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COMMENTARY

Intelligence Games: A Useful Tool in Philosophy and Logic Education

Longjun Zhou

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"Logic is the beginning of wisdom, not the end." –Leonard Nimoy

INTELLIGENCE games are mainly comprised of intellectual activities and often based on certain intellectual training purposes. They are designed for individuals to increase knowledge and develop thinking skills in a voluntary and relaxed mood through vivid, novel, and engaging activities (Huang, 1985). Intelligence games require thinking skills such as reasoning, logical thinking, imagination, strategical judgement, creative thinking, etc., thus having the potential for positively affecting student cognitive development. They can be organized by adults or initiated by students themselves. The content of intelligence games covers a wide range of domains such as computer, mathematics, literature, and more.

Philosophy is the study of theories about fundamental topics such as the nature of existence, knowledge, and thought. It is also a rational and critical inquiry of its own methodology and assumptions, which differentiates it from other disciplines. This means philosophy education is not only about students' mastery of philosophical knowledge, but more importantly about the development of independent and critical thinking power in them. To achieve the goal of philosophy education, the teacher must introduce students to the processes of philosophical investigation rather than solely emphasizing the study of abstract concepts (Sun, 2000).

Logic is the study of correct reasoning. It plays a pivotal role in many fields and is the foundation of all learning (Zhang, 2003). The renowned mathematician Kurt Godel claimed that logic is the most crucial among all academic disciplines, containing all the basic concepts and principles of science. The German logician, philosopher, and mathematician Gottlob Frege stated that the laws of logic are not confined to the domain of logic itself, but instead, they are the foundation of natural laws. Logic education is to teach students the basic rules and laws of logical thinking and help them attain the skill of reasoning, a cognitive competence critical throughout their lives.

The *Place of Intelligence Games in Philosophy and Logic Education* in this issue is a study of the effectiveness of intelligence games in philosophy and logic education. The research highlights that intelligence games and philosophy and logic education share identical educational objectives, that is, to develop essential cognitive skills in students, such as criticism, questioning, reasoning, problem solving, association, and discrimination. Intellectual games that provide individuals the opportunities to tap their potential and develop strategies to solve problems can serve as a tool in philosophy education to apply philosophical knowledge to seeking solutions to problems. To make prompt and effective decisions in the problem-solving process, it is necessary for student to develop systematic logical thinking competences including skillful reasoning (Duman et al., 2023). It is hoped that this study can spark more research on the roles of intelligent games in school education.

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COMMENTARY

Enriching Students' Academic Life with Creative Education

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"Creativity is a type of learning process where the teacher and pupil are located in the same individual." –Arthur Koestler

AS research and practical exploration in education intensify, the awareness that school education should aim at outcomes more than just student academic achievements has been heightening in the educational community. Social advancement raises more demanding requirements for education, posing increased responsibilities on schools and instructors. There is a growing consensus that schools should provide students with a more colorful academic life, which goes beyond curricula content and allows students rich academic experiences, in order to foster all-round development in them.

Articles published in this issue exhibit common concern about this topic. *Effects of After-School Programs on Student Cognitive and Non-Cognitive Abilities: A Meta-analysis Based on 37 Experimental and Quasi-experimental Studies* is a comprehensive evaluation of the impact of after-school service on student growth with the conclusion that diverse and meaningful after-school programs have positive influences on cognitive and non-cognitive development of students (Yao et al., 2023). This study yields scientific evidence for school administrators and teachers on how to optimize the planning and execution of after-class activities. The other two original articles study the utilization of intelligence games and scientific models in disciplinary instruction and investigate the roles of games and models in nurturing students' cognitive capabilities. The findings of these two studies indicate that well-designed intelligence games and scientific models can serve as effective means for students to deepen their thinking and develop systematic thinking skills, facilitating the instruction of complex, challenging subject matter. The lesson study titled *Practical Exploration of the Holistic Module Learning Model* provides an example of how to employ a well-crafted learning protocol to implement student-centered, captivating classroom teaching (Zhang, 2023).

Discourses like these are unquestionably of practical significance. Against the backdrop of aggravated uncertainty where political and economic situations as well as science and technology are undergoing dramatic changes, it is possible that today's students will have difficulty tackling future challenges with established knowledge, methods, and experience. It is imperative that schools help students develop adaptive capacities through creative education. The traditional linear teaching paradigm that pursues definite answers and solutions will inevitably be replaced by more innovative, competence-based education. Although the articles in this issue are not intended to offer conclusive solutions for such a shift, efforts to present evidence-based research findings on specific areas and to provide educators with practical instruction approaches will ultimately contribute to educational transformation. Despite that it is impossible to teach students to get fully prepared for all future uncertainties; we believe that we are on the right track when offering students diverse, novel educational experiences.

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ORIGINAL ARTICLE

The Primary Students' Understanding of Scientific Models through Epistemological and Ontological Perspective

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Abstract*: Achieving the targets of science education mostly depends on the true understanding of the fundamentals where science and the scientific efforts are embedded through the realist ontology and epistemology that science is based on. Models have a special place in science education revealing to understand the nature and status of scientific knowledge. By considering this function of models, this research puts forward the views of the primary students on scientific models. The participants of this qualitative survey research are twenty-eight 7th graders of a primary school in Izmir, Turkey. The participants are given a questionnaire and a worksheet, which were developed by the researchers, addressing both epistemological and ontological character of models. The results showed that students have generally moderate understanding of models through perceptual and ordinary reality.*

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Introduction

MODELING is an evolving area for many science education researches and curricula emphasizing the scientific and technological practices based on inquiry (Turkish Ministry of National Education [TMNE], 2018); American Association for the Advancement of Science [AAAS], 1993; Erduran, 2006; Abd-el-Khalick et al., 2004; Boujaoude, 2002; The National Research Council [NRC], 1996, 2007, 2012). When learning science through inquiry as well as developing models, students should ask questions to define problems or to make sense of phenomena, plan an investigation, collect and analyze data to create explanations and solve the problem. Therefore, running models and modeling have been seen as an important element of scientific inquiry (Giere, 1999) and we cannot think of science through the history without them (Matthews, 2007).

Models and modeling are broadly known with its representational characteristics in the classroom settings in the pragmatic sense such as making understanding easier and clear. However, if teaching and learning with models involves constructing science concepts and processes it should also include the views about these efforts (Lee, 2017; Gobert et al. 2011; Prins et al. 2010). Moreover, studies have reported that understanding about various features of models and modeling is effective on science learning and scientific practices and inquiry (Lohner et al. 2005; Schwarz and White 2005; Lederman 2007). Therefore, researchers pointed that teaching models and modeling should also focus on sophisticated views of scientific models and modeling as well as science concepts (Gobert et al. 2011; Prins et al. 2010; Raghavan & Glaser 1995). Especially views and questions about reasons of scientific models stimulate students reflect on their understanding of science (Arons, 1990). This research aims to search for the views of students on models and modeling.

Models and Modeling

Models and modeling have an important place in various science disciplines from cosmology to biology, from geology to chemistry, from physics to mathematics etc. Some of the most known examples are the double-helix model of DNA, atomic models, various molecular models, system models, inflationary models in cosmology. Researchers, scientists, teachers and etc. construct scientific models for simplifying the comprehension of natural phenomena or systems by representing the target (Silva, 2007; Grosslight et al., 1991). Models help science and science teaching by different types each emphasizing different dimensions of the relation of the target and model object exists. For example, conceptual model, mathematical models, computerized models, scale models, mental models etc. Although they emphasize different aspects of the relation, they all facilitate understanding.

In pedagogical manner, modeling enables to activate many competences as it serves an intrinsic process of construction and use of science concepts (Lopes & Costa, 2007). It helps teachers for explaining scientific phenomena and students make their understanding through (Treagust et al., 2002). While, students in modeling classrooms experience learning by doing they also have the excitement of learning about the natural world resulting in sense making through representations and building representations. According to Chamizo (2013) these representations models and modeling gain meaning by who identifies them in a defined context. These help making meaning of the environment or the unknown, which makes representations important and valuable. Lehrer and Schauble (2010), emphasize that using models or modeling helps highlight the core components of phenomenon or object by establishing the special conditions of seeing. In another words, models and modeling help build scientific knowledge. For example, in teaching of atoms we do not focus on the existence of atoms at first but on the validity of an atomic model to explain the macroscopic properties of mater (Albanese & Vicentini, 1997). Therefore, in model-based science teaching models and modeling have important roles in producing (justification and formation of) knowledge (Tapio, 2007). Moreover, according to Justi & Gilbert (2002), the purposes of science can be satisfactorily realized when students also have a consistent understanding of "model" with the community of scientists' including the gain of modeling competence. Practicing modeling competence is seen in an important part of scientific literacy (Gilbert & Justi, 2016; Nicolaou & Constantinou, 2014; Louca & Zacharia, 2012).

Based on the literature, Chiu & Linn (2019) summarizes the modeling competence by dividing into three main heading: "models and modeling knowledge"; "practice" and "metacognitive knowledge of models and modeling." In the first heading there lie the knowledge of "ontology," "epistemology" and "methodology." The second heading includes "process" and "products" separately. The last heading has "planning," "monitoring" "executing" and "evaluating." Actually why this summary starts with models and modeling knowledge have roots extending down to Kuhn's (1996) understanding of paradigm and Halloun's (2006) ontological and epistemological tenets of a scientific theory that model belongs to revealing models and modeling.

Epistemological and Ontological Aspects

A model focuses on key features to explain and predict scientific phenomena through representations by abstracting and simplifying (Schwarz et al., 2009). These key features position models and modeling in a realist perspective with experimental consistency of the process through a match between theory and progression (Koponen, 2007). Extension of this ideas reflects that science and science teaching benefit from models and modeling through connections among various components of science contexts such as theory and objects or phenomena (Develaki, 2007; Silva, 2007). These relations are mostly based on analogical reasoning and established by considering the structural mapping between the model object and the target to be modeled (Unal Coban, 2009). The connection between model and modeled phenomenon is generally established in analogical manner within representational propositions. We name the object as a model which is used for representation.

As a natural consequence of discussing the degree of the similarity or representational power of various models and modeling procedures in educational settings rise questioning leading to a degree on philosophizing about models and modeling. Therefore, as stated in the previous section models, explanations, arguments, and reasoning supported by models and evidence are all included in science instruction in addition to concepts. (Penner, 2000). Similarly, Koponen (2007) argues that the philosophical concerns surrounding the relationship of theory to the reality as experienced or as accessed through experiments are strongly impacted by the epistemological and methodological questions relating to models and modeling. However, Séré et al. (2001) claim that the ontological dimension, which deals with scientific models and their experimental correspondences, and the epistemological dimension, which ensures the validity of explanations, are the two dimensions of the philosophy of science that determine the state of scientific knowledge. Similarly, Mahr (2015), argues that models depend on the presence of the steps that the model object is intended to reflect in the background and that models are used to explain the experience world from an epistemic viewpoint. The ontological dimension deals with how and under what circumstances the scientific entities addressed by models are defined, termed, and functionalized based on scientific realism (Eflin and et al., 1999). It also addresses our understanding of the universe, the world we inhabit, and even our own self. The epistemological dimension conceptualizes models and constructs images of objects or rules revealing the reality (e.g., Gentner & Smith, 2012; Johnson-Laird, 1983; Nersessian, 2008)

Enhancing scientific literacy is a goal of science education, and it depends on accurate scientific understanding and endeavors (Hodson, 1999). To achieve this goal, realist ontology (what models are made of) and epistemology should be introduced to scientific education along with the philosophical foundations upon which science is based (what models are for) (McCharty & Sears, 2000:376). Similar to Sere and et al. (2001), in her study about the models and modeling in physics education, Koponen (2007) put forwards three aspects to focus on; “empirically reliable models are our bridges to reality," "empirical reliability is established in the process of matchmaking." and "an authentic image of physics requires empirical reliability, but only minimal realism. Since there is not a one to one correspondence between models and reality they represented some misconceptions may occur (Grosslight et al., 1991; Harrison & Treagust, 1996, 2000). For example, using sticks to hold the clay balls in the model of a molecule may be misunderstood by the students representing the bonding just as then copies of sticks.

"Models and Modeling" in Science Education

When contemporary scientific education research is examined, it becomes clear that some scientists believe the nature of models and modeling to be both a component of the nature of science and a component of its epistemology (Gobert et al. 2011; Justi & Gilbert, 2002). Various studies have been done on this subject. For example, Grosslight et al. (1991), interviewed with 7th and 11th grade students about what models are and reported that most of the students thought of models either as toys or as copies of reality having aspects or parts of the real thing omitted and are produced to provide copies of objects or actions (level 1). Only minority of students thought of models as being created and tested for a purpose where the emphasis on some components therefore altered, but the template of reality still predominates (level 2). They also noted that none of the students realized that a model is created to test ideas, rather than as a copy of reality; the modeler has an active role in its construction for a specified purpose and a model can be tested and changed to inform the development of ideas (level 3). Similarly, Harrison & Treagust (1996) determined that more than half of the tenth graders they studied with were at level 1, the rest were at level 2 and none were at level 3.

Treagust et al. (2002) developed the Students' Understanding of Models in Science (SUMS) questionnaire to probe students' understanding of the role and purpose of scientific models. They found that students' interpretation of the term 'scientific model' depends on their experiences and personal understanding. Models as multiple representations were recognized as being necessary and useful by the majority students, and they appreciated the visual value of scientific models in helping generate their own mental models. Students showed good appreciation for the changing nature of scientific models which was linked to the changing nature of scientific knowledge. They also reported that students understanding of model more commonly fit into general models apart from scientific models and more generally they understood the descriptive role of models. There found to be a gap between this description in terms of the applicable role of models in scientific ways such as making predictions and testing ideas.

In their study, Schwarz & White (2005) designed a model-enhanced curriculum based on categorization tasks in a physics course in which the students learn about scientific models and engage in the process of modeling. They reached that the development of metamodeling knowledge can be effective in teaching students about scientific modeling, inquiry, and physics. For example, students got significantly better conclusions on the inquiry test and performed better on some of the far-transfer problems on. They concluded that model-based inquiry, accompanied by the development of metamodeling knowledge, can facilitate learning science content while also developing students' understanding of the scientific enterprise.

Al-Balushi (2011) mentioned that learners being studied' epistemological perceptions regarding the existence of natural entities. They proposed four levels about the existence of natural entities and phenomena; certainty level (the student believes that the natural entity or phenomenon is real and the textbook illustrations reflect how it really is); imaginary level (the student believes that the natural entity or phenomenon is real, but the textbook illustrations reflect the scientists' imagination of how it really is); suspicious level (the student believes that the natural entity or phenomenon is real, but scientists cannot imagine it, then these illustrations are far from reality) and denial level (the student believes that the natural entity or phenomenon is not real; it does not exist). They found that students tend to perceive entities, which are usually represented by photographs or micrographs such as meteors and meteorites, blood cells and bacteria and into the certainty-level category and the entities, which are usually represented by detailed sketches and rarely by micrographs such as animal and plant cells, fall into the certainty–imaginary combinational level category. There are other ways to depict things that were at the hypothetical level, like atoms, water molecules, enzymes, and chromosomes: drawings, symbolic representations, little two- and three-dimensional models, or historical models. More abstract models such as symbolic, iconic models and dots- and arrows-based diagrams (e.g. Lewis structures) are frequently used as a means of representation to illustrate entities that were in the imaginary–suspicious combinational level such as sub-atomic entities (electrons and protons). Theoretical entities such as e-cloud, photons, alpha rays, atomic orbits, and magnetic and electrical lines of force were at the imaginary–suspicious–denial combinational level. Students' perception of models and determined that they tended to associate more concrete representations, such as a photograph of bacteria, with certainty. On the other hand, students believed that concepts like photons or alpha rays, which were presented in a more abstract way; either "could not be conceptualized by scientists" or "did not exist."

Similarly, Krell et al. (2014) assessed students' different levels of understanding of models, multiple models, the purpose of models, testing models, and changing models. During their research, each item included a description of the original phenomenon and a model representing the phenomenon. The students had to rank the three levels of statements after viewing the model and phenomenon pair. The results showed that the students had "partially inconsistent" views of models across the five aspects. The researchers found that the students with a higher level of nonverbal intelligence and with good grades possessed a higher level of understanding.

Moreover, Gogolin & Krüger (2018) investigated students' understanding of the nature and the purpose of models in biology with respect to context- and grade-specific differences. They reached at most students in all grades see models as idealized representations of an original that have the purpose to show or to describe this original. The students' levels of understanding of the nature and the purpose of models increase only little across grades. Besides, they found that the students' understanding becomes more consistent in higher grades. In another study, Lee and et al. (2017) examined the potential impact of the representational characteristics of models and students' educational levels on students' views of scientific models and modeling through an online multimedia questionnaire. They found that the high school students were more likely to recognize textual and pictorial representations as models, while also being more likely to appreciate the differences between 2D and 3D models.

Barzilai and Eilam (2018) conducted a study including the epistemic criteria used by the students. They grouped the data collected into three major categories of communicative criteria (the relation between the visual representation and the viewer), the representational criteria (the relationship between the representation and the reference) and the epistemic affordance criteria (refer to whether the visual representation enables the viewers to achieve their epistemic goals). They found that different designs and the inclusion of information in the scientific visual representations could evoke different evaluative criteria. However, only a minority of students were concerned about the validity of information and the source trustworthiness of the scientific representations.

However, Lee et al. (2021) investigated students' views of model evaluation through the lens of personal epistemology. They developed an integrated analytical framework by combining a developmental framework, including absolutist, multiplist, and evaluatist, with a multi-dimensional framework, including limits of knowing, certainty of knowing, and criteria of knowing. They reported that the percentages of 11th-grade students choosing the evaluatist assumptions were higher than the eighth-grade students. For students choosing multiplist and evaluatist assumptions, the 11th-grade students were more likely than the eighth-grade students to think in terms of pragmatic and evidential criteria as the criteria of knowing.

In their study revealing the research reviews on models and modeling, Machado & Fernandes (2021) stated that model conceptions are mostly attributed with concrete, construct and mathematical models. They concluded that, in most of the researches concrete models ultimately consisted in providing ways to create and use material and pictorial forms of visualization of objects and events – therefore trying to make them more concrete – construct models, in contrast, tended to emphasize the abstract, idealized, conceptual nature of models. The researches in science education mostly emphasize the external visualizations in terms of the representations. Another interesting finding addresses about the lack of a universal and single definition of what a model is.

To summarize, models are based on evidence about the phenomena (Schwarz et al. (2009), they constitute representational criteria (Barzilai & Eilam, 2018), they are consistent with empirical evidence (Pluta et al. 2011) and therefore, powerful tools of thinking about reality, scientific knowledge and inquiry. As mentioned previously, many of the science education curriculums tend to cover modeling. However, research results in the field of science education regarding the views about models and modeling, overwhelmingly, address the epistemic nature of models in a varying and inconsistent spectrum as stated in the previous paragraphs. Taking the research results into account, it is seen that there is a discontinuity from inquiry to the nature of modeling such as the students' lack of concerning about the validity of information and the source trustworthiness of the scientific representations (Barzilai & Eilam, 2018), denying the existence of natural entities and phenomena (i.e. Al-Balushhi, 2011), thinking of models as being created and tested for a purpose (Grosslight et al., 1991), lack of describing models in scientific ways such as making predictions and testing ideas (Treagust et al., 2002), etc. Moreover, it is also noteworthy that as the students' grade level increases the inconsistencies in their understanding of models and modeling tend to decrease (Gogolin & Krüger, 2018; Lee et al., 2017).

These findings reveal that most of the researches deal with epistemic side of models and modeling and few research mentions about ontological part models and modeling refer to. Depending on this, it is thought that there are still some issues to be worked on such as the reality the models address and how models work in science especially in lower grades that may result in lack of an either conceptual clarity or consistency extending to the construct validity, theory development, and via leading prevention science education researchers and educators from focusing on the precise skills they wish to study as stated by Kahn & Zeidler (2017). Therefore, the aim of this study is, besides uncovering various aspects of students' perceptions regarding scientific models and modeling also finding out the students' epistemological and ontological positions regarding the models. Moving from this perspective, this research may contribute to science educators to organize, design and plan their courses by knowing how students think of model and modeling through the epistemological and ontological perspective.

Methodology

The research is in simple descriptive survey design. The study was conducted with twenty-eight 7th graders of a primary school in Izmir, Turkey. The participants are randomly selected by considering their voluntariness. The data were collected through a questionnaire and a worksheet qualitatively. The researchers created a questionnaire and worksheet that ask about the epistemological and ontological characteristics of models. The questionnaire has 12 questions in three parts namely "description and use of models" (4 questions), "scientific models" (3 questions) and "the reality of models" (5 questions). The worksheet is composed of an inquiry about the historical evolution of the atomic model with a textbook paragraph and 5 questions following it. The textbook paragraph gives information about the atomic theory starting from Dalton's to modern atomic theory and the models behind these theories. Following the text are some sample evaluation questions. Students are tasked with identifying historical models and their attributes, presenting their best and weakest arguments, and determining whether or not scientists agree on or acknowledge the existence of new things in the atom from an ontological point of view. The data collection instruments were presented to experts and piloted on another group of primary students for providing its validity and reliability.

Since the data were qualitative in character its content was analyzed. In the analysis, the structures toward particular meanings, concepts and relations were tried to be figured out where it is necessary to establish these structures over the categories with the codes identifying them (Buyukozturk et al., 2008). Therefore, the answers were examined to draw comparisons and distinctions according to their meanings to identify the codes. The answers were recorded by the two of the researchers. The level of agreement between the researchers as the reliability of the procedure was found as 0.91. After that, the codes addressing the same structures were categorized. The codes and categories were analyzed using an evaluation key which was derived by the researchers from the works of Kuhn, Cheney & Weinstock (2001), Smith et al. (2000), Carey & Smith (1993), Grosslight et al. (1991), Treagust et al. (2002). The evaluation key aimed at classifying the students' answers regarding the epistemological and ontological perspectives.

In the epistemological perspective, the rubric defines three levels of understanding of models addressing the "description and use of models," "scientific models" and "the reality of models." The explanations for each level are given in **Table 1**.

As seen from **Table 1**, Level 1 is the basic level in which students see the models as the one to one copy of the real things without any purpose or idea in the mind. Level 2 is more developed than Level 1 in realizing the effect of the ideas where the level 1 type relations are still dominant. Level 3

Table 1. The Explanations of Levels Given in the Evaluation Key for Epistemological Perspective.

	Level 1	Level 2	Level 3
Description and Use of Models	A model is the copy or reproduction of something (copy, scale models, toy car and etc.). A model only requires surface similarities (color, length, shape and etc.) A model is for only observable properties.	One starts to understand that geometrical shapes, set of numbers, graphs, diagrams, maps and stories and etc. are used for representing objects, events and processes. Even though one starts to understand the functional properties that models exhibit, fundamentally s/he concerns the surface properties dominantly.	One can classify the models and do the necessary changes. Besides the scale models, geometrical shapes, number sets, diagrams and maps one can use the mathematical models. The same target model can be represented by more than one model. One can decide which model to use considering the functional and structural properties of the model.
Scientific Models	One is not aware of the distinction between the ordinary and scientific models	Realizes that models are used in the scientific studies. It is enough to use a model in a scientific explanation to call it a scientific model. It does not require an experimental correspondence or effort. Scientific model is one which is accepted by most people. The only explanation is enough for a model to be correct, no need to support by experimental evidence. The correctness of a model is validated not for the correctness of the idea but the self-competence of the model.	Knows that models are vehicles for testing the ideas in scientific studies. Understands that models verify the results of the real observations or experiments.
The Reality of Models	The model is not real but can be used for obtaining information about real things. Only the objects having a physical appearance have model correspondence. Everything is already represented by only a model.	One can see the possible effects of the changes done on the model. One starts to be aware of that every model cannot respond to the reality including all details. One starts to think that events and processes have model correspondences as well as objects. Starts to think that the ideas of the model maker are important but the importance of the ideas are unclear yet.	Models are used for representing the processes that are very slow, very quick, at insignificant or large scale to observe directly or dangerous experiences. Although it gives almost true result it is not only that replace with the reality. The idea of modeling the modeling was developed and modeling the objects, events and processes.

is more sophisticated than the other levels representing that models are the product of idea and used as vehicles for testing the ideas. The codes grouped under each category are given in **Table 2**.

In the ontological perspective, the key has 5 parts namely perceptual realism, ordinary realism, structural realism, entity realism and scientific re-

Table 2. Codes for Categories Defined for Epistemological Dimension.

Level	Description and Use of Models	Scientific Models	The Reality of Models
Level 1	Maquette, writing, drawing, design, similarities, observation, appearance	No model, that is model, (ordinary) model	The copy of the reality, Very close to reality in appearance similarity, the appearance is important, only one model represent one thing
Level 2	Used for better understanding, can be used in everywhere, symbolic representation, a shape, everything cannot be modeled	Scientists use, model that is based on science and used for science, helps inventing, drawn by scientists	Models may not one to one copy of reality since it represents similarity (the similarity is unclear), models scale the original one, models may have rules, anything can be modeled with more than one model, models cannot produce knowledge
Level 3	Help making works and researches easier, everything can be modeled	Universally accepted models (i.e. Bohr's atom model), proven to be true by scientists through experiments, used for scientist's idea testing	No one to one copy of reality, models , models can help producing knowledge, represents the realistic elements

Table 3. The Categories and Codes for Ontological Dimension.

Category	Explanation	Codes
Perceptual Realism	For understanding the real-world representation of the things and events around us, the things or models that we sense are sufficient.	Seeing, touching, checking physically (i.e. with microscope.), using technology
Ordinary Realism	Understanding reality and models depend on the efforts. These efforts may be in a range of from conducting research, developing instruments and collecting data. However, the qualities of these efforts are unclear. The reality of the event or object which is represented with model may only be known if the efforts turn out to successful.	Conducting research, investigating, arguing, comparing, developing an instrument, being inadequate for explaining
Scientific Realism	Understanding objects and events require scientific efforts. The events and objects explained by science are real. We can only achieve true understanding of events and objects by using scientific efforts. Scientific thoughts are important to design the scientific efforts and models. For an entity to be proven scientifically requires correct experimental results and theoretical explanations at the same time.	Scientific research, proving scientifically, checking the fort he effects the objects and events on the others, the model (knowledge or information) is revised according to the true results, model (knowledge or information) is falsified, circumstances are affective on the scientific efforts.
Structural Realism	Successful experimental results are not needed for any explanation or theory to be true. What important is the explanations and theories postulating the unobservable entities even the experiments conducted with them give wrong results. That the correctness of the explanations is important not the entities.	Explanations (information), which are always improving, can nevertheless be given for things that no longer exist.
Entity Realism	Scientific theories that assert the reality of some unobservable entities are not what support their existence; rather, experimental findings do. While the approach to entities is realistic, the approach to explanations is not always realistic.	It still exists, it is present as it can be experimented, the explanation is insufficient, nothing happens to the object

Table 4. Students' Views on Models from Epistemological Perspective.

	Description and Use of Models N (%)	Scientific Models N (%)	The Reality of Models N (%)
Level 1	22 (79)	9 (32)	15 (54)
Level 2	4 (14)	15 (54)	11 (39)
Level 3	2 (7)	4 (14)	2 (7)
Total	28 (100)	28 (100)	28 (100)

Table 5. Students' Views on Models from Ontological Perspective.

Category	N, For all 5 of the Questions	%, Rate
Perceptual Realism	46	33
Ordinary Realism	43	31
Scientific Realism	12	9
Structural Realism	8	6
Entity Realism	1	1
No Answer	30	21
Total	140	100

alism. The explanations for each component of ontological categories with the identified codes are given in **Table 3**.

The categories in the ontological frame are based on realism. Perceptual realism, ordinary realism and scientific realism address the realistic perspective evolving from rough realism to scientific realism. However, structural realism and entity realism address an incomplete realistic or anti-realistic understanding.

The two researchers also assigned codes to the various groups. The level of agreement for code assignment was found to be 0.89. The level of agreements obtained at both describing codes (0.91) and assignment of codes into the categories (0.89) provide that the data is analyzed at reliable rate. The data is analyzed descriptively by giving the number of students on each category.

Findings

The finding of the research is given in two main parts: epistemological and ontological dimensions.

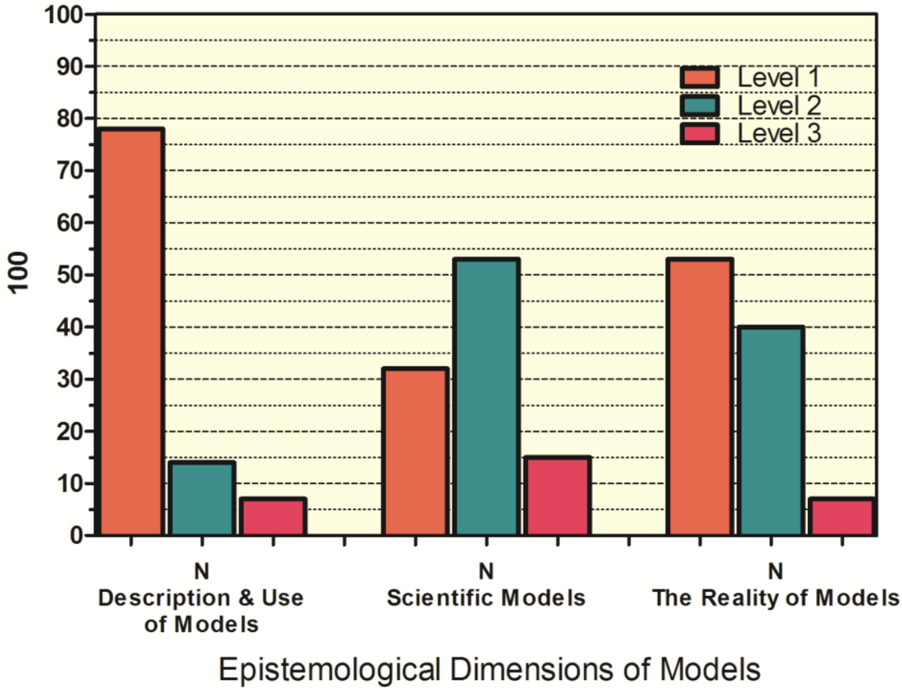

Figure 1. The Epistemological Profiles of Students' Ideas about Models.

Epistemological Dimension

The students' views about models from epistemological perspective were given in **Table 4**.

The data is also piloted into the below graph of **Figure 1** in a clear way.

As both **Table 4** and **Figure 1** show, almost all the students' descriptions and use of models are at level 1. However, for scientific models and the reality of models more than half of the students' understanding of scientific models is at level 2. Typically, the level 3 understanding of models at every dimension is observed to be the least. Some examples of students' expressions are given below.

On descriptions and use of models":

"... the models are used by scientist, science teachers and students to understand what an atom is like." Level 1 (Student A)

"… model is a maquette of a thing" Level 1 (Student B)

"… if anything can be designed than it can be modeled" Level 1 (Student R)

"… it comes my mind the shape of an atom like this (drew the model of an atom that is given below). Level 1 (Student L)

"… model is used to understand and tell well what thing is and can be used in every area." Level 2 (Student H)

"… model make easier the way we use while doing research,… everything can be modeled by various ways" Level 3 (Student Y)

Students mostly relate models to on "scientific models":

"… I have never seen a scientific model. … the scientific models should have correspondences in the real life." Level 1 (Student H)

"… the scientific models are the models used by scientists for scientific works" Level 2. (Student A)

"… a scientific model is based on a scientific event, for example atom model is based on atoms, they are important because experiments are conducted on models." Level 2 (Student N)

"… a scientific model means that it is accepted by a scientist from worldwide, for example the Bohr's atom model in the textbook…they guide scientists in their scientific studies,… they are formed by scientists. Level 3 (Student U)

On "reality of models":

"… the models are the copy of the real things; they reflect everything in a one correspondence." Level 1 (Student H)

"… any model should look like whatever it represents." Level 1 (Student S)

"… models are not the copy of what they represent." Level 2 (Student B)

"… anything can be modeled by various models; in each representation some points should be considered" Level 2 (Student N)

"… models reflect the reality of what they represent in various forms for producing knowledge" Level 3 (Student V)

Ontological Dimension

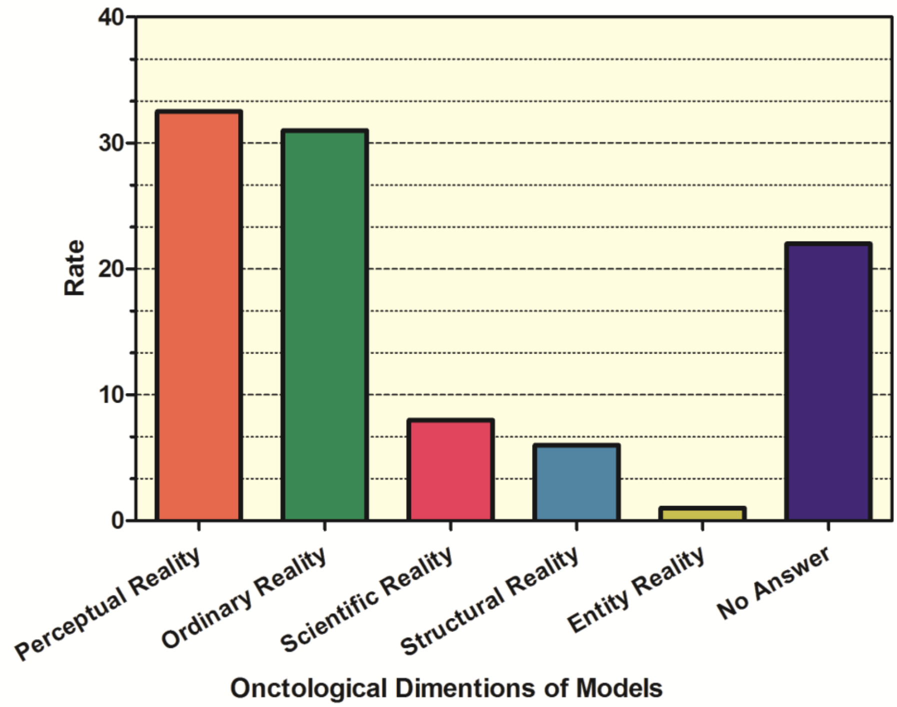

Figure 2. The Ontological Profiles of Students' Ideas about Models

The students' understanding of models from ontological perspective was evaluated using the categories and codes given in **Table 5**. The data was analyzed for all 5 questions by introducing the rate of the category among the answers for all the questions (for 5 questions N become 140, as equal to 5 times N that is 28). First, the number of students agreeing on a category for all the questions was defined. Afterwards, the rate was calculated for a category as the percentage of the students whose answers fall in that category in total answers.

The distribution of the rates to the categories are also represented in **Figure 2**.

Figure 2 shows that students' ontological understanding of the models address perceptual and ordinary realities at most. However, a considerable number of students had no idea about the subject. Scientific realist views are less than 10% among the other views. Structural and entity realistic views have the least rates.

Some examples from students' expressions are given below.

"... atoms are not present actually and do not correspond to anything since they are not alive." Perceptual Realism (Student G)

"... atoms do have correspondence in real life as we figure out what we see under electronmicroscopes." Perceptual Realism (Student E)

"... atoms are proven models by works, researches of scientists." Ordinary Realism (Students L)

"... atoms can be understood by the works of scientist" Ordinary Realism (Students A, I and E)

"... the scientist changes the atomic model when he or she tests the idea and get different result apart from the model offers. Scientific Realism (Students U, N and W)

"... the raisin pudding model of the atom constituted by Thomson was checked by scientists for several times and finally it falsified. Scientific Realism (Students H)

"... Dalton's atomic model still exists although it was unsatisfactory in explaining the mass relations. Structural Realism (Student S)

"... the scientists explanations are progressing all the time." Structural Realism (Student F)

"... scientists conducted experiments by using the models, ... sometimes they (models) failed but the atom is still there..." Entity Realism (Student C)

Discussion

This study, which is expected to contribute to the literature in the field, intended to present 28 seventh grade students' perspectives on the ontological and epistemological foundations of scientific models. Although the results are not encouraging, they do indicate the need for further thorough research.

Most students' views on description and use of models and their reality address level 1 understanding. This means students mostly believe that a model is the copy or reproduction of something (copy, scale models, toy car and etc.). Moreover, they also highlight only surface similarities (colour, length, shape and etc.) and emphasize observable properties and evaluate model attributions according to the physical appearance. Similar research findings from Harrison & Treagust (1996) and Grosslight et al. (1991) indicate that children perceive models as physical representations of reality. This finding supports Cheng & Lin's (2015) research on students' perceptions of scientific models and their capacity to create their own models (where they mostly lie on observational models to provide an explanation). This research has shown that middle school and high school students tend to have a narrow understanding of scientific models, considering them as physical replicas of target things. There is additional research with equivalent results to this result (Gobert et al., 2011; Treagust et al., 2002). However, the participants mostly have ideas about scientific models at level 2. They realize that models are used in the scientific studies, but do not have idea how they are used. Additionally, they appear to undervalue the experimental data that supports or refutes a scientific model. As the level 2 understanding of model reveals, the correctness of a model is validated not for the correctness of the idea but the self-competence of the model. Corroborating the results of this study, Carey & Smith (1993) also discovered that pupils' traditional views of science may exist despite the constructivist program. Models and real, unchanging, and absolute knowledge are always produced by science, according to the traditional understanding of science (Aikenhead, 1997). It may be concluded that they still think of depending on concrete elements. They seem not to be aware of the effect of ideas for producing a model. Another result that should be paid attention is that models are vehicles for helping scientists or others during testing of their ideas. The students' omission of critical scientific study concepts like hypothesis testing, fair testing, variable control, or scientific method abilities may account for this result (Chin & Brewer,1993; Sandoval, 2005).

The students' ontological perspectives on models show that they mostly possessed perceptual and common sense understandings associating models to the things we see through sight, touch, and other senses. Also, they believe in that models and modeling can be understood by efforts in a range of from conducting research, developing instruments and collecting data unclearly. Besides, understanding reality and models depend on the efforts for understanding. These efforts may be in a range of from conducting research, developing instruments and collecting data. However, the qualities of these efforts are unclear and using technology. Less than 10 percentages of students had understanding based on scientific realism. It is also worth noting that structural realistic and entity realistic ideas are represented at very lower rates. The model evaluation of the students was the subject of a study by Lee et al. (2021), which discovered that beliefs that "one model is better than another" were supported by true/false and pragmatic criteria of knowing, while beliefs that "both models are valuable" were supported by certainty of knowledge and pragmatic criteria, and beliefs that "depends on the evidence" tended to be informed by evidential criteria of knowing and the bounds of knowledge. As a result, it is assumed that students lack the necessary content knowledge or methods that make an issue scientific. Additionally, this might be the outcome of the fact that distinguishing a model in realistic way requires cyclic modeling activities identifying the features of this model as well as its strong and weak points for dealing with phenomena involving causal mechanisms as (Soulios & Psillos, 2016) offer. The studies conducted with model-based learning show that modeling help students' understanding of reality and the reality of model's representation (Barab and et al. 2000; Coll & Treagust, 2003; Taylor, 2003). Some studies have hypothesized that students' modeling practices may be influenced by their comprehension of scientific models (Schwarz et al., 2009), or that students' modeling practices may be shaped by their understanding of models (Crawford & Cullin, 2004; Nicolaou & Constantinou, 2014). For example, Mashhadi & Woolnough (1998) determined that secondary school students had scientific realistic views when true modeling occurs in the classroom.

As modeling-based activities occur in the classroom, students develop and improve their epistemological understanding of models and modeling (Tasquier et al. 2016), as well as their knowledge of science-related material (Soulios & Psillos 2016; Treagust et al. 2002). Therefore, models and modeling should be firstly considered in the classroom than they need to be implied carefully. Models are validated by comparing them to actual observations and data, and model evaluation should be based on and the goals of modeling (Grosslight et al. 1991; Schwarz et al. 2009). Students' focus on certain representational affordances when deciding what information should be included in a model might also result in a more simplistic understanding of modeling (Lee et. al., 2017). Therefore, the models given in the curriculum should be investigated in terms of modeling procedure. Besides, teachers' views on models and modeling should be investigated for better student understanding. The illustration presented above may be the outcome of students' experiences in the classroom, when they are frequently handed information without being explained the procedures that have led to consensus on a certain model (Mohanan, 2000). Therefore, due to their faith in the teacher as an authoritative figure rather than due to reasonable considerations (those they have not heard of), many students start to believe in scientific models (Hansson, 2018). They can create their own mental models with the aid of the models, which are physical representations of the concepts. This is very pertinent and practical for abstracting concepts in science education (Treagust et al., 2002). Nowadays students use new technological tools such as computer animations, simulations, mobile applications when they learn some science concepts. These visual tools may affect students' understanding of scientific models. So, it can be investigated that there is a significant difference between the students who use this tool heavily and who don't use them.

Conclusion

The purpose of this straightforward survey study was to learn more about how different students perceive scientific models and modeling from different epistemological and ontological perspectives. The results showed that the students' description and use of models addressed surface similarities and appearance mostly for observable properties. However, they overlooked what scientist do and how they use and test models. They did not tend to view that models are vehicles for verifying; instead they see models as they are just explanations without a need for experimental evidence. Additionally, they do mention the rules or the process in the representation.

They also have understanding that models are true images of the objects as long as we perceive them through perceptual and ordinary realism. However, students are the lack of scientific or structural realist view that are mostly about the theory-evidence coordination revealing the reality through model and modeling.

These findings show somehow consistent with research findings of the other research reports. The learner should examine models logically. Many pupils believe in scientific theories because they have faith in the authoritative figure (the teacher), rather than because of logical justifications (those they have not heard about). Therefore, more research especially including the validation processes of models based on scientific evidence including science process skills such as observations, gathering data and inferring should be conducted to understand how to overcome the confirmed or classical interpretation of models as the copy of the real world. Schwarz & White (2005) recommended explicit modeling training in order to develop scientific models and an epistemological grasp of their nature and function. Moreover, with age or more education in school, pupils' knowledge of models and modeling would get more advanced (Lee et al., 2021), the results of this study needs to be compared with the elder students' views of modeling within the same framework since the epistemological and ontological views may be context depended (Krell et al. 2014; Lee & Tsai, 2012).

This study has two major constraints that we believe will be taken into account in future studies. The first limitation of this study is gathering the data based on only paper-pencil questions. As a suggestion for further researches, the students' understanding of models and modeling should be intervened by the practical models and modeling questions. The other limitation is the number and the grade level of participants. We believe, expanding the number of participants and including different class levels can yield more valid results for further researches.

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Effects of After-School Programs on Student Cognitive and Non-Cognitive Abilities: A Meta-Analysis Based on 37 Experimental and Quasi-Experimental Studies

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Abstract: *The after-school program is a crucial initiative for implementing the Double Reduction policy; however, prior research has not provided conclusive evidence on whether extended school hours contribute to students' cognitive and non-cognitive development or on which types of after-school services are more beneficial for student development. This study analyzed 37 after-school programs from 18 publications using meta-analytic techniques, and the results indicated that participation in after-school programs had positive effects on student cognitive and non-cognitive development despite the small effect size (d = 0.327, p = 0.000). The decomposition of the effects of after-school programs revealed that they had modestly positive effects on academic achievement (d = 0.369) and social-emotional competence (d = 0.220). In addition, the analysis of moderating variables revealed that socioeconomic status, educational phase, number of after-school service days per week, sample size, and testing instrument all influenced the after-school program effects. This study concludes, based on the results of the meta-analysis, that there should be a balanced consideration of the development of student cognitive and non-cognitive abilities in planning after-school service, a substantial variety of activities in after-school programs, a flexible adoption of diverse after-school programs, and a reasonable participation frequency in after-school service.*

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AS a crucial measure in the implementation of the Double Reduction policy, after-school programs play a pivotal role in achieving the desired outcomes. They include a variety of after-school educational activities organized by the school, such as assignments, reading, cultural and sports activities, recreational games, extended training, and club activities, with the goal of promoting the physical and mental health development of students (Zhang et al., 2021). After-school programs extend students' time in education. Policymakers intend to use them to promote educational equity and reduce the burden of caregiving on families, thereby maximizing schools' role as primary educators in fostering students' cognitive and non-cognitive abilities (Gao et al., 2022; Yang, 2021; Zhang et al., 2021). However, there is no academic consensus on whether extended school hours can improve these skills. Some studies have found that a student's cognitive development is not enhanced by remaining in school longer (Fang et al., 2018). In addition, despite the fact that the majority of schools offered after-school services to students, practices varied from school to school, and the effects of these programs varied greatly due to factors such as program type, intensity, and quality. In addition to the duration of service, the question of which types of after-school programs are most beneficial to student development must be addressed.

Currently, the existing body of research pertaining to after-school services in China is deemed inadequate. The majority of the extant literature comprises theoretical analyses and experiential overviews, lacking robust and scientifically rigorous empirical investigations. Consequently, China currently faces a dearth of scientific evidence pertaining to crucial inquiries, such as the potential benefits of after-school programs on student development and the identification of more effective types of after-school programs for fostering student development. To address these concerns, the current study utilized a meta-analysis approach to examine the influence of after-school programs on student development. Furthermore, the study aimed to analyze the effects of different types of programs by drawing upon existing literature on this topic. The ultimate objective was to offer recommendations for enhancing after-school services in China.

Literature Review

Against the backdrop of the implementation of the Double Reduction Policy, after-school programs are playing an increasingly significant role in the cognitive and non-cognitive development of students, as most institutions now offer such services. It is necessary to investigate how to develop these skills in students through extended school hours and better-planned extracurricular activities.

The effects of after-school programs on students' cognitive and non-cognitive skills have been examined in the past, and the results have been mixed. Some of them discovered that after-school programs could aid in the growth of students. The Expanded Learning Programs in California and the 21st Century Community Learning Centers are just two examples of after-school programs that have been evaluated and found to significantly improve students' academic performance and social-emotional skills. Yang (2021) reviewed evidence-based studies on after-school programs in the United States and came to this conclusion. In South Korea, a comparison of after-school programs offered by schools and off-campus tutoring organizations indicates that both can increase students' academic performance, with the former outperforming the latter (Ha & Park, 2017).

Other studies, however, have indicated that after-school programs do not aid in improving students' academic and social-emotional abilities. For instance, some studies compared math test results between students who participated in after-school programs and those who did not, and they discovered that these programs have little to no impact on students' academic achievements (Hobbs, 2012). According to other research using multilevel growth modeling, students' self-efficacy is often constant and is not influenced by their level of involvement in after-school programs (Niehaus et al., 2012). The fact that after-school programs lengthen children's academic time is another crucial aspect of these programs. However, some research revealed that longer tutoring sessions lead to higher losses in academic accomplishment (Fang et al., 2018) and that on-campus after-school tutoring has a significant negative influence on student academic performance (Li & Pan, 2020; Wang et al., 2014).

Therefore, the cognitive and non-cognitive effects of after-school programs on students are complex issues that are largely the result of a multitude of factors.

Evidently, the effects of after-school programs are largely determined by the personal characteristics of students, including their socioeconomic status (SES) and educational levels. As per a number of studies, the majority of schools offer these programs for free or at a nominal cost; therefore, they can help to close the academic achievement disparity between students from diverse socioeconomic backgrounds (Zhang et al., 2021). According to other studies (Bohnert & Ward, 2013), after-school programs have no significant impact on the social-emotional development of students from low socioeconomic backgrounds. In addition to the socioeconomic status of the family, the educational phase is a significant factor influencing the heterogeneous effects of after-school programs. Zhang et al. (2021) discovered that the influence of after-school programs on students varies by educational phase and family context. A previous meta-analysis of after-school programs that used educational phase as the moderating variable concluded that after-school programs have significant effects on both elementary and secondary school students, albeit with much smaller effect sizes for elementary school students than secondary school students (Crawford, 2011).

The elements influencing the development of students' cognitive and non-cognitive skills in after-school programs have also been specifically examined, and it has been discovered that student personal qualities do have a substantial impact on students' growth of their cognitive and non-cognitive skills. According to a study, family background elements, including father's occupation and economic position, have a significant impact on how students' cognitive and non-cognitive skills develop (Yang, 2020). Students from privileged socioeconomic origins tended to rate their social-emotional competence higher than those from disadvantaged socioeconomic backgrounds, according to a comparative study based on the results of an OECD survey (Xu & Yang, 2021). Students in various educational phases exhibit variety in the development of their cognitive and non-cognitive skills. While kids' social-emotional skills may not always be as developed as their cognitive skills as they age, the latter tend to be. The OECD survey found that elementary school students were more socially and emotionally capable than their secondary school counterparts (Xu & Yang, 2021). It might be argued that after-school programs have different effects on students' cognitive and non-cognitive abilities because these effects are influenced by the students' individual traits.

Further studies have provided evidence indicating that the nature, level, and standard of after-school programs exert an impact on the cognitive and non-cognitive development of students. Different types of programs have diverse effects on the development of students. After-school programs designed to enhance student academic performance have been found to have a noteworthy influence on their cognitive development (Gardner, 2014). Conversely, programs that target the improvement of personal and social skills have been shown to have a favorable effect on student social-emotional development, leading to a substantial rise in self-confidence, self-esteem, and self-efficacy among adolescents (Durlak et al., 2010). Simultaneously, the impact of after-school services on student development is contingent upon the intensity of these programs, which is primarily characterized by the frequency of sessions offered per week and the subsequent level of student engagement. The existing literature on the relationship between participation rates in after-school programs and student academic and social-emotional outcomes is limited, with only a few studies examining this association. However, these studies suggest the presence of a positive relationship (Roth et al., 2010). The study conducted by Mahoney et al. (2007) indicated that variations at the program level in after-school service participation have implications for the development of students' social skills.

Moreover, factors such as the type of literature, sample size, and testing tool are associated with the heterogeneous effects of after-school programs and warrant in-depth analysis (Zhang et al., 2015).

In short, student personal characteristics such as family socioeconomic status and educational period, as well as other factors such as the type and intensity of after-school programs, can influence the programs' effects on the cognitive and non-cognitive development of students. Existing research on after-school programs in China, however, focuses primarily on research on policy implementation and international experience. These studies are primarily theoretical discussions and experience summaries, and they lack scientific, rigorous evidence. CMA3.0 was used to conduct a meta-analysis of experimental and quasi-experimental studies on the relationship between after-school programs and student cognitive and non-cognitive development, with the aim of identifying the general patterns of the impact of after-school service on student development. In addition, it investigated the factors that may account for differences in the cognitive and non-cognitive developmental effects of after-school programs on students.

Research Process

Literature Retrieval

Meta-analysis is a research approach that involves the application of consistent inclusion criteria to identify and evaluate literature in a specific field, with a particular focus on experimental research. Through a secondary analysis of the literature, the effect size of each study meeting the inclusion criteria is calculated. By considering sample sizes and employing the weighted average method, a comprehensive conclusion is derived. Furthermore, researchers employ statistical methods to investigate the underlying factors contributing to heterogeneity (Zeng & Yao, 2020). When comparing meta-analysis to traditional literature reviews and literature research, it becomes evident that meta-analysis offers notable benefits in terms of mitigating selection biases and achieving reliable, replicable, and verifiable outcomes. The current study involved a comprehensive literature search conducted in various databases, including CNKI, Web of Science, Elsevier SDOL, EBSCOhost, Springerlink, and Google Scholar. The search applied specific keywords such as "after-school program," "after-school service," "student outcomes," "student performance," "academic achievement," "non-cognitive," "social-emotional," "self-control," "emotional control," "social skill," "self-efficacy," "experimental," and "quasi-experimental." In order to ascertain the contemporaneity and pertinence of scholarly works, the present study has delimited the publication timeframe to encompass the years 2000–

2021. This temporal boundary has been established with the aim of investigating the overarching trends characterizing the evolution of after-school programs during the 21st century. Furthermore, a diverse range of literary sources was incorporated into the present investigation, encompassing journal articles, dissertations, and research reports. Consequently, a total of 3,397 pertinent studies were identified, of which 18 satisfied the established criteria for inclusion. From this subset, a total of 37 effect sizes were extracted. The process of collecting literature was conducted independently by the research team members without engaging in any discussions. Additionally, the search results were evaluated to ensure their consistency. To achieve a comprehensive compilation of literature, the team members additionally employed the snowballing technique to carry out a secondary literature search until consistent search outcomes were attained.

Literature Inclusion Criteria

To establish a literature pool that satisfies the needs of the research subject and supports further research, meta-analysis requires consistent inclusion criteria. These criteria must be used to acquire and screen publications linked to a specific issue. In this study, it was essential to first define after-school programs and the research issue in order to gather relevant literature. Pre-class, lunchtime, and summer programs are not included in after-school programs, which are defined as services offered or coordinated by schools and received by kids after school hours. This study's focus is on how participation in after-school activities affects students at basic education levels' development of both cognitive and non-cognitive skills. As a result, the intervention is whether or not to enroll in both academic and extracurricular after-school activities. Students in elementary, middle, and high schools are the study's participants. Academic performance is used to gauge a student's cognitive ability, while the OECD's social-emotional skill framework, which takes into account sociability, emotional regulation, self-control, and other social-emotional domains, is used to gauge a student's non-cognitive ability (Chernyshenko et al., 2018).

Based on the definition of after-school programs, the study theme, the subjects, the features of the literature, and the statistical requirements of meta-analysis, the following criteria for literature inclusion were established:

i. The study's intervention must be participants' decisions on whether or not to take part in academic and extracurricular after-school programs offered or planned by their schools, excluding extracurricular off-campus activities like private tutoring, enrichment classes, and training. Students in elementary, middle, and high schools should serve as research participants.

ii. The goals of the research should be in line with how students' cognitive and non-cognitive capabilities, including their academic performance and social-emotional skills, are developing.
iii. The included studies must have been released between 2000 and 2021 in either Chinese or English, with no restrictions on the publications' genres, in order to be current and relevant.
iv. With the use of experimental groups and control groups, the study design must be experimental or quasi-experimental. While control groups may be placed in different scenarios, experimental groups must be placed in a scenario of the after-school program.
v. To prevent biases brought on by exceptionally small sample sizes or a wide disparity in sample sizes between the experimental and control groups, the sample sizes of the two groups should be comparable.
vi. To determine effect sizes, the study should provide details like the mean, standard deviation, sample size, t-value, and p-value.
vii. The experimental and control groups' pretest results should not significantly differ, and the pretest effect size d should not be greater than 0.5 (Cheung & Slavin, 2016).

The experimental intervention time, sample size, and testing method should all be included as screening criteria in a meta-analysis when experimental studies serve as the main source of data for analysis (Cheung & Slavin, 2016). These factors were not included in the inclusion criteria for the current investigation, despite the fact that other heterogeneity analyses would have looked at them.

Literature Coding

As mentioned previously, a meta-analysis is an analysis based on the integration of a large corpus of literature, with the possibility of heterogeneity between studies. For subsequent analysis, the included studies must be coded (as shown in **Table 1**), and the specific codes are described below.

i. Types of literature: Journals are coded as journals, and other types are coded as others.
ii. Types of after-school programs: Academic programs are coded as academic; art and sports programs are coded as art and sports; programs focusing on interactions with nature, such as Equine Facilitated Learning[1], are coded as close to nature; programs covering multiple aspects, such as academic activities and recreational activities (e.g., 21st Century Community Learning Centers[2]), are coded as mixed; and those that do not report the type are coded as unreported.
iii. Testing tools: Standardized tests (including standardized tests and assessment scales) are coded as standardized, and unreported tests are coded as unreported.

iv. Family economic status: Low family economic status is coded as low, middle classes are coded as middle, a mixture of different family backgrounds is coded as mixed, and the unreported are coded as unreported.
v. Length of after-school programs: programs not shorter than 12 weeks or one school year are coded as > 12, those lasting 6–12 weeks or half a school year are coded as 6–12, those shorter than 6 weeks are coded as < 6, and the unreported are coded as unreported.
vi. Frequency of participation (per week): One time and 2–5 times are coded as 1 and 2–5, respectively, and the unreported are coded as unreported.
vii. Educational phases: Elementary schools (K–5) are coded as elementary, junior secondary schools (K6–8) are coded as middle, senior secondary schools (K9–12) are coded as high, and a mixture of different educational stages is coded as mixed.
viii. Sample sizes: Studies with sample sizes smaller than 100, between 100 and 250, and larger than 250 are coded as < 100, 100–250, and > 250, respectively, for both experimental and control groups.
ix. Types of outcomes: Outputs related to academic performance are coded as academic performance (including math, reading, language arts, etc.); outputs related to social-emotional skills are coded as social-emotional; and outputs related to artistic performance are coded as artistic performance.

Research Results and Analysis

Heterogeneity Tests and Analysis Model

A meta-analysis is based on the integration of a large body of research, but there is heterogeneity among individual studies. Chen et al. (2016) cite the Q statistic, the H statistic, and the I^2 values as the primary methodologies for heterogeneity tests. Using the Q statistic and I2 values, the present investigation analyzed the heterogeneity between studies. The Q statistic indicated that there was heterogeneity among the samples ($Q = 102.041$, $p = 0.000$), while the I^2 values indicated that there was significant heterogeneity among the studies ($I^2 = 64.720$). As the testing results indicated sample heterogeneity, the random-effects model was utilized for the analysis in this study.

Analysis of the Effects of After-School Programs on Student Development

As shown in **Table 2**, the effect size of after-school programs on student development was 0.327% ($p < 0.05$). According to Cohen (2013), the effect sizes of 0.2, 0.5, and 0.8 are minor, medium, and large, respectively. According to his criteria, after-school programs have a significant positive

Table 1. Literature Coding.

Literature	Type of outcomes	Type of literature	Type of after-school program	Testing instruments	Family economic status	Length of after-school programs	Frequency of participation per week	Educational phases	Sample sizes
Dreyer, 2010a	Academic performance(m)	O	Ac	Std	Low	>12	2-5	Mx	<100
Dreyer, 2010b	Academic performance(r)	O	Ac	Std	Low	>12	2-5	Mx	<100
Venze, 2011a	Academic performance(la)	O	Mx	Std	Mx	>12	Ur	M	<100
Venzen, 2011b	Academic performance(m)	O	Mx	Std	Mx	>12	Ur	M	<100
Venzen, 2011c	Academic performance(la)	O	Mx	Std	Mx	>12	Ur	M	<100
Venzen, 2011d	Academic performance(m)	O	Mx	Std	Mx	>12	Ur	M	<100
Fulmer, 2014a	Academic performance(la)	O	Ac	Std	Low	>12	1	H	<100
Fulmer, 2014b	Academic performance(m)	O	Ac	Std	Low	>12	1	H	<100
Gardner, 2014	Academic performance(r)	O	Ac	Std	Low	6-12	2-5	E	<100
Ha & park, 2014	Academic performance(t)	J	Mx	Std	Ur	Ur	Ur	H	>250
Townsend & collins, 2019	Academic performance(v)	J	Ac	Std	Ur	<6	2-5	M	<100
Moldow, 2007a	Academic performance(rw)	O	Mx	Std	Low	>12	2-5	E	100-250
Moldow, 2007b	Academic performance(s)	O	Mx	Std	Low	>12	2-5	E	100-250
Moldow, 2007c	Academic performance(m)	O	Mx	Std	Low	>12	2-5	E	100-250
Moldow, 2007d	Social-emotional(sk)	O	Mx	Std	Low	>12	2-5	E	100-250
Jones, 2014a	Academic performance(m)	O	Ac	Std	Low	>12	2-5	M	<100
Jones, 2014b	Academic performance(r)	O	Ac	Std	Low	>12	2-5	M	<100
Hobbs, 2012a	Academic performance(m)	O	Mx	Std	Mx	>12	Ur	Mx	<100
Hobbs, 2012b	Academic performance(m)	O	Mx	Std	Mx	>12	Ur	E	<100
Hobbs,2012c	Academic performance(m)	O	Mx	Std	Mx	>12	Ur	M	<100

Yun, 2011a	Artistic perfor-mance	O	AS	Ur	Middle	>12	1	M	<100
Yun, 2011b	Social-emotion-al(se)	O	AS	Std	Middle	>12	1	M	<100
Martin, 2000a	Academic perfor-mance(r)	O	Mx	Std	Low	6-12	2-5	E	<100
Martin, 2000b	Academic perfor-mance(m)	O	Mx	Std	Low	6-12	2-5	E	<100
Martin, 2000c	Academic perfor-mance(r)	O	Mx	Std	Low	6-12	2-5	E	<100
Martin, 2000d	Academic perfor-mance(m)	O	Mx	Std	Low	6-12	2-5	E	<100
Londreg an,2011	Academic perfor-mance(m)	O	Ac	Std	Low	6-12	2-5	M	<100
Pendry et al., 2014	Social-emotion-al(sk)	J	CN	Std	Low	6-12	1	Mx	<100
Pendry & roeter,2 013	Social-emotion-al(sk)	J	CN	Std	Low	6-12	1	Mx	<100
Ariyo & adeleke ,2018	Academic perfor-mance(m)	J	Ac	Ur	Ur	Ur	Ur	H	<100
Lecroy, 2004a	Social-emotion-al(a)	J	Mx	Std	Mx	>12	Ur	M	<100
Lecroy, 2004b	Social-emotion-al(sef)	J	Mx	Std	Mx	>12	Ur	M	<100
Morri-son,200 0a	Academic perfor-mance(m)	J	Mx	Ur	Low	Ur	Ur	M	100-250
Morri-son,200 0b	Social-emotion-al(sc)	J	Mx	Std	Low	Ur	Ur	M	100-250
Morri-son,200 0c	Social-emotion-al(c)	J	Mx	Std	Low	Ur	Ur	M	100-250
Morri-son, 2000d	Social-emotion-al(a)	J	Mx	Std	Low	Ur	Ur	M	100-250
Biggart, 2013	Academic perfor-mance(r)	J	Mx	Std	Ur	>12	2-5	E	100-250

Note: there exist variations of the dependent variable in some experiments due to differences in disciplines and social-emotional skill categories. In such circumstances, each variation is treated as an independent effect size and differentiated by annotations. For academic achievement, m, r, la, t, v, rw, s stands for mathematics, reading, language arts, general, vocabulary, reading and writing, and speaking, respectively. For social-emotional skills, sk, se, a, sef, sc stands for social skills, self-esteem, assertiveness, self-efficacy, and self-control, respectively.

E: Elementary School; M: Middle School; H: High School; Std: Standardized; J: Journals; O: Others; Ac: Academic; Mx: Mixed; AS: Art & Sports; CN: Close to Nature; Ur: Unreported;

Table 2. Effect Sizes Of Student Development

		K	Q	ES	95%CI		p
Type of outcomes	Academic performance	27	3.907 (p = 0.142)	0.369	0.247	0.491	0.000
	Social-emotional skills	9		0.223	0.132	0.314	0.000
	Artistic performance	1		0.429	-0.059	0.917	0.085
Student cognitive and non-cognitive abilities		37	102.041 (p = 0.000)	0.327	0.238	0.416	0.000

effect on the cognitive and non-cognitive abilities of students, albeit with a modest effect size (d = 0.327).

As was already said, a student's academic success and social-emotional skills primarily reflect both their cognitive and non-cognitive talents. Because it possesses characteristics of both academic performance and social-emotional skills, student artistic performance was discussed independently. To investigate the specific impacts of after-school programs on these skills, a thorough analysis of the output types of student's cognitive and non-cognitive abilities was done. **Table 2**'s findings demonstrate the after-school programs' considerably beneficial effects on a variety of outcomes, including academic performance (d = 0.369, p = 0.000), social-emotional skills (d = 0.223, p = 0.000), and artistic performance (d = 0.429, p = 0.085). The small sample sizes of this study, particularly for social-emotional skills and artistic performance, may explain the modest effect sizes of all three output types. Additionally, the findings indicate that after-school programs are substantially more effective at fostering students' cognitive development than at enhancing their social-emotional competencies. This finding may be related to the types of after-school programs that were covered in the literature. The authors discovered that earlier research had placed a stronger emphasis on academically oriented after-school activities and had given more consideration to student academic performance improvement than to the growth of their social-emotional skills.

Analysis of Moderating Variables

As indicated previously, there was significant heterogeneity among the samples included in this study (Q = 102.041, p = 0.000, I^2 = 64.720), which may be a result of differences in the type of after-school programs and student family socioeconomic status. To determine the reasons for the heterogeneous effects of after-school programs, which were examined at both the individual and program levels, analyses of moderating variables were required.

Table 3. Heterogeneity at the Individual Level.

		K	Q	ES	95%CI		p
Family SES	Low	22	7.034 (p = 0.071)	0.228	0.166	0.289	0.000
	Middle	2		0.244	-0.115	0.604	0.183
	Mixed	9		0.463	0.261	0.664	0.000
	Unreported	4		0.680	0.117	1.243	0.018
Educational phases	Elementary	13	13.067 (p = 0.004)	0.147	0.068	0.226	0.000
	Middle	4		0.376	0.264	0.488	0.000
	High	15		0.733	-0.038	1.505	0.063
	Mixed	5		0.299	0.129	0.468	0.001

Table 4. Heterogeneity at the Program Level.

		K	Q	ES	95%CI		p
Types of after-school program	Academic	10	2.662 (p = 0.447)	0.499	0.177	0.820	0.002
	Art and sports	2		0.244	-0.115	0.604	0.183
	Close to nature	2		0.393	0.095	0.691	0.010
	Mixed	23		0.259	0.181	0.336	0.000
Lengths of after-school program	< 6	1	2.411 (p = 0.491)	0.212	-0.436	0.861	0.521
	6-12	8		0.276	0.125	0.427	0.0
	> 12	22		0.279	0.184	0.373	0.000
	Unreported	6		0.520	0.221	0.818	0.001
Frequency of participation per week	1	6	10.410 (p = 0.005)	0.303	0.119	0.488	0.001
	2-5	16		0.179	0.106	0.251	0.000
	Unreported	15		0.487	0.308	0.667	0.000

Table 5. Heterogeneity of Characteristics of the Literature and Studies.

		K	Q	ES	95%CI		p
Types of literature	Journals	12	1.439 (p = 0.230)	0.402	0.222	0.581	0.000
	Others	25		0.278	0.186	0.370	0.000
Sample sizes	< 100	27	7.797 (p = 0.020)	0.419	0.280	0.558	0.000
	100-250	9		0.187	0.102	0.272	0.000
	> 250	1		0.253	0.122	0.385	0.000
Testing tools	Standardized	33	3.561 (p = 0.059)	0.251	0.187	0.316	0.000
	Unreported	4		0.805	0.234	1.376	0.006

Individual-level heterogeneity resulted from the SES of the student family and their educational stages. **Table 3** presents the outcomes. Although the effect size is modest (d = 0.228, p = 0.000), after-school activities significantly benefit individuals from poor socioeconomic backgrounds in terms of family SES (Q = 7.034, p = 0.071). This shows that although the compensating objective of after-school activities has been achieved, there is still potential for improvement. There is statistically substantial evidence that after-school activities have an impact on students in basic education in terms of educational phases (Q = 13.067, p = 0.004). The largest effect size (d = 0.733) comes at the senior secondary phase, followed by the junior secondary phase (d = 0.376), indicating that after-school programs have a bigger impact on secondary school children than on elementary school kids (d = 0.147).

Table 4 displays the results of heterogeneity at the program level, which is caused by changes in after-school program type, duration of intervention, and frequency of participation. The development of students' cognitive and non-cognitive skills was significantly aided by programs like Equine Facilitated Learning, which allow students to interact with nature (d = 0.393), and academic programs produced the strongest effect of all after-school programs (Q = 2.662, p = 0.447). Additionally, blended programs with both educational and recreational components, like the 21st Century Community Learning Centers, had statistically significant positive effects on the participants (d = 0.259). Programs lasting 6–12 weeks or more than 12 weeks had significant impacts, though with minor effect sizes (0.279 and 0.276, respectively), whereas programs shorter than 6 weeks had worse results (d = 0.212, p = 0.521). This is according to the length of the intervention (Q = 2.411, p = 0.491). "One day per week" has a bigger influence (d = 0.303), which is still a tiny but statistically significant effect size, on the frequency of involvement in after-school service (Q = 10.410, p = 0.005).

Furthermore, characteristics of literature and studies may also be significant heterogeneity factors. Considering this, the current study examined the moderating effects of literature type, sample size, and testing instruments. **Table 5** provides the results. Even though the sample size in journal articles is much smaller than that in other types of literature (Q = 1.439, p = 0.230), its effect size (d = 0.402, p = 0.000) is substantially greater than that of other types (d = 0.278, p = 0.000), both of which are statistically significant. The effect size of small sample sizes (with less than 100 subjects) is the greatest (d = 0.419), followed by that of large sample sizes (over 250 subjects) (d = 0.253). In terms of testing instruments (Q = 3.561, p = 0.059), the effect size derived by evaluating students via standardized tests is relatively larger (d = 0.251) and statistically significant, but still falls within the category of small effect sizes.

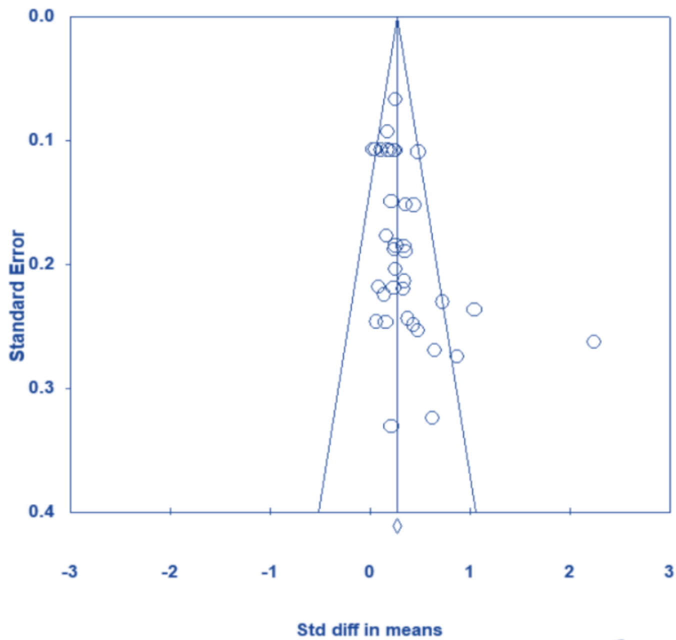

Figure 1. Funnel Plot.

The aforementioned analyses demonstrate that only the SES of the student family, educational phases, frequency of after-school program participation, sample size, and testing tool have a significant impact on the heterogeneity of experiments, whereas other factors like the type of after-school programs and the duration of the intervention were not the causes of the heterogeneity in this study. The reason could be that the current study, which mostly focused on on-campus after-school services, had a limited scope compared to other studies. The fact that there were so few sources of heterogeneity in this study may possibly be due to the fact that several of the studies that were included in the meta-analysis did not explicitly state whether the control groups were free from the intervention of after-school programs.

Robustness Testing

Publication Bias

Publication bias jeopardizes the validity of quantitative evidence from meta-analyses because the studies included in the meta-analysis are the result of publishers' selection, and this selective bias typically produces positive results. It is therefore necessary to evaluate the scientific validity of the meta-analysis results. The present study utilized commonly used funnel diagrams and Egger's Regression coefficient to assess publication bias. This study's funnel plot is depicted in **Figure 1**, which is roughly symmetrical. The effect sizes of the included samples are primarily concentrated in the effective region of the funnel plot's middle and upper portions. Egger's Regression coefficient indicates a significant result of the Egger test (B0 = 1.75488, t = 2.7674, p1 = 0.00448 and p2 = 0.00897), indicating publication bias in this study. The Trim and Fill method was used to correct the effect size of this investigation, which was 0.203.

Sensitivity Analysis

Commonly, the Fail-Safe N is used to evaluate the dependability and robustness of the results. A larger fail-safe N indicates that the meta-analysis results are less sensitive to the excluded studies, indicating greater robustness (Zeng & Yao, 2020). According to Rosenthal (1979), the conclusions of a meta-analysis should be viewed with caution if the fail-safe N is less than 5K+10 (K is the number of studies included). In the present study, the fail-safe N was 1,285 ($\alpha = 0.05$, $p < 0.0000$), indicating that 1,285 additional studies would be required to render the results non-significant or to refute the conclusions. Consequently, the findings of this investigation were relatively reliable.

Discussion and Conclusions

Discussion

In the context of the implementation of the Double Reduction policy, after-school programs are significant initiatives in reducing the burden on students and enhancing their learning efficacy. There is an urgent need for evidence-based answers to queries such as "whether and how after-school programs can promote the development of students' cognitive and non-cognitive abilities." This study analyzed 37 after-school program interventions from 18 studies using meta-analytic techniques to investigate the effects of after-school programs on students' cognitive and non-cognitive development and their general patterns. The objective was to provide scientific evidence to support the improvement of related work.

After-school programs can considerably foster students' cognitive and non-cognitive growth, according to the current study ($d = 0.327$, $p = 0.000$), with an influence on academic achievement that is bigger than that on social-emotional abilities ($d = 0.223$). This finding is in keeping with the findings of other studies of after-school programs carried out in various countries, as well as the conclusion reached by Durlak et al. (2010) that after-school services have a good impact on student academic achievement and social skills. Despite the constant favorable influence, this study's effect size was different from the conclusions of these academics. Although the effect size of after-school activities was just 0.17, Durlak and coworkers discovered that they significantly improved student academic performance. This can be connected to the different ways that after-school program interventions are defined. Researchers from other nations have defined after-school programs as ones offered by communities, schools, and mixed environments involving schools, covering pre-class and lunchtime scenarios as well as summer vacations. In the current study, after-school programs are defined as services provided or organized by schools during after-school hours. Even though summer camps were not included in Durlak and coworkers' definition of after-school programs, their research may have included treatments that took place before classes, during lunch, and on other occasions. They added that some activities organized by communities as well as those by schools were included in the activities they analyzed. As a result, in terms of research scope, their study differs greatly from the one under consideration.

Zief et al. (2006), in contrast to the findings of the present study, reported that after-school activities had little to no impact on participants' social-emotional abilities and had a minimal and insignificant impact on their academic performance ($d = 0.083$, $p = 0.16$). This might be brought on by differences in how after-school programs are defined as interventions. The coupling of youth entertainment and/or development activities with academic support services was stressed by Zief and colleagues as one of the inclusion criteria for after-school program research. According to them, after-school activities can run in a variety of locations, including schools, communities, and places of worship. The definition of output results may also play a role in the discrepancy in findings. While the current study is based on the OECD framework of social-emotional skills, which includes sociability, emotional control, self-efficacy, self-regulation, and more, Zief et al.'s definition of social-emotional skills focuses more on aspects like college aspirations, perseverance, social integration, etc.

This study found that additional after-school service hours positively affect the cognitive and non-cognitive development of students, whereas Fang et al. (2018) and Li and Pan (2020), whose studies focused on after-school programs in China, reached the opposite conclusion. The inconsistency may result from differences in after-school service components between China and other countries. In some foreign countries, after-school services consist of a variety of components rather than being dominated by demanding extra tutoring. According to Dreyer's (2010) description of the after-school program's schedule, the program in question did not begin with purely academic activities but rather with a half-hour refreshment break;

subsequent learning activities were interspersed with other enrichment activities. Such examples are useful for refining after-school programs in China. The results of the present study indicate that academic learning in after-school programs may enhance student academic performance if it is not overly burdensome. However, more rigorous empirical evidence is necessary to corroborate whether academic learning in after-school programs in China, where students generally face enormous academic pressure, can help improve student academic performance in the same way as foreign researchers have discovered.

The present study has its limitations due to the information provided in the literature. It was challenging to determine whether the control groups in some of the included studies actually did not participate in after-school programs as defined in the current study because it was unclear from some of the studies whether the control groups were truly free from the interventions of after-school programs. As a result, the results of the meta-analysis may be adversely affected if these studies are unable to provide clean, uncontaminated control data. Few Chinese experimental or quasi-experimental studies on the outcomes of after-school programs match the requirements for inclusion. As a result, the current study was unable to incorporate any material that had been published in China, which may have somewhat diminished the value of the study for how after-school programs are implemented in China. These issues probably played a role in why this study failed to pass the publication bias test. We undertook the literature review procedure several times in an effort to incorporate more qualified papers in order to overcome this problem, but we were unable to completely eradicate publication bias. To finally fix the overall effect size, we have to use the Trim and Fill approach. Though no systematic biases were found in the final meta-analysis results, more studies with trustworthy research findings are required to get more substantial and all-encompassing evidence. Basically, this study examined the effects of after-school programs on the growth of students' cognitive and non-cognitive abilities as well as the impact of various program types in an effort to provide implications for the successful implementation of the Double Reduction policy and the optimization of the quality of after-school programs. It was based on findings from previous empirical research.

Conclusions and Suggestions

The present study analyzed 37 after-school program interventions from 18 studies using meta-analytic techniques to investigate the effects of participation in after-school programs on students' cognitive and non-cognitive abilities. In addition, because of the heterogeneity of the studies, their causes were examined at the individual and program levels. Even though the overall effect size is modest ($d = 0.327$, $p = 0.000$), the findings indicate that (i) after-school programs can considerably enhance student development. (ii) After-school programs have positive effects on student academic performance (d = 0.369) and social-emotional skills (d = 0.223), with modest effect sizes on both aspects but a larger effect on academic performance. (iii) The socio-economic status of the student's family, the educational phase, the frequency of participation, the sample size, and the testing instrument are the primary sources of heterogeneity, while other factors have no significant associations with the heterogeneity.

Further investigation revealed a link between the various after-school services' effects on students' development and the different kinds of after-school programs mentioned in the literature. Academic after-school programs greatly outnumbered other types of activities in the studies that were considered. For instance, assessing the impact of the 21st Century Community Learning Center programs on student academic attainment was a major part of the study.

The identification of overarching patterns pertaining to the impact of after-school programs on student development can facilitate the advancement of after-school services in China. Based on the preceding analysis, the authors propose enhancements to after-school programs in China in the following areas:

First, balance cognitive ability- and non-cognitive ability-focused after-school programs. The findings of the meta-analysis indicate that after-school programs yield notable and favorable impacts on the enhancement of both cognitive and non-cognitive abilities among students. Hence, it is imperative to prioritize the enhancement of both academic achievement and social-emotional competencies when implementing after-school programs. The primary objective is to foster comprehensive student development rather than transform the programs into a mere extension of the traditional classroom setting.

Second, introduce diverse after-school programs. The findings of the meta-analysis indicate that various types of programs, including academic programs, art and sports programs, programs emphasizing interactions with nature, and mixed programs, have a positive impact on the cognitive and non-cognitive abilities of students. Moreover, the effect sizes of academic programs, programs focusing on interactions with nature, and mixed programs are larger. Currently, the prevailing emphasis of after-school programs in China lies in academic tutoring, while arts and sports activities, which foster social-emotional skills to a greater extent, receive comparatively less attention. Hence, it is recommended that future after-school programs focus on enhancing their curriculum rather than imposing excessive tutoring or course instruction, which may place additional demands on students. The arduous and monotonous nature of learning hampers the effectiveness of studying, and establishing a harmonious equilibrium between academic endeavours and leisure activities is more favorable for the holistic growth of students.

Third, control the intensity of after-school service. The findings of the meta-analysis indicate that engaging in after-school programs on a weekly basis yields the most optimal outcomes for both cognitive and non-cognitive development among students. In China, a significant proportion of educational institutions offer after-school services on weekdays, thereby facilitating parental retrieval of their children following their work commitments. According to Fang et al. (2018), further research has indicated that extended school hours may have a negative impact on the development of specific essential skills among students. Furthermore, the implementation of a uniform after-school service model undermines the individualized developmental requirements of students and imposes an excessive workload on teachers. Hence, it is advisable for educational institutions to exercise reasonable regulation over student school hours and offer increased flexibility in terms of the frequency of after-school services to enhance their overall efficacy.

Note

1. *Equine Facilitated Learning is an 11-week after-school program that consists of 90-minute sessions of individual and group activities. Its goal is to help kids become more socially adept and well-behaved through activities that make use of horses' instinctive behaviors and their connections with people.*
2. *The 21st Century Community Learning Centers, which opened schools to the community in an effort to improve the academic abilities of public-school kids from lower socioeconomic backgrounds, were approved by the US Congress in 1994. In 1998, the program started concentrating on offering educational and leisure activities in public schools before school, after school, on weekends, and during summer vacations. Therefore, only those projects from the program that specifically incorporate after-school activities in schools were included in this study.*

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REVIEW

The Place of Intelligence Games in Philosophy and Logic Education

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***Abstract**: Education is an applied field of science and so what is expected is that it must respond to the practical needs besides theoretical field. These needs are of importance with the indication of active nature of students in learning in 21st century. For that reason, it has started to give places for many applications in practice to increase the permeance of information by internalizing the theoretical side of education. One of the applications in question is intelligence games. Intelligence games is a tool for individuals in revealing their own potentials, in developing different and original strategies for the problems, in making a fast and true decision, and what is more in making them attain a systematic structure of thinking. Therefore, it would not be surprising to associate this tool with the education of philosophy and logic. It is because intelligence games are a material to be used in philosophy education in using philosophical knowledge and seeking for the solutions of philosophical problems; in using logic education in conveying true thinking ways to daily life, being aware of contradictions by thinking consistently and basing their thoughts. As a result, it is believed that intelligence games will make the theoretical-based structure practical in philosophy and logic education and will add variety with the current study.*

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Introduction

UPON having a look at the application of learning and teaching activities by organizing them from a larger perspective, it is likely to see significant differences resulting from the attitudes, behaviours, knowledge, and cultural infrastructure together with their experiences. These differences in question prevent educational activities to reach the determined targets. In the current age of information, the search for new and applicable educational technologies is going on with an increasing speed to be able to overcome the problems preventing further success in education and teaching activities (Engin et al., 2004). This speed will be attained through material developing works in terms of the dimension of course tools and materials.

The world we live in also affects the features that individuals must have. The expectation of the world from the individuals is that they can produce original and different solutions the problems they experience, they put the solutions they produce into practice rapidly and they have any kind of mental competence that will help overcome a difficulty (Ulusoy et al., 2017). In this period when students' learning by experiencing and practicing will be a basic principle, it will be likely to see that complementary games which can increase participation up to highest levels are ideal reinforcing components. It is because using games in education will be an effective way to realize the determined objectives.

Game has a history as far back as humanity. Despite such an old history, its effect upon human development has still been investigated. Basically, game is the most natural learning tool having an impact on all development fields of child whether it is on a certain purpose or without purpose, with a rule or without a rule, in which every child can be involved on purpose, and enjoyment, realized directly or indirectly (Koçyiğit et al., 2007). Game is comprised of learning by discovering. It provides to speed up such mental processes as knowing the objects and naming them, their functions, reasoning, making a cause-and-effect relation, making a choice, focusing attention, guiding oneself to an objective, thinking, perceiving, sorting, classifying, making an analysis, making a synthesis, evaluating and problem solving. At the same time, the mental development of an individual within a game is supported through the development of such skills as commenting, perceiving, evaluating, making a decision since he is in a mental activity (Özer et al., 2006). Besides that, game activities include open-ended learning; children are not directed to the correct answer. Game experiences produce ideas rather than memorising certain information chunks and individuals learn actively in a game. They talk to each other and share ideas, make predictions, work in cooperation in learning groups. Experiences are repeated in a game, and new things are tried. Games as a dynamic process are done freely and automatically (Uskan & Bozkuş, 2019).

Game stimulates all development areas (language, mind, social, emotional, physical, personality and morality development) and constitutes a base for the attainment of skills. Individuals playing the game have an experience on life skills, social skills, research skills, problem solving skills, thinking skills, communication skills and the skills of personal management and administration skills in the process of playing a game (Tuğrul, 2018, p. 15). The contribution of game to mental development, to the development of upper cognitive skills, healthy mental mood, linguistic skills, representing, self-regulation has evolutional, sociological, and psychological evidence. As an example, the researchers investigating game in an evolutional process put a premium on the increasing size of their brains and of their problem-solving skills with the skill of driving by mammals (Whitebread, 2012). In this way, it is likely to say that game and the tools used in a game led to an increase in the mental capacity.

Besides being a tool, in which students can actively be interested and carry out their activities individually, games also offer some settings allowing them to learn by doing and experiencing. They allow them to make a true-false evaluation by giving feedback to their activities directly and to be aware of their mistakes instantly. By helping them to turn back to the same point in a wrong action or proceeding, they can find what is true. By addressing more than one sense, they help learning to be permanent. While providing all these things, they entertain students, and in this way, they learn better when they are active, when they control themselves and when they search and discover. Upon the review of these relations between game and learning, it is likely to think that game-based learning settings are of a quality to respond all these needs, and they are the very thing to be used in education (Akın & Atıcı, 2015).

Game can be defined as the whole of the rule-based activities bearing competition components which are the targets, gains and results where one or more than one player. As for the using of games in education ore educational games, it means educative entertainment derived from the concepts of education and entertainment. Accordingly, when these games are used in the purpose of education, they have such benefits that they motivate learners more, they spend more time with the teaching program, education turns into an entertaining thing rather than an obligation and it increases internal motivation (Demirel, T., 2021, p. 3-5). Games used in education (educational games) can be defined as a teaching method supporting the shaping of information in a comfortable setting, making a connection of learning information with each other, and reinforcing them, and the development of skills in an enjoyable way (Güler, 2011, p. 26). Thanks to these games, subject matters in the courses can be made more attractive, it can be possible to teach new concepts and reinforce the newly learned information, and the interests of students in the course can be increased. In addition, learning will be more comfortable and easier thanks to the settings provided by the active involvement of students through educational games (Kaya, 2007, p. 30). Educational games make such many supports as changing attitudes, special behaviour change, increase in motivation, developing analytical thinking, making changes in role meaningful, helping people in having possible role in the future, developing skills with the adopted principles, facilitating the understanding of high-level problems, being sensible to the roles of individuals except himself (Atay, 2018, p. 23). These games are valuable as they offer learners the opportunity to learn through structured experiences (Lynne, 2004); they increase social skills of students as they give a group responsibility together with an individual responsibility, affect self-confidence, creativity and entrepreneurial skills in a positive way, students learn how to deal with fear, excitement, anxiety and stress, by making a connection between old and new learnings, they provide a meaningful and permanent learning thanks to educational games, they make the abstract subject concrete and reinforce information, making a permanent learning (Karataş, 2021, p. 28-29). Giving such a big contribution to active learning, educational game is encountered in intelligence games as an efficient method today.

Intelligence Game

With the skill of saving one from a trouble, taking him out of a hole, being aware of a whole mind is something to set up similar barricades, barbs and exits. If mind is the competence to differ what is tight, think what is difficult and make the difficult easy, mind game is the task of construction for fictionalized tight and difficult ones. If mind is the competence to find a solution and a skill to find a way in a place where there is no way out, make a trace where there is no trace, mind games is the construction of designing all these. It is the fictionalized way of finding the truth in the true path. If mind is something making the tight world loose, making the hard world easy, mind games is the mind construction producing services for human in both directions (Ünal & Ünal, 2005, p. 13-14). As for intelligence, it is one of the most powerful sources human being has. Developing this source opens new horizons for human and humanity, makes him attain new opportunities and new powers. Intelligence games in finding the truth enhance the intelligence level of human being. The outcome obtained is the skill to define the question in hand and solve the problem (Ünal & Ünal, 2005, p. 18-19).

Intelligence games are such kind of games that require deep thinking and reasoning power independent from knowledge and competence in school subjects. The features differentiating intelligence games from other games are that these games improve reasoning and logical thinking skills of individuals, and their imagination, memory, logic and strategical judgements with original and constructive, creative thinking. The aim of these games is not only to entertain, but also to solve a hard problem mentally and achieve a given task (Sütçü N. D., 2021, p. 183-184). Therefore, these games in question could be used as a teaching material that is likely to be used in different courses and grades.

It is known that the mind, logic, cognitive capacity and reasoning that allow us to think differently and produce different solutions are improvable qualities throughout human life. Just transferring information to students at schools is not enough to develop students' cognitive capacities, problem solving skills, thinking skills and the skills of forming different strategies and using them. It is necessary for students to develop their mental capacities and skills through various games and activities. Intelligence games could be used as an effective tool in developing their skills. It is because intelligence games are the gamed position of any problem comprising real problems as well. For that reason, it is a good tool to be used to teach problem solving (ME, 2013, p. 1). The tool in question provides individual with a lot of outcomes in terms of cognition. As an example, it improves visual memory skill, helps develop the spatial perception, develops attention and concentration, focusing perception, prediction skill, rapid thinking skill, sequential thinking skill and the skill of perceiving the relation between part and whole, also develops the skill of thinking possibilities in a rapid way, paying attention to the details, and of imagination (Oruç, 2019, p. 18-19).

In the basis of these outcomes lays thinking. Thinking is the heart of cognitive skills, because it is a cognitive process but resulting from behaviour, coming out of mind or cognitive system, comprising the whole or some variables of a whole of processes based on information in the cognitive system (Başerer, 2017); it is a function of judgment valuing evaluating various events and conditions by means of objective and analytical ways and making rational decisions accordingly (Saban, 2014, p. 11). One of the objectives of education is to teach the ways of true thinking. Critical and creative thinking skills are of great importance for individuals in thinking truly. It is because individuals make an evaluation by taking a criterion into consideration and make a decision in this way. Making an analysis, judging, putting a hypothesis forward, making an explanation, making a decision, problem solving, making an observation, reasoning, making an inference etc. bare a great number of skills in them (Kızıltan & Dombaycı, 2020). By means of creative thinking, they develop the skills of originality, flexibility and detailing in the cases where what is in hand is not sufficient. In this way, when he uses critical and creative thinking skills as is required, it will contribute to cognitive thinking because it comprises such cognitive processes as making an analysis, evoking and making an inference (Bacanlı, 2012; Dombaycı, 2012). These thinking forms are a skill each. For that reason, people can develop their skills by means of intelligence games both cognitively and affectively. Thanks to games, everyone playing the game could be aware of their powerful sides peculiar to them. As an example, while some can solve problems in rapid way through the method of trial and error, some other will be in a tendency to solve them slowly but in a systematic way (ME, 2013, p. 5). The self confidence of the individuals playing the game will increase, their skill of obeying the rules will develop, he will respect to teammates and opponents make empathy and have an opportunity to test his patient if he plays the game in a group.

Intelligence games are defined as the activities that require deeply thinking and reasoning independently from their knowledge and competencies in their school subjects (Sütçü, 2021), developing their individual cognitive skills, reasoning and logical thinking skills by making brain do exercises (Ott & Pozzi, 2012), developing imagination, memory, combination, logic and strategical judgements, relaxation and improvement, original and positive, creative thinking; and the activities offered for individuals to be able to be aware of their own potentials, make a quick and true decision, produce peculiar ways of solution and the last but the least is that renew themselves consistently (Devecioğlu & Karadağ, 2014, p. 43). Children playing intelligence games could learn a great many mental processes. Besides such concepts as proximity, ordering, time, space, they could have the chance of learning such processes as classifying, matching, analysing and synthesising (Ergin & Köse, 2008, p. 206). Pushing individuals to think, intelligence games require individuals to develop strategies and find solutions by carrying out logical processes. In this process, brain discovers new ways for a solution through exercises (Howard-Jones, 2009). These games are the ones having certain rules and an objective, putting a problematic context waiting for a solution with the least factor of chance, requiring employing special thinking skill, psychomotor skills, memory and attention power, basic mathematical skills and cognitive strategies (Erdoğan et al., 2017). Intelligence games facilitate learning by keeping intelligence active, attain the skill of moving in a plan, strengthen the capacity of predicting events, improves the skill of producing solutions and thinking multiply, and use logical reasoning away from memorising (Oruç, 2019, p. 13).

The Place of Intelligence Games in Türkiye

Games are regarded as effective tools to learn and improve skill at education since learning through games is a skill acquisition process. As individuals encounter with the same or similar challenges repeatedly, their skills improve. As a matter of fact, a lot of studies have been carried out in Türkiye in order to encourage game-based learning and skill development at schools in 21st century.

First one of these studies is the foundation of the Federation of Whole Mind and Intelligence Games (FWMIG). The mission of this federation is to follow up the studies regarding mind and intelligence games in order to keep up with the ever-developing world and conduct studies in order to increase its use in Türkiye in a conscious way. The vision of the federation is to represent Türkiye in national and international competitions and similar activities, carry the national organizations to international settings and help successful Turkish competitors in mind and intelligence games to gain ground in in international arena (FWMIG, 2023). This federation has organised tournaments regarding such intelligence games as Q Bitz, Equilibrio, Pentago, Mangala, Reversi, Kulami and Küre and the first one was in 2018. It has organized workshops regarding these tournaments and trainings over mind and intelligence games with the Ministry of Education.

Another study carried out in Türkiye regarding intelligence games is the championship of intelligence games organized by Zeka Vakfı (the Foundation of Intelligence). The purpose of this championship is to improve the thinking, decision-making and problem solving skills of students and make them attain different team-work habits. It is content is the competitions organised over twelve grades, which are primary school (Grades 1-2-3-4), secondary school (Grades 6-7-8-9) and high school (Grades 9-10-11-12) (TZV, 2023).

Another organisation working in intelligence games in Türkiye is Türkiye Satranç Federasyonu (Turkish Federation of Chess). The foundation that was founded for the purpose of spreading the sport of chess throughout Türkiye, introduce it and make it widespread, represent Turkish chess in international arena, attain more championships and master sportspersons in the country with an innovative and reasonable approach (TSF, 2022).

The most basic element taking place in the educational system in Türkiye with regard to intelligence games is the curriculum for intelligence games. Intelligence games are an optional course included in the program by the Ministry of Education for 5th, 6th, 7th and 8th grades. As for the general objectives of the course, it is aimed that students know and develop their intelligence potentials, develop different and original strategies against problems, make a rapid and true decision, improve a systematic structure of thought, and develop a positive attitude for problem solving. The course of intelligence games provide students with developing their capacities of perceiving and evaluating the problems, form a different perspective, improve their habit of focusing on a subject or solution, and develop their capacity of using their reasoning and logic in an effective way (Ministry of Education [ME], 2013, p. 1-2).

The reason for the start of the course of intelligence games as an optional course at secondary schools in the educational year of 2012-2013 depends on these basic acceptances. In this sense, intelligence games contain games not only to develop their mathematical skills but also the ones that will develop such critical thinking and creativity skills as logic, verbal and visual intelligence, problem solving, producing ways of solution, thinking three-dimensionally, developing peculiar approach, making designs, forming shapes, developing tactics (Devecioğlu & Karadağ, 2014, p. 43). It is thought that intelligence games will make a contribution to thinking skills in terms of the fact that they contain various problem cases and require using problem solving processes and that students are required to use some of the strategies, and they allow different ways of solution (Terzi, 2019, p. 18).

With the start of teaching the course of intelligence games at secondary schools as an optional course, a great number of researches have been made regarding intelligence games in recent years and it still goes on. Upon the review of the researches in this field, the effect of intelligence games on various mental skills and some attitudes of primary and preschool period students was investigated in some studies (Şen, 2020; Altun, 2017; Yağlı, 2019; Marangoz, 2018; Şahin, 2019; Esen, 2019; Aşuluk, 2020; Ott, Tavella & Bottino, 2013; Kula 2020; Zengin, 2018; Altıner; 2018); while the effect of intelligence games on the attitude and mental skills of secondary school students was studied in some studies (Sütçü, 2017; Demirkaya, 2017; Demirel & Yılmaz, 2019; Çağır & Oruç, 2020; Yılmaz, 2019; Demirel T., 2015; Aksakal, 2020, Bayramin, 2020; Kurbal, 2015; Yöndemli, 2018; Gençay et al.,2019), teachers views were given place in some other studies (Adalar & Yüksel, 2017; Sargın & Taşdemir, 2020; Çalışkan, 2019; Sadıkoğlu, 2017; Yılmaz Ş., 2019; Güneş D., 2021; Kul & Kel, 2021). And in some studies, the views of prospective teachers upon intelligence games were investigated; in their studies Yüksel et al. (2017) examined the contribution of geometric-mechanic games taking place in the curriculum of the course of intelligence games to the cognitive, affective, and psychomotor development.

As is seen, there are a great number of studies regarding intelligence games in the related literature. These studies are the ones carried out into the mental skills and attitudes of preschool, primary and secondary school students with the views of prospective teachers and teachers as well. For that reason, intelligence games were investigated from different perspectives aiming at different masses in the related literature. Therefore, since the lack of a study carried out into the place of intelligence games in philosophy and logic education makes the current study significant, it is believed that this study will fill in this gap in the literature and make a good contribution. This study offers recommendations regarding the fact that the intelligence games taking place in the educational games could be related to the courses of philosophy and logic. In this study, it is highlighted that the objectives of both philosophy and logic educations and of intelligence games are similar. In this way, it is thought that using intelligence games in philosophy and logic education will both make a positive contribution thanks to the skills that will be attained in the development of the individual, and it will offer a recommendation for the educators who are also the practitioners to reinforce the subject.

In the current study, document analysis method, a qualitative research design, comprising the analysis of written materials having information about the phenomena which are aimed to be investigated, (Yıldırım & Şimşek, 2016: 189) was used. The documents to be used as a data source in the study are teaching program of intelligence games and philosophy and logic curricula to make connection given in the purpose of the research.

The Relation between Curricula, Cognitive Skills and Intelligence Games

The education given at schools and just transferring knowledge to students is not enough to develop students' cognitive capacities, problem solving skills, thinking skills and the skills of forming different strategies and using them. It is because cognitive skills are a concept related to the changes happening in thinking, reasoning, memory and perception systems of individuals. It allows individuals to understand their environment, to acquire knowledge and use it. In addition, cognitive skills become active at such points as paying attention, perceiving the information, attaining the concepts, making a comparison, classification, ordering and making a cause-and-effect relation (Kızıltepe et al., 2017). In this way, the attainment of the skills in question has become one of the basic objectives of education. As a matter of fact, students will be aware of their own aptitudes and potentials more in individual and group works, they will improve them and their self confidence will increase, they will attain systematic and disciplined working habits for success and in the case of a failure, they will develop attitudes and behaviours to form alternative solutions and strategies without giving it up. Depending on sequential teaching program, intelligence games provide students with learning opportunities moving from simple to complex, from easy to difficult, from concrete to abstract, from known to unknown and showing the relation of sequence, so a road going from teaching basic information and skills to acquiring high-level skills will be followed thanks to these stages (ME, 2013, p. 1-2).

Developing these skills is within the objectives of philosophy and logic disciplines as well as those of intelligence games. When it comes to the visions of the curricula where there are these disciplines, it is likely that to see that they aim at training individuals who can make criticism, questioning, reasoning, problem solving, and being aware of the relations and differences, just as intelligence games do. It is because they aim at developing cognitive skills that will be obtained through logical thinking. Based on this target, curricula are prepared, and which skills will be made to be attained is determined. Such kind of skills in this group as being able to differentiate the relation between two cases, determining similar and different cases, making various comparisons require logical thinking structure. In this way, individuals conduct a cognitive process as a result of logical thinking. The process in question shows their cognitive skill (Arslan, 2018, p. 156). The reason why cognitive skills are insistingly focused in curricula is that the rapid change experienced in science and technology and that this change affects the expected roles from individuals directly. Today the individual producing information, using it functionally in his life, being able to solve problems, thinking critically, having enterprising, decisive and communicative skills comes to the forefront. The curricula that will serve for training individuals with these qualifications were prepared for the purpose of making students attain value and skills. In this way, curricula guiding toward using upper cognitive skills, providing a meaningful and permanent learning, integrated with life around values, skills and competencies were prepared. By means of these programs, it is aimed to make students attain such a great number of skills as reasoning, questioning, thinking analytically, thinking critically, producing original ideas, expressing and writing (ME, 2018, p. 13).

Philosophy is an act where human being tries to give the meaning of himself, his life and other things. Therefore, the purpose of the course of philosophy is to make students attain the skill of reasoning rather than forming thinking and logic and to provide the application of this skill in all areas of life (Hannam, 2017). The student can practice these skills attained to his daily and social life. In this way, he is in the field not as a spectator but as an active player. The subject that will be taken philosophically must be connected with the familiar events to the student, since the purpose of philosophy education is to include the inner voice of the student into philosophical activity and make him improve his thinking abilities (Miller, 1995). In this sense, general objective of the philosophy course is to provide students with asking questions regarding human being, information and the world he lives in, seeking for answers for these questions based on reasoning and depending on the knowledge to be acquired about the questions with the basic fields of philosophy, improving their skills of thinking and expressing what they think (ME, 2018, p. 12). For that reason, the objectives mentioned and the expected roles from the individual correspond to the objectives and expectations highlighted in the curriculum of intelligence games. It is because in the basis of intelligence games lay the training of individuals who can question, think regarding the problem, make an inference and comment, and produce ideas just as it is mentioned in the curriculum of the course of philosophy.

By means of intelligence games activities, it is possible to provide students with fictionalize the problems they encounter with the real-life materials and with real world problems. A lot of different methods could have to be used in the problems encountered since some problems could be solved through a very simple and practical method while a detailed and more systematic work and research will need for some others. Once again, such kind of features as being able to be aware of problems and recognising them, being able to see different attitudes against the problem, questioning, forming a strategy, discovering alternative ways of solution, taking place in the solution, being able to convey problems solving skill into life by means of intelligence games in a systemic and improvising way (ME, 2013, p. 6; Terzi, 2019, p. 28). In the field of philosophy, it is also likely to see questioning, critical, creative and holistic thinking regarding basic questions in such issues as the meaning and whatness of human being, his existence, of the universe and life, the problem of values, reliability of information, source of sovereignty, the purpose of art and its value. Therefore, it is aimed that students can ask questions regarding the world they live in; express their thoughts that they prepare answers based on thinking and reasoning for the questions in a written and verbal way, and think in a consistent and grounded way that they can relate them to the real world (ME, 2018, p 12). On the other hand, intelligence games indicate the active nature of the student in learning. In a sense, using intelligence games can be regarded as an active learning technique. Active learning is a process where the learner has the responsibility of learning process, the learner is given the opportunity to make a decision with regard to various sides of learning process and make a self-arrangement, and the learner is forced to use his mental abilities during learning (Açıkgöz, 2014. P. 17). For that reason, intelligence games will address to the active nature of the student.

Since the student-centred learning where the transfer of knowledge and restraining it by the student is valid instead of repetition of information allows an opportunity to the learner to structure information, form, and comment and develop it, it is likely to relate it with the logic education. As a matter of fact, students are expected in the curriculum of the course of logic to reach the knowledge that logic is related to reasoning, which is a form of thinking, be aware of their own ways of thinking, transfer true thinking ways to daily life, attain the skill of being consistent while thinking, supervise the consistency of their thoughts, developing awareness against contradictory thoughts, and base the trueness of information (ME, 2009, p. 6-7). In this sense, it helps individual to develop a cognitive concept, make reasoning by envisioning a subject with all its sides, produce ways of solution and think logically by means of thinking developing the skills of making a decision and solving problems by activating cognitive processes (Güneş, 2012). It is because logical thinking also comprises a cognitive structure in it (Arslan, 2018, p. 155).

Logical thinking is the key to make strong decisions and solve complex problems. It is a kind of thinking providing to solve problems, use the ways realizing reasoning, and to make a decision by means of various comparisons and inferences. Logical thinking skills are the ones using the process of reaching to the whole from the part, from the whole in hand to the parts, and the skills of sorting and classifying the data behaviours (Başerer, 2017). In this way, cognitive development influences the attainment and development of logical thinking skills. At the same time, logical thinking skills are effective in the cognitive development process, since the more individual is encouraged for multiple thinking, his approach to the events and the way of environmental perception is dimensioned (Bozdoğan, 2007).

Why logic science was chosen as a tool in order to provide the development of information, skills and strategies for the purpose of supporting the skills of students will be possible to clarify with the explanation of what logic is both as a discipline and as a thinking way. Besides using logic as a discipline or a name of a course, it is also a sort of thinking. The science of logic is a discipline presenting the rules and laws of logical thinking (Emiroğlu, 2012. P. 13). Logic is not interested in any kind of thinking but in the form of thinking called as reasoning, discoursing and argumentation (Özlem, 2012, p. 29). The science of logic as a discipline having the opportunity to be applied in daily life and different disciplines and as a science presenting the rules and laws of true thinking is given a place at the stage of secondary education by means of the curriculum of the course of logic. Within the context of the program, it is aimed that students can transfer true thinking ways to daily life, be aware of their own thinking ways, think consistently, be aware of contradictions, think independently, produce solutions for the problems they encounter and base their thoughts (ME, 2009, p. 4-5). The relation of these objectives with such skills showing a change depending on the conditions of the day as critical thinking, problem solving, information and technology literacy, coding skill that are known as 21st century skills (Can et al., 2019). The most significant of these skills is the skill of reasoning. Reasoning is the process of reaching a reasonable decision by thinking with the information in hand, paying attention to all factors and evaluating the evidence. The very points highlighted in reasoning are making a decision and obtaining concrete results by means of true inferences.

The basis of the course of logic is to make students attain the skill of true reasoning. Similarly, success in intelligence games depends on rapid and true reasoning, since reasoning is a significant mental skill that students will use throughout their lives together with a systematic problem-solving skill. Thanks to these games, individuals will have such a great number of skills as being able to produce based on logic, improve their grouping skills, to make inferences from their experiences, to solve problems by means of similarity, to solve problems by means of deductive method, develop operant strategies, to form action strategies using abstract symbols, to develop semantic strategies in verbal games, to improve their thinking and reasoning skills and to develop prediction skills based on assessment (ME, 2013, p. 8). As in the course of logic, there are the skill of reasoning based on the skills of thinking, forming ideas and grounding among the objectives of the course of philosophy as well. It is expected in this sense that teacher support students in developing their philosophical reasoning skills and improve their reasoning activities (Hannam, 2017). In this way, reasoning taking place in the definition of logic and comprising a significant part will help the transformation of human thought into concrete products (Ergül, 2014, p. 12) and this is realized through intelligence games.

Besides that, it is likely to say that both philosophy and logic affect communication skills in the relation of individual with others and these skills could be developed through intelligence games. It is because while logic help prevent a lot of misunderstandings, unnecessary discussions by showing the ways of telling thoughts and feelings in clear way through an understandable language (ME, 2009, p. 4), philosophy develops the discussion culture of individual, helping him use concepts in a true and suitable way while expressing his thoughts, and in his taking care of making his expressions grounded (ME, 2018, p. 13). In this sense, as intelligence games will make a contribution to the communication skills as in logic and philosophy, it is thought that they will be beneficial at the points of using vocabulary, being in a team work and expressing their thoughts.

As a result, upon the review of curricula used both in philosophy and logic education, it is likely to see that there are a lot of similarities between the intelligence games curriculum and general objectives and sub-objectives. Among the leading skills that are aimed to be attained to students in each of the three programs are reasoning, thinking critically, thinking analytically, producing original ideas, being consistent, thinking truly, being aware of the contradictions, grounding the trueness of information, thinking in an abstract way, forming different strategies, and problem solving. It is believed that these cognitive skills taking place both in logic and philosophy education will be used in education through intelligence games and develop the mental skills and competencies of individuals, offering an alternative way in making students attain basic information and skills by practicing the theoretical content of the courses of philosophy and logic by means of intelligence games.

The Troubles Encountered in the Education of Philosophy and Logic

It looks possible to use intelligence games in different processes of teaching. It gives a lot of advantages, but the most import one of these advantages might be the relation between the general objectives of education and the skills that intelligence games are likely to make an individual attain. Even though intelligence games are not related to a course, they make a contribution to the improvement of mental skills, but improving the target skill could not be possible through a course alone. For that reason, including intelligence games in different disciplines will contribute to improvement of all skills (Savaş & Kara, 2021, p. 230). Using these games in philosophy and logic courses will be a step towards improving cognitive skills as well.

The problems experienced in Turkish education system are a long way ranging from basic education to higher education. In this way, it is aimed to provide the physical, mental and emotional developments of individuals and create a suitable training environment. Therefore, an important step will be initiated in training the qualitative human power needed for a country. A similar target is present int the curriculum of logic aiming at training individuals who can transfer their true thinking ways to their daily life, think consistently, who are aware of the contradictions, think independently and produce solution methods for the problems they encounter (Arslan, 2022, p. 137-138).

In a study by Duman and Arslan (2021, p. 96-97), it was found that a change in the teaching time of the course of logic brought about a decrease in the interest in the course of logic and they developed a negative attitude towards the course since it affected both in which year the course would be taught, whether it would be a compulsory of elective course and it affected the teaching hours in the selected fields. Suggesting that teaching logic would be effective in the development of logical thinking in the case of it is thought properly, Başerer (2019, p. 90) pointed out that the course of logic would be taught in an entertaining and effective way by using such various teaching methods as question and answer, discussion, problem solving, case study, educational games, and logical thinking would be improved in this sense. This result is also present in a study by Duman and Arslan (2020, p. 137). Accordingly, using the most suitable strategy, method and technique for the content in teaching logic would make the quality of teaching, learning level and learning outcomes efficient. As for supporting logic teaching with games, it would provide with the socialization of the students their active participation and reinforce the subjects. In this way, the course of logic would be a course listened with pleasure and willingly by being away from boredom for students.

A similar case is also true for the course of philosophy. Since it would not be sufficient to merely transfer information to students in developing their cognitive capacities, there is a need for some practices to eliminate the course of philosophy from a theoretically limited area. One of the components to meet this need is intelligence games. It is because the intelligences to be used to strengthen the practical side of the course of philosophy besides the theoretical side would dramatize the content of the course and make it enjoyable for students (Duman & Petek, 2022, p. 8). The leading problem in philosophy education is that the subjects in this discipline are abstract ones, the subjects are away from daily life, the course is carried out depending on memorizing them, the content comprises too many details, lack of teaching concepts in the process of teaching and learning, teaching is of secondary importance and it guides student to memorizing. Accordingly, the fact that the concepts in the course of philosophy are abstract makes the course harder and teachers try to make the subjects concrete using examples to overcome this problem (Biçer, 2013). In his study, Dombaycı (2008, p. 166-167) pointed out that mostly direct instruction method is used in teaching the course of philosophy, such methods and techniques as discussion, presentation and exemplification are rarely used, the language in the course books are hard to understand, the outcomes must contain knowledge, skill, attitude and values, and that the course content must not only comprise philosophical information and problem, but also thinking skills. Kızıltan (2012) pointed out that regarding the course of philosophy as a course which has no contribution to the university entrance scores by the students is a problem in terms of philosophy and indicated that students regard the course of philosophy as an abstract course focusing on the ideas of philosophers, away from daily life and requiring memorizing, so they have a negative attitude towards the course. Bayrak and Duruhan (2016) emphasized that teaching must be student-centred by giving places to group work in philosophy teaching, teaching settings must be diversified to develop the commenting and thinking skills of students and that the learning strategies of learning by doing must be used in order to increase the interaction between teacher and student. Therefore, the course must be attractive in a way to support the content in the course of philosophy, student must share their ideas, and they must be given opportunities to express their thoughts in various topics and to make analytical reasoning.

To sum up, it is known to us that the courses of philosophy and logic are compelling mentally, there are some troubles in understanding the courses, these troubles lead to the feeling of failure at students, a negative motivation is formed against courses and that the concern and anxiety level is high. For that reason, it is of necessity that the branch teachers must include intelligence games in the curriculum and they must eliminate negative thoughts and feelings among students. In this way, it must be taken into consideration that intelligence games are a significant factor both in the rehabilitation of course success and the attitudes of students towards the courses and in the attainment of such versatile outcomes as knowledge, skill and attitude, so these games must be benefitted at maximum level.

Using Intelligence Games at Philosophy and Logic Education

It is of importance to include games in the learning settings in terms of providing individuals with meaningful learning and increasing their cognitive skills. Among the games making a great contribution to development and learning, intelligence games are one of the earliest known game materials. According to Çağır and Oruç (2020) they could be considered as the new generation educational materials serving as an alternative against the problems caused by technology, besides being the earliest game materials. It is because some games offered by technology which are not considered as educational make individuals addicted to technology and prevent them from socializing. However, integrating games that would encourage socializing, learning, entertaining, skills and competences with the field of education turns intelligence games into a functional teaching tool.

The role of intelligence games in attaining a great many skills is a known fact, but it is an issue to be considered in applying it in a systematic way. One should bear in mind that student could be attained skills in a systematic way by means of intelligence games and that these games could be used in an active way in different courses. One of these courses is philosophy and logic. It is known that intelligence games are the games contributing the development of cognitive skills. At the same time, it is likely to see that a common sense was adopted in the curriculum of philosophy and logic courses after the latest updates and the skills that individuals must have were mentioned. In both curricula, it was highlighted that students must be equipped with such skills and competencies that could keep up with the science and technology era, meet their needs, and support them to solve problems they encounter, which are all regarded as 21st century skills. This was given in the curriculum of the course of logic (ME, 2009, p. 6-7) as follows: "It is aimed to have students completing the course of logic that they can transfer true thinking ways to daily life, they are aware of their own thinking ways, they can attain the skill of being consistent while thinking, they can supervise the consistency of their thoughts, they are aware of contradictions, they can think independently, they can produce ways of solution to the problems they encounter and they can ground the trueness of knowledge." A similar emphasis was placed in the curriculum of the course of philosophy (ME, 2018, p. 13) as follows: "there are such basic competencies that are thought to be attained by the students with the curriculum of philosophy as acquisition of philosophical concepts and information, reasoning, questioning, argumentation, analytic thinking, critical thinking, the skill of expression and writing, philosophical literacy, producing original ideas".

Considered in the category of educational games, intelligence games are the games with which the learners can practice their knowledge, skills and strategies in the roles they have. They can also be used in philosophy and logic teaching in order to develop and apply the knowledge and skills acquired beforehand, determine the gaps and weaknesses of the knowledge and skills develop new relations and principles between concepts and principles (Demirel T., 2021, p. 5). For that reason, these games could be used as reinforcers in the philosophy and logic courses by applying in the beginning and at the end of the units. As an example, the levels of readiness of the students could be determined by means of intelligence games applied in the beginning of the unit, or they could be used as an assessment instrument at the evaluation stage to determine how much the subject was taught by practicing them at the end of the unit. An intelligence game given in the beginning of a unit where the concepts or movements are abundant in the course of philosophy will both inform the teacher for the sake of predicting the knowledge of the students regarding the issue and activate the present knowledge and skills the ones playing the game. A similar case is also valid for the course of logic. As an example the intelligence game of ABC Bağlama could be used to determine the concepts which are both frequently mixed and synonymous such as induction, analogy, assertion, assumption in the course of logic. In this way, it is likely that synonyms of concept could be related to each other and taught in an understandable and enjoyable way.

In philosophy and logic teaching, reasoning games in the form of puzzles that could be solved by evaluating the given clues and only logical assumptions, and operational games where logical assumptions as well as four mathematical processes are used (sudoku, minesweeper puzzles, and logic square) are other examples to be used. Besides that, verbal games could also be benefitted to facilitate the courses in question, since they are the kinds of games where those playing the games could benefit from logical assumptions as well as their vocabulary and general knowledge skills. Those playing such games as anagram, word puzzle, attention test, word hunt could produce meaningful words, could place the words given in lists in a table in a way that they are compatible with each other, and produce meaningful words out of the letters regarding a theme given in a mixed way. In the metal games based on visual or verbal memory, which are one of the intelligence games, such games as matching and rebus where you can find meaningful words produced out of a picture or alphabet depending on a theme could be benefitted and such other strategical games as reverse, tic tac boom, go, mangala where both the individual and the other player could apply their logical assumptions as well as intuitional tactics in their experiences at the different stages of the game could be used.

In this way, as it will be possible to make the content of philosophy and logic courses understandable and enjoyable by benefitting from the intelligence courses as an educational game or an activity, the success in these courses will increase. In this context, it is of great importance to relate the intelligence games with the learning outcomes of the courses of philosophy and logic and to apply the activities to be developed.

Conclusion

Game in the field of education comes to the forefront as an alternative activity out of courses for many years. For that reason, it did not find its place neither in school programs nor in course plans for a long time. With the changing and developing educational approaches, game is now regarded as an activity that must be benefitted for an efficient and permanent learning. Studies (Aşuluk, 2020; Atay, 2018; Karataş, 2021; Lynne, 2004; Uskan & Bozkuş, 2019; Uslu, 2022; Şentürk, 2020; Whitebread, 2012) show that game makes a positive contribution to the development child. With these developments, game has been encountered so often in recent years.

Any development and invention facilitating human life and allowing the accomplishment of a trouble is the product of unusual minds. It is known that mind, logic, cognitive capacity and reasoning that help think differently and produce different solutions that human being can develop throughout his life. However, this development serves for developing mental capacity and skills much more by means of various intelligence games and activities. Intelligence games are an activity making the active learning desired to be realized more permanent and enjoyable. Human being in the twenty-first century must have a quality of being able to think critically, analytically and creatively, having a high-level problem-solving and communicating skill, to produce original ideas, in short, a quality with high level thinking skills to respond the needs of the age. To be able attain these qualities will only be possible through educational settings. In this sense, intelligence games will offer an opportunity for the applications based on active learning by doing and experiencing in educational processes and help them attain high-level thinking skills. Therefore, it looks as a need to use it in the philosophy and logic education where a practical field is needed to increase the permanence of what is learned as there is an intensive theoretical field.

Intelligence games make a contribution to individual mostly by means of cognitive skills as they activate cognitive process of individual and improve his problem-solving skills. Developing these skills are among the objectives of intelligence games as well as those of philosophy and logic disciplines. Upon the review of the visions of the curricula of these disciplines, it is likely to see that they aim at training individuals who can make critical, questioning, reasoning, who can solve problems, become aware of the relations and differences just like those of intelligence games.

The basic importance of philosophy education is to inspire the student effort of an individual who encounter any problem to solve this problem in a rational way. Here, the combination of theory and practice is of importance, but philosophy courses are mostly taught theoretically. For that reason, there is a need for practices that will enable student to use philosophical knowledge and enter its experience area. This need of practical field could be obtained through intelligence games. Providing students with asking questions regarding human being, knowledge and the world he lives in and seeking for answers based on reasoning, providing them with developing their skills of thinking and expressing their thoughts, which take place in the general objectives of the course of philosophy, correspond to the objectives of training individuals who can question, think regarding the problem, make inferences and comments, and produce ideas, which take place in the curriculum of intelligence games. Besides that, while it is provided that they set over the problems they encounter with real life materials and relate them to the real-world problems by means of intelligence games activities, it is aimed to question the issues regarding the world they live in such as whatness and meaning of existence, universe and life, and they can relate their thoughts with daily life in the field of philosophy. Also, the active nature of the learner was emphasized both in philosophy education and intelligence games.

On the other hand, intelligence games allowing the student-centred learning and the learner to structure, form, comment and develop knowledge could be related to logic education as well. As a matter of fact, students are expected to have such qualities as being aware of the own thinking ways, transferring the ways of true thinking to the life, developing awareness for contradictory thoughts and grounding the trueness of knowledge. Making students develop their knowledge, skills and strategies regarding how to support reasoning skills is both a result of logic education and the basic aim of intelligence games. The idea of making students attain a reasoning skill which is the objective of both of them is one of the most important skills that will be used throughout life. Thanks to intelligence games, these skills will be developed because of a practical application field. In this way, the skill of true thinking and reasoning in the logic and philosophy education will be turned into concrete products and their permanence will be increased. It is because game is a tool making the individual recognise the world he lives in and make it meaningful. For that reason, it will certainly be true to benefit from games in education system. A similar thought can be seen in a study by Uskan & Bozkuş (2019). Accordingly, when behaviour, knowledge and skills are internalized with games, they become more permanent, and they are learned in a natural way. Therefore, the power of game must not be ignored, and it must be provided to be taken more places in education system by delivering its value it deserves.

According to Uslu (2022), since game-based learning is not an education in games but a technique adopting the logic of game in education, education symbolizes the whole and game symbolizes the part. For that reason, building a sense of education based on games could mean ignoring other strategies used and diminishing education to entertainment. What must be taken into consideration is to be aware of this distinction. The purpose of designing games could be entertainment and having a good time, but what is important in a game that will be benefited in education is not just playing it as a game but that it could be benefitted in teaching with the activity design and guidance of the teacher.

The current study was carried out into the importance of intelligence games in philosophy and logic education taking place in secondary education; however, upon the review of the related literature, it was found that there was no study regarding intelligence games related to philosophy group education and the ones found was very limited. In addition, when it is considered that most of the studies were conducted at a certain stage of teaching (preschool, primary, secondary education) in certain courses (Turkish language, mathematics, science, social sciences), it is believed that it is of importance to carry out researches at various teaching stages and disciplines.

It was found that what is learned in the practice will increase the interest and motivation and improve academic performances in the case of preparing intelligence games within learning setting suitable for the curriculum and it will have a positive effect on the school success, so they can be practiced in logic and philosophy education. Since the subjects of the two courses are hard to understand and abstract for the students, educators have significant tasks in order to eliminate this thought and make the course more effective and understandable. The first one of them is to relate the subjects of philosophy and logic to daily life with the help of intelligence games and makes them concrete, offering students some practices about how to learn philosophy and logic. In this way, using intelligence games will make the interests of students alive and increase their interest, knowledge and skills regarding these fields.

Besides that using intelligence games as a course material is of a quite efficient function in attaining students such features as increasing communication skill, empathy abilities of students, expressing their thoughts, acquiring self-esteem. In addition, students will both learn to be patient and respectful among them and peer learning will be realized thanks to intelligence games based on cooperation. In this way, the subjects both in philosophy and logic courses must be arranged by paying attention to the interests and needs of students and they must be taught in relation to daily life, and also methods and techniques where the student is active and reasoning is realized must be used in teaching process. By this means, it is believed that such problems as forgetting based on memorising caused by traditional teaching methods and developing negative attitudes towards the course will be decreased through the philosophy and logic courses that are planned in an effective way and that the importance deserved by the two courses will be regained.

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REVIEW

A Practical Exploration of the Holistic Module Learning Model

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Abstract: *The holistic module learning model was initially developed by the Shandong 271 Education Group as part of their efforts to reform classroom instruction. With the progress of basic education reform in China, the model has evolved into a pedagogical approach that prioritizes student-centered learning and teacher-guided instruction, with the goal of nurturing students' self-development and exploratory skills. Furthermore, the productivity of this approach has been demonstrated through experiments conducted by various schools across the nation. This study provided a concise overview of the historical development of the model and demonstrated its core elements and implementation strategies through its application in Chinese courses. The aim was to offer valuable insights into holistic module learning for the basic education community.*

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BASED on the principles of humanistic theory, the holistic module learning model is designed with the primary objective of fostering comprehensive development in students. The instructional approach under consideration comprises three fundamental components: major concepts, module learning, and holistic learning. The approach utilized in this context involves the utilization of major concepts to reintegrate the learning contents, with a particular emphasis on the integrity of learning. Additionally, the organization of learning materials is structured around holistic modules as opposed to isolated lessons. Furthermore, it is advocated that both teachers and students cultivate a systematic and holistic perspective on knowledge across all subject areas.

The concept of holistic module learning represents a novel approach that seeks to address the limitations associated with conventionally fragmented instructional methods. The approach involves the restructuring of student learning content by focusing on fundamental disciplinary concepts. It incorporates learning protocols to enhance the implementation of the national curriculum program and course standards, as well as the teaching of national uniform textbooks. Additionally, it aims to address the interplay between learning and teaching as well as learning and practice. Furthermore, it introduces innovative learning methods, such as cooperative group learning, situation-based study, and inquiry-based learning, to foster the integration of knowledge and experience and the application of learning. This article provides a comprehensive overview of the evolutionary trajectory of the holistic module learning model. It elucidates the core components and implementation strategies of this model, employing instructional practices in Chinese courses as illustrative examples.

The Background of Holistic Module Learning

The idea of module learning was introduced to China subsequent to the May Fourth Movement, a socio-political movement initiated by patriotic youth in 1919 that represented China's cultural transition into the modern era and encompassed anti-imperialist and anti-feudal sentiments. Since then, the practice of compiling textbooks by unit, which is analogous to the teaching concept of "module" in China, has persisted until the present time. However, there was a limited amount of research conducted on this particular teaching paradigm during its early stages. During the 1980s, there was a notable increase in the research conducted on module learning. In the late 1980s, the Educational Science Institute of Shandong Province conducted a study on criterion-referenced module teaching and developed a novel standard framework for implementing this instructional approach. This research has yielded substantial results through its sustained implementation (Wang & Guan, 1992). Numerous scholarly researchers have underscored the importance of module-based learning in their respective studies. Cui (2019) posited that the implementation of module learning requires an instructional design approach that encompasses holistic modules rather than focusing on isolated and fragmented learning materials. This approach should incorporate real-world situations and tasks, with the ultimate goal of enhancing the effectiveness of classroom teaching.

Shandong 271 Education Group has officially introduced the concept of holistic module learning. Because of the Group's ongoing experiments in classroom instruction reform, it has evolved into a student-centered instructional model with an emphasis on cultivating students' self-directed and cooperative learning skills. This learning model has four prevalent characteristics: task-driven learning, situational experience, autonomous inquiry, and promotional transfer (Zhao, 2022a). It facilitates students' mastery of fundamental theories, logical structure, and practical application of disciplinary knowledge and develops their thinking skills through a holistic cognitive process involving autonomous study, dialogue, critique, application, and creation.

The primary objective of holistic module learning, which is to cultivate essential competencies in students, is in accordance with the fundamental principle that underlies the recently implemented national curriculum program. This teaching method promotes the establishment of a democratic and inclusive environment within the classroom, wherein recognition is given to the unique individual traits of students and efforts are made to enhance their engagement in the learning process. Students are afforded the opportunity to cultivate their character and enhance their capabilities through engaging in dialogue, interacting with others, participating in experiential exploration, posing thoughtful inquiries, and engaging in reflective practices. Consequently, the implementation of holistic module learning has emerged as a noteworthy endeavour within the framework of the recent curriculum reform.

Fundamental Elements of Holistic Module Learning

Cultivation of Student Key Competencies

The release of The National Senior Secondary Education Curriculum Program and Course Standards 2017 and The National Compulsory Education Curriculum Program and Course Standards 2022 ushered in the era of competency-based education. Holistic module learning satisfies not only the National Curriculum Program requirements but also those of the Double Reduction policy. It shifts from a focus on knowledge itself to a focus on student development; from teachers' knowledge transmission to the cultivation of students' important competencies; and from students' knowledge acquisition to their mastery of methods for analyzing and solving problems. It encourages a student's intrinsic motivation to learn rather than forcing them to study (Zhao, 2022b).

Construction of Instructional Modules

Instead of using predetermined textbook units, holistic module learning is structured using modules. Teachers must first identify the key learning goals outlined in the National Course Standards, construct major ideas based on these goals, and then group pertinent learning resources into self-contained modules.

In a study conducted by Cui (2019), a comparison was drawn between curricular modules and building units. The author posited that the desired outcome of a module is not limited to discrete knowledge and learning techniques, much like how raw materials such as cement and steel bars are not visible in a home unit. The primary function of modules is to facilitate the development of key competencies in students as building blocks are mainly for human inhabitation. A module, which is constructed around a central concept, can be described as a self-contained collection of subject matter that emphasizes the development of one or more fundamental skills or abilities (Liu et al., 2022). The successful attainment of the module's objectives by learners signifies their acquisition of a comprehensive set of knowledge and competencies that can be effectively utilized in practical contexts (Yelon, 2015). The module within the instructional model being discussed differs from the traditional textbook unit in that it possesses a higher-order objective and there is an inherent linkage between the lessons contained within the module.

Focus on the Learning Process

The learning process is prioritized over the learning outcomes in holistic module learning. Task-driven learning, situational experience, autonomous inquiry, and promotive transfer are characteristics of a typical holistic module learning process where self-directed learning, cooperative study, and inquiry-based learning predominate. Study groups are given top priority in the classroom since encouraging students' autonomy and self-regulation in learning is one of the main goals of holistic module learning. Group study is the most fundamental structure for implementing holistic module learning, and it is also the most widely used type of cooperative learning. Until the group comes to a consensus on a particular issue or question, everyone is free to think and speak. Students' agency in classroom inquiry significantly rises when the learning process is emphasized. This also improves students' self-efficacy and aids in character development.

The two pieces "*Elderly Wang*" by Jiang Yang and "*Ah Chang and the Classic of Mountains and Seas*" by Luxun, for instance, are included in the module for the seventh-grade Chinese course's major concept of "probing into the emotional developments of the authors." In "*Elderly Wang*" and "*Ah Chang and the Classic of Mountains and Seas*," respectively, there are two statements that are frequently cited: "That is the feeling of guilt of a lucky person towards an unfortunate one" and "O kind-hearted earth mother, may her soul rest in your arms!" Why did cerebral Jiang Yang feel bad for the old, destitute Wang, who lived by carrying the cart? Why did Luxun, the most well-known author in contemporary Chinese literature, show his affection for his childhood nanny in such a passionate and emotional manner? Students can discover similarities between the two articles by closely examining the text while keeping two concerns in mind: the authors' shifting attitudes about the protagonists as well as their genuine compassion for the oppressed.

The most remarkable event in "*Elderly Wang*" is "Wang gave Yang some sesame oil and eggs before he died," as described in the following passages:

> *"His face was deathly pale, with a layer of pannus on both eyes, making it difficult to distinguish which one was blind and which one was not. To put it a bit exaggerative, he was like a corpse poured out of a coffin, or like the zombie I had imagined, with dry yellow skin stretched over the skeleton. One single hit of a stick would make it collapse into a pile of white bones."*
>
> *"I accepted them. A bottle of sesame oil and eggs were wrapped in a piece of cloth. That's what he gave us as presents."*
>
> *"He quickly stopped me and said, 'I don't want any money."*
>
> *"I hurriedly opened the door for him and stood at the landing, watching him descend step by step with a worry that he would fall halfway down the stairs. When I got back to my room, I felt sorry that I had not asked him to sit down and have a cup of tea."*

The following are some questions that the teacher can help students consider: What would Yang have done and said if the guest had been one of her family members? Sesame oil and eggs were considered luxuries rather than everyday foods during those times; possibly these were the only precious assets old Wang had when he passed away. Yang spoke about her interactions with him in hospitals and at her house when her husband was very ill and on the day before Wang passed away. She recalled his constant regard for her and his real and helpful demeanor. Via this analysis process, students learn to comprehend Yang's emotional shifts, which lead to her feeling extremely remorseful for the lonely, poor man. The same examination of "Ah Chang and The Classic of Mountains and Seas" will enable students to comprehend how Luxun modifies his affectionate feelings for Ah Chang, his humble childhood nanny.

Implementation Strategies for Holistic Module Learning

Well-crafted Learning Protocols

Well-designed learning protocols are essential to the execution of holistic module learning. Teachers create the learning protocol based on course standards, textbook content, and student learning conditions. A typical holistic module learning protocol includes learning objectives, tasks, scenarios, and evaluation for a particular module. The objectives for learning are determined in accordance with the module's central idea. They are to be attained with the aid of a standard classroom procedure consisting of four phases: overall perception, inquiry and construction, application and transfer, and reconstruction and expansion.

In order for students to genuinely experience the context of learning activities and be self-motivated to pursue further inquiry, teachers typically give or create real settings for learning materials during the initial stage of overall perception. Students identify the knowledge, techniques, and skills that should be learned in the current module through self-directed and cooperative learning in the second stage of inquiry and construction. They create the crucial links between information and skills on their own. Students examine the rationale underlying the information based on that foundation. The learning protocol contains learning activities created to address real-world issues in order to facilitate knowledge application and transfer. Students continually review previous lessons as they complete assignments and refresh their knowledge, strategies, and abilities to develop new ones. They also discuss how to use newly acquired information, techniques, and abilities in social settings to address novel issues. Such understanding-generation cycles have the potential to continuously produce stronger understandings of the module's fundamental ideas. The final stage of reconstruction and expansion involves students reviewing what they have learned, evaluating if the module's learning objectives have been reached, and summarizing various approaches to solving problems. Students reconstruct their knowledge structures, create mind maps, and optimize learning strategies throughout the full curriculum by looking at completed assignments, solved issues, and new learning.

The seventh-grade Chinese course incorporates the module entitled "Scientific Imagination and Exploration," which comprises the lessons "A

Great Tragedy," "With Her Eyes," "One Day in Space," and "Typographs." The learning protocol for this module follows a designated procedure, outlined below.

Step one: Using the requirements of the National Course Standards and the information in the textbook, determine the module's major concept and the pertinent core competencies that need to be developed.

i. The Course Standards' Requirements that Pertain to this module are:
   - Acquire personal emotional experience in the appreciation of literary works and comprehend their underlying meanings to comprehend their implications for nature, society, and human existence; examine the work's evocative language and demonstrate one's own comprehension of its impressive characters and situations.
   - Focus on the scientific spirit and methods of thinking conveyed when reading about science and technology events to develop evidence-based, truth-loving scientific attitudes.

ii. The Major Concept of the module is the significance of expeditions and scientific imagination in the history of scientific development.

iii. Relevant Key competencies are rigorous attitudes towards science and a willingness to explore uncharted territory.

Step two: Establish the module's learning objectives in accordance with the criteria of the course standards and the major concept.

i. Identify the essential information in the four stories by scanning the text, provide concise descriptions of the explorations in the stories, and discuss scientific imagination with the class.

ii. Examine the characterization techniques employed by the authors through intensive reading and summarize the common characteristics of the explorers.

iii. Use the writing techniques presented in the text to compose a minimum of 800 characters on a scientific topic such as aerospace, biology, computer science, or new energy.

iv. After studying the module, reconstruct one's existing knowledge structure regarding genres, characterization, and artistic expression. Through extensive reading of science fiction and expeditions outside of class, one can increase his or her comprehension of scientific imagination and exploration.

Step three: Create learning activities and situational tasks for each of the four steps in the classroom procedure. For instance, the following is how the learning protocol for the process of overall perception is created:

i. Situational Assignment: The school prepares an essay solicitation with the theme “Adolescents’ Marvelous Adventures” for the following week to ignite students’ interest in exploring natural and scientific domains and to encourage their passion for the unexplored terrain. The current module must be thoroughly researched by the students to prepare them for the “Adventures”.

ii. Learning Activities

- Scan the four stories for key facts; express the characters’ inquiries in your own words; and recognize humanity’s physical weakness and spiritual brilliance.
- Read the text carefully to find sentences that convey the explorers’ emotional reactions to the challenges they face.
- Share your thoughts about the value of imagination based on your own life experiences with the class.

Step four: After completing the four-step classroom procedure, evaluate the students’ learning outcomes using assignments requiring both individual and group work.

i. “One Day on the Space” aims to elucidate the reasons behind the commendation of Liwei Yang as an esteemed figure in the field of aerospace, commonly referred to as an “aerospace hero.” What topics would you inquire about during a potential visit by Yang to your educational institution, where he engages in dialogue with both faculty members and students? Please ensure that you have formulated your questions in advance.

ii. In the lesson “A Great Tragedy,” Robert Scott penned his final sentiments to the British populace within the frigid confines of his tent as he neared the conclusion of his existence. The noble attributes exhibited by him have elicited admiration and resonance among individuals globally, persisting throughout time. Compose a critical analysis of the narrative in order to demonstrate comprehension of the protagonist’s behaviour and choices.

iii. According to Albert Einstein, the significance of imagination surpasses that of knowledge due to its boundless nature, in contrast to the limitations inherent in knowledge. Imagination possesses the capacity to encompass all aspects of the world and serves as the wellspring from which knowledge originates. Through the utilization of imaginative faculties, individuals can attain the long-desired realm they have sought after. Examine the literary techniques employed in the four given texts and select a subject of personal interest from scientific domains encompassing aerospace, biology, computer science, and new energy. Compose a fictional narrative, comprising a minimum of 800 characters, which portrays an exploration of an imaginary realm.

iv. Please distribute your composition among the members of the study group. Enhance and refine the text by incorporating the feedback and recommendations provided by members of the group, resulting in a well-crafted narrative with suitable literary techniques and an imaginative and captivating theme.

A Multidimensional Evaluation System

A crucial educational tool for directing, controlling, and motivating student learning is the school evaluation system. The holistic module learning approach utilizes a multidimensional evaluation framework that includes student academic performance, physical and mental healthiness, personality development, social skills, and more to enhance student all-round development. This is distinct from the conventional approach to evaluating education, which relies solely on exam outcomes.

In holistic module learning, both formative and summative assessments carry equal weight. The overall performance evaluation of a student during a term consists of module assessments, monthly performance reports, and terminal exams. The model's multi-level assessment consists of a national uniform examination, city-level exams, and school-, class-, and subject-based evaluations to evaluate every aspect of student development. In addition, multiple evaluators, including teachers, parents, peers, and the community, participate in this evaluation system. In addition, it is a merit-based evaluation system designed to emphasize the unique strength and talent of each student, as examination results alone cannot fully reflect students' attitudes, commitments, learning styles, innovative dispositions, and practical skills. Such a student-cantered, scientific, and multidimensional evaluation system plays an essential role in promoting competency-based education and fostering the holistic development of students.

Conclusion

Holistic module learning is a goal-directed learning model whose primary educational objective is the development of students' essential competencies. According to the competencies to be fostered, major concepts in each discipline are identified and used to organize modules for implementing structured, integrated instruction. The development of students' higher-order skills, such as self-directed learning, independent inquiry, and creativity, is facilitated by protocols for holistic learning that are thoughtfully designed. Its multidimensional evaluation frameworks encourage students' holistic development. Consequently, it is a student-cantered instructional approach in which the learner is viewed as an end rather than a means. The effective implementation of the new National Curriculum Program and Course Standards will be facilitated by an instructional model exemplified by the successful application of holistic module learning.

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