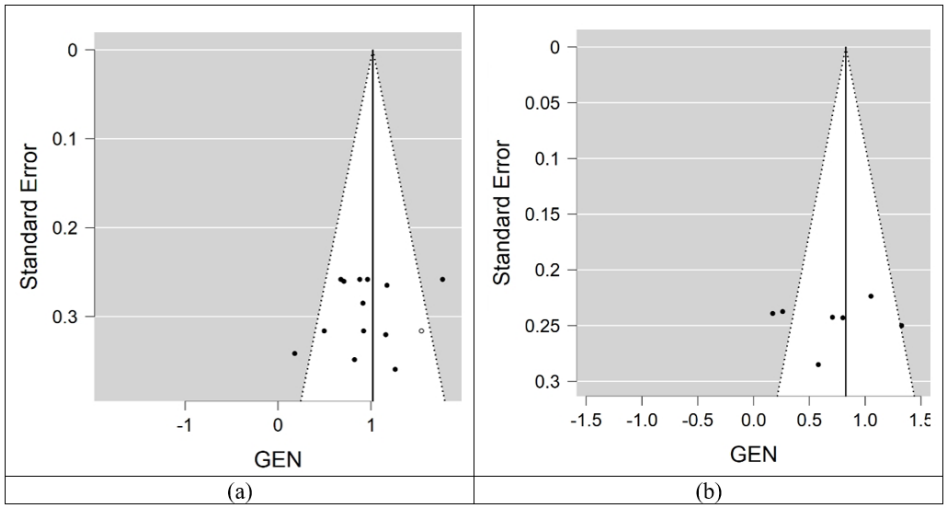

Figure 5: Funnel plot of effect size data based on sample size (a) 1 to 30 (b) more than 30 students

The results of the funnel plot analysis in Figures 4 and 5 show that the effect sizes are visually distributed symmetrically around a vertical line consisting of closed or open circles contained in a pyramid. Even if several research studies in Figures 4(a) and 5(a) have a closed circle on the exterior and are near the bottom of the pyramid, these results show no publishing bias.

The regression method examines the linear relationship between the estimated intervention effect and the standard error (Egger et al., 1997), while the rank correlation method examines the relationship between the estimated intervention effect and variance in sampling (Begg and Mazumdar, 1994). The *p*-value, which produces an asymmetric funnel plot graph so that publication bias does not indicate the sample utilised in the study, is used to identify publication bias using both approaches. Table 3 summarises the findings of the JASP (Jeffreys's Amazing Statistics Program) tool's calculation study of the two techniques.

Moderate	Variables	Regression Method		Rank Correlation Method	
		Regression Coefficient	*p*-value	Correlation Coefficient	*p*-value
Grade	10	-0.531	0.595	-0.099	0.616
	11	0.896	0.370	-0.200	0.719
Sample Size	1 to 30	-1.161	0.246	-0.067	0.756
	more than 30	0.049	0.961	0.255	0.383

Table 3: The results of analysis using the regression method and rank correlation

Table 3 shows the results of the calculation analysis using the regression method and rank correlation to identify publication bias based on the research study sample used in the meta-analysis. Identification of publication bias based on research papers on learning outcomes of vocational high school students utilising cooperative and conventional models on mathematical learning outcomes using grade level variables and sample sizes utilised in learning. The regression coefficients show that the cooperative learning model in grade 11 and using more than 30 students have a positive value of 0.896 and 0.049, respectively. With a sample size of more than 30 students, the coefficient utilising rank correlation for the cooperative model learning variable was 0.255. The results of the regression coefficients and other rank correlations obtained negative values indicating the results of the research studies used in this study using a dominantly small sample size. The results of other analyses using the two methods obtained a *p*-value greater than 0.05 for each moderator variable, which shows an asymmetric funnel plot graph with no publication bias. Research by Setiana et al. (2020) also identified publication bias using the regression method and rank correlation. The results of the two methods respectively obtained regression and correlation coefficients of 0.683 and 0.247 with *p*-values greater than 0.05. The findings also suggest no evidence of publication bias in the meta-analysis' study articles.

Moderate	Variables	*k*	FSN	5*k* + 10	Target Significance	Observed Significance
Grade	10	15	851	85	0.050	< 0.001
	11	6	143	40	0.050	< 0.001
Sample Size	1 to 30	13	623	75	0.050	< 0.001
	more than 30	8	261	50	0.050	< 0.001

Table 4: Analysis results of file drawer

Table 4 shows the FSN scores for each moderator variable consisting of cooperative learning in grades 10 and 11 and using a sample size of 1 to 30 students and more than 30 students. The FSN values for each moderator variable are greater than $5k + 10$, with k representing the number of research studies used in the meta-analysis. According to Mullen, Muellerleile and Bryant (2001), these requirements imply that the meta-analysis research study sample does not contain biased publications. It suggests that there is no potential publication bias in learning effectiveness with a cooperative model on the mathematics learning outcomes of vocational high school students depending on the level variable and the number of students in the class. Furthermore, each FSN value denotes the number of research studies that should be included in the meta-analysis to reduce the likelihood of publication bias.

DISCUSSION

Researchers' meta-analysis study of the impact of learning with cooperative models on the mathematics learning outcomes of vocational high school students is still relatively small. The meta-analysis study uses data from identifying research results conducted in Indonesia. So that the results of the meta-analysis review obtained only contribute information to the scope of the Indonesian state. Nonetheless, this study's results were compared with those of several relevant studies conducted in several countries. A meta-analysis study on cooperative learning has been carried out by Capar and Tarim (2015) and Turgut and Turgut (2018), with each dependent variable being data on student mathematics learning outcomes in Turkey. The same research study was also conducted by Xie, Wang and Hu (2018) and Setiana et al. (2020) to identify the effect of cooperative learning models on student learning outcomes in China and Indonesia. While research by Mansurah et al. (2021) and Ridwan, Hadi and Jailani (2022) also identified the effectiveness of the cooperative learning model on student learning outcomes in Indonesia.

Identifying the effectiveness measure of the cooperative learning model in this study is based on the variable level and the number of students in the class. The effect size of the summary of cooperative learning at the 10th and 11th-grade levels was 0.86 and 0.92, respectively, in the medium effect size category. Meanwhile, cooperative learning based on the sample size variable uses 1 to 30 students and more than 30 students, respectively, the medium effect sizes are 0.93 and 0.81. So far, research with a meta-analysis approach uses the variables of education level, the field of study, culture, mathematics, cooperative learning techniques used, and duration in learning mathematics (Capar and Tarim, 2015; Mansurah et al., 2021; Setiana et al., 2020; Turgut and Turgut, 2018).

Capar and Tarim's (2015) research use moderator variables based on education level, mathematics field, cooperative learning techniques used, duration of mathematics learning, and mathematics learning outcomes. The results of the measurement of the effectiveness of learning with the cooperative model show that it is most effective at the tertiary level with an effect size of 1.33, while at high school in the medium category, it is 0.54. Then, research by Mansurah et al. (2021) used moderator variables based on subjects consisting of mathematics, natural sciences, and social sciences. The other variables are based on elementary, junior high, and high school levels. The results showed that learning using the Two Stay Two Stray cooperative model effectively measured 0.558 at the high school level. The results of research by Ridwan, Hadi and Jailani (2022) also show that the effectiveness of cooperative learning on mathematics learning outcomes for middle school students is 0.89 with a medium effect size category. In addition, the learning model also affects the mathematics learning outcomes of high school students with an effect size of 0.445. The same result was also obtained by Xie, Wang and Hu (2018), showing that the cooperative learning model has a significant effect on improving mathematics learning outcomes with a medium effect size of 0.67. However, the research results by Setiana et al. (2020) show that learning with a cooperative model has a weak effect

on students' mathematics learning outcomes for all levels of education. Furthermore, the findings of a meta-analysis review by Turgut and Turgut (2018) demonstrate that cooperative learning has no significant impact on mathematics learning outcomes when variables at the elementary, junior high, high school, and college levels are taken into account.

Another result of the analysis is identifying publication bias against the research studies used in the meta-analysis. Identification uses funnel plot analysis, regression, rank correlation methods, and the FSN method. The results of the funnel plot analysis in Figures 4 and 5 show that the effect sizes are visually symmetrically distributed around the vertical line in the funnel plot. Based on the visual analysis of the effect size on the funnel plot, this condition indicates no publication bias. However, because the funnel plot identification results are subjective, they cannot demonstrate publication bias in the research study population. Therefore, identifying other biased publications uses the regression and rank correlation and FSN methods.

The regression method's identification results and rank correlation in Table 3 show that a *p*-value greater than 0.05 was obtained for each moderator variable. Thus, an asymmetric funnel plot is shown, so there are no biased publications. The results of other identification methods in Table 4 show that the FSN value of 851 is more significant than $5k + 10 = 85$. It shows that research studies on the effectiveness of learning with cooperative models on mathematics learning outcomes of vocational high school students in grade 10 are free from publication bias. The other moderating variables also show a higher FSN value of $5k + 10$, with k representing the number of research studies. These conditions indicate research studies related to the effectiveness of cooperative learning on the mathematics learning outcomes of vocational high school students based on grade level variables and sample sizes free from publication bias conditions.

Moreover, the meta-analysis review by Mansurah et al. (2021) identified publication bias using three methods: funnel plot analysis, rank correlation and regression methods, and the FSN method. Identification of publication bias against research studies related to the effectiveness of learning the Two Stay Two Stray type of cooperative model on student learning outcomes. The funnel plot analysis results were visually carried out based on the condition of the open and closed circles in the funnel plot. The results of the rank correlation and regression methods also use a comparison of *p*-values with a significance level of 0.05 and the FSN method by comparing the FSN value and the equation value of $5k + 10$. Both methods also show no publications. Then, Setiana et al. (2020) identified biased publications based on research studies on the effect of cooperative learning models on students' mathematics learning achievement. Identification of publications also uses funnel plot analysis and Rank and Regression correlation methods. Funnel plot analysis is done visually by comparing plot results based on conditions before and after using the Trim and Fill models. Then the rank correlation and regression methods results also show that research studies are free from publication bias, which also compares *p*-values with significance levels. It suggests that a meta-analysis review by Mansurah et al. (2021) and Setiana et al. (2020) also showed no indication of publication bias towards the research studies used in the meta-analysis.

CONCLUSION

This study's meta-analysis technique shows that the cooperative learning model positively impacts the mathematics learning outcomes of Indonesian vocational high school students. The effectiveness of learning with cooperative models on mathematics learning outcomes in grades 10 and 11 are 0.87 and 0.92, respectively, in the medium category. Learning with the cooperative model also provides an effect size based on the sample size used in the study, which is 1 to 30 students and more than 30 students each of 0.94 and 0.83 also in the medium category. The results of other analyses using the funnel plot method, the regression method and rank correlation, and the Fail-Safe *N* method show no indication of publication bias for each moderator variable. It demonstrates that the meta-analysis included a sample of research studies in determining the impact of cooperative learning methods on vocational high school students' mathematics learning results. This study provides information to teachers regarding the application of effective cooperative learning models to mathematics learning outcomes at the 10th and 11th-grade levels and the efficiency of learning to the number of students in the class. Then, the limitation of this research is the grouping of research studies only in the scope of Indonesia and based on vocational high school-level variables. Another limitation is the numerical information results based on descriptive data analysis of research studies used in the meta-analysis published in journals indexed by Google Scholar, GARUDA, and SINTA index. As a result, more research is needed to use the findings of research studies, considering the journal's international scope and credibility, and other moderating variables like education level, mathematics field, cooperative learning techniques used, and length of time spent learning mathematics.

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APPENDIX

RESULTS OF GROUPING RESEARCH STUDY DATA

Researcher and Year	Access of Journal
Ayu and Gusmania (2018)	https://www.journal.unrika.ac.id/index.php/jurnalphythagoras/article/view/1319
Cahayati and Irwan (2017)	http://jurnal.una.ac.id/index.php/jmp/article/view/122
Dhema and Wahyuningsih (2018)	http://jurnal.ikipmumaumere.ac.id/index.php/birunimatika/article/view/95
Dida et al. (2018)	http://jurnal.ikipmumaumere.ac.id/index.php/birunimatika/article/view/8
Dunir (2019)	http://jurnalmandiri.com/index.php/mandiri/article/view/62
Ebe (2019)	https://www.ejournal.lppmunidayan.ac.id/index.php/fkip/article/view/292
Ernanda et al. (2021)	https://www.journal.unrika.ac.id/index.php/jurnalphythagoras/article/download/3127/pdf
Febriani et al. (2020)	https://proceeding.unikal.ac.id/index.php/sandika/article/view/414
Fitria and Leonard (2015)	https://journal.lppmunindra.ac.id/index.php/repository/article/view/2409
Natalia and Leonard (2015)	https://journal.lppmunindra.ac.id/index.php/repository/article/view/2394
Rahayu et al. (2017)	https://jom.unri.ac.id/index.php/JOMFKIP/article/view/12482
Ramadhani and Azis (2020)	http://jurnal.umsu.ac.id/index.php/jmes/article/view/4025
Saragih (2019)	http://jurnal.una.ac.id/index.php/jd/article/view/642
Setiawan et al. (2020)	https://jurnal.radenwijaya.ac.id/index.php/PSSA/article/view/196
Setyawan and Leonard (2017)	https://journal.lppmunindra.ac.id/index.php/repository/article/view/1954
Sudirman (2015)	https://gemawiralodra.unwir.ac.id/index.php/gemawiralodra/article/view/118
Sumiati and Sumartono (2017)	https://ejournal.unitomo.ac.id/index.php/mipa/article/view/452
Suryani et al. (2019)	https://www.journal.unrika.ac.id/index.php/jurnalphythagoras/article/download/2011/1435
Thifal et al. (2020)	https://jurnal.ustjogja.ac.id/index.php/union/article/view/8062
Wahyuningsih et al. (2013)	https://ojs.unud.ac.id/index.php/jmat/article/view/16568
Wulandari and Leonard (2015)	https://journal.lppmunindra.ac.id/index.php/repository/article/view/2503