Evaluation of Studies Based on the ICAP Framework in Learning Environments

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ABSTRACT
ICAP is a framework that classifies learning processes based on students' explicit behaviors. The framework is developed for testing the hypothesis that interactive exercises are better than constructive exercises, and active exercises are better than the passive exercises for higher cognitive engagement and better learning outcomes. The ICAP Framework is intended to assist researchers, instruction designers and instructors in determining the activities appropriate for the aimed research and teaching. This study aims to evaluate articles based on or supported by the ICAP Framework from various aspects. In the study, employing the descriptive survey method, data collection was conducted through document analysis, while content analysis was utilized to analyze the data. The 71 articles reviewed within the study's scope were examined through the "data collection form" developed by the authors. In this context, the articles' general and methodological characteristics and themes and the findings related to ICAP contexts are presented. As a result of the research, no study regarding the ICAP Framework was conducted in Turkey. It was revealed that most of the studies, which have increased in number since 2017 in various countries, utilize the ICAP framework at the analytical level or create models-modules and develop tools-scales based on the ICAP Framework. Additionally, it was observed that mostly undergraduate and K12 students were studied in face-to-face education, with social sciences as the leading disciplinary field and teaching-learning approaches and design-development-evaluation as the most frequently studied topics, while in studies in which mixed and qualitative methods were the leading methods, exploratory and experimental approaches were more preferred. In line with these results, recommendations are presented to contribute to the field.
Keywords: ICAP Framework, ICAP Hypothesis, Cognitive Engagement, Active Learning, Explicit Behaviors

INTRODUCTION

Interactive-Constructive-Active-Passive (ICAP) Theory; is a cognitive engagement theory developed to define cognitive engagement and active learning in a way that can encourage deeper learning. Before explaining the theory and the ICAP Framework developed based on it, it is essential to examine how cognitive engagement and active learning are defined in the literature.

Engagement, which refers to the student's level of commitment and involvement in school, has been examined primarily as a construct discussed in the K12 education literature (Fredricks, Blumenfeld, & Paris, 2004). Reschly and Christenson (2006) state that engagement, considered multidimensional in the literature, has three important dimensions: cognitive, emotional, and behavioral. While behavioral engagement means actively taking part in the in-class exercises and learning processes such as studying and doing homework; in cognitive engagement, subjects such as students' including the learning in their cognitive processes or having aims for learning, and the association of the new knowledge with the old knowledge are discussed. Emotional engagement stands for building positive relationships with teachers and peers, wanting to participate in the lesson, being curious and interested, feeling belongingness to school, etc. At this point, Chi, Adams, Bogusch, Bruchok, Kang, Lancaster, ... &Yaghmourian, (2018), emphasize the three elements related to engagement in K12 literature regardless of the dimension of it. These are the lack of systematic definitions and criteria for degrees of engagement, the lack of a clear definition of cognitive engagement from these three engagement perspectives, and its merging with related constructs such as motivation, self-regulation, metacognition, strategy use (Ravindran, Greene & DeBacker 2005; Greene, 2015; Sinatra, Heddy, & Lombardi., 2015, as cited in Chi et al., 2018), and the difficulty in measuring cognitive engagement with survey instruments.

One another concept that relates to the ICAP Framework is active learning. The recent efforts in structuring the learning environments to make learning more productive and efficient are shaped through the current term, active learning. Chi, (2009), Menekse, Stump, Krause, & Chi (2013) define active learning as the contemporary student-

centered teaching approaches that dynamically include students in the learning processes; and state that the main components of active learning are students' participation in the concrete learning experiences, building knowledge through meaningful learning techniques, and student interaction to a certain extent throughout the process.

Active learning at the university level is defined in two ways: from the perspectives of students and teachers. Passive learning is defined as the context in which students learn, usually only when the teachers are lecturing. At the same time, active learning is defined as anything else students can do when they are not being lectured to, usually collaborative/interactive exercises in small groups or pairs. (Chi et al., 2018) In professional development literature, active learning refers to the general thought that a professional development program should embed active learning strategies throughout the whole program. Such strategies include a variety of teacher activities such as requiring teachers to practice as learners under simulated conditions, review the works of students, observe expert teachers, or be observed by other teachers, followed by feedback and discussion (Van Driel, Meirink, Veen, & Zwart, 2012).

Chi et al. (2018) state that active learning is a popular construct aiming to demonstrate that active students learn more than passive students; however, emphasize that neither explicit parameters nor concrete operational definitions regarding what kind of exercises are active learning exercises and how to decide whether an active learning exercise is better than the other are present, and that the criteria cannot be met. Therefore, teachers and instructors face practical difficulties of not knowing how to design active learning exercises, other than avoiding lecturing. Freeman et al. (2014), state that active learning does ƒnot define in any way that can refer to any kind of learning strategy other than lecturing, and therefore, the educators are deprived of guidance in deciding what kind of exercises need to be included in the classroom. Therefore, the absence of a broad framework and classification related to the elements and characteristics of active learning makes it difficult to determine the value of active methods in different studies. Against these issues in the literature about engagement and active learning, ICAP, an evidence-based theory and learning science to help teachers design and practice active learning strategies, offers a heuristic method for improving learning to differentiate the types of active learning exercises from each other. (Chi & Whylie, 2014)

Interactive-Constructive-Active-Passive (ICAP) Framework

ICAP Framework, initially put forward by Chi (2009), with its initial form DOLA (Differentiated Overt Learning Activities), classifies students' learning processes based on their explicit behavior. Within the DOLA, ICAP which presents three cognitive modes of cognitive engagement as interactive, constructive, and active; was improved in 2014 in a way that includes the passive mode. (Chi & Wylie, 2014) Because many studies related to laboratory and classroom studies show that the passive mode is confused with one of the three modes. The term 'active' in active learning refers to the three modes (interactive, constructive, active) of cognitive engagement. 'Active' in the ICAP Framework, on the other hand, is a term referring to only one (active) engagement mode. (Menekse et al., 2013)

ICAP Framework provides a taxonomy of learning exercises based on explicit behaviors of students, categorized into one of the four modes (Chi & Whiley, 2014): Interactive (I), Constructive (C), Active (A) and Passive (P). Explicit behaviors as indicators reflecting cognitive engagement can be observed, elicited, or directed by the instructor, evaluated in frequency of occurrence, coded, and analyzed as proof of the mediums in learning. This framework was developed to test the hypothesis that interactive exercises are more beneficial than constructive exercises, and active exercises are more beneficial than passive ones (I>CA>P). Chi & Whylie (2014) argue that drawing a line between these constructs is necessary for not only designing learning environments but also assessing which learning exercises are the most effective in mediating student learning.

The framework is different than the others in terms of emphasis and results. For instance, Cognitive Load Theory emphasizes the prescription of certain principles related to how learning materials need to be designed. (Pass, Renk & Sweller, 2004) SAMR Model provides learning designers with a framework to create the most appropriate learning experiences. (Conole &Brown, 2018). In the design of lesson plans and course work, typically used frameworks; for instance, Bloom's taxonomy, begins with classifying learning objectives and assessment elements from the teacher's point of view. (Krathwohl, 2002). ICAP, in contrast, designs lesson plans based on student's points of view and what they are supposed to do when interacting with teaching. The proposed framework focuses on understanding how different learning exercises contribute to or encourage learning. Each mode in the framework is operationally defined with heuristic methods consisting of two explicit indicators. These are the visible outcomes that students generate during the physical actions as they engage with learning. (Chi, 2009; Chi &Wylie, 2014; Chi & Boucher, 2023).

Accordingly, passive engagement mode defines the state in which students are the recipients of information without engaging or interacting in their learning processes. For instance, if students listen to the lecture carefully or watch a video about the taught subject without note-taking, and are not interested in any other observable behavior; it is concluded that students are in passive mode. Therefore, two indicators of involvement in passive mode are paying attention, and producing observable outcomes. (Chi, 2009; Chi &Wylie, 2014; Chi & Boucher, 2023).

In active learning mode, students engage with materials in a more direct way, such as underlining or copy-pasting certain parts of a text and pausing and reversing video tapes. However, since active exercises do not include creating new knowledge through making conclusions or rebuilding prior knowledge, they only reflect superficial work (Chi, 2009; Chi &Wylie, 2014; Chi & Boucher, 2023; Gadgil, 2014).

In constructive learning mode, some additional outcomes students produce such as drawing mind maps, note-taking with their own words, asking questions building hypotheses, and casual connections, contain new ideas going beyond the given information about the content (Chi & Boucher, 2023). However, Chi (2009) points out that if a student asks a superficial question that is the word-for-word repetition of a text sentence, that is not constructive exercise, but an active exercise engaging with materials.

On the other hand, in interactive learning mode, which refers to a unique form of mutually co-productive collaboration, each partner should be constructively productive by not only going beyond the presented instructional information but also building onto the contributions of the other. Therefore, interactive exercises that provide students with the opportunities to create shared representations, lead to better learning outcomes than active and constructive exercises (Chi & Boucher, 2023).

The main hypothesis of ICAP theory has been supported by many laboratory and classroom studies, often comparing two conditions (Interactive>Constructive, Interactive>Active, Interactive>Passive, Constructive>Active) and mapping various circumstances into ICAP modes. (e.g., Freeman et al, 2014; Lin, Lee, Kalyuga, Wang, Guan., & Wu, 2017; Menekşe et al., 2013; Zhang & Linn, 2013; Legare & Lombrozo, 2014; Henderson, 2019; Leary, 2012; Chen, Wang, Kirschner, & Tsai, 2018). Despite the empirical support for the ICAP framework at various levels (K12, undergraduate, etc.) in the literature, especially in face-to-face learning, Thurn, Edelsbrunner, Berkowitz, Deiglmayr, & Schalk (2023) critically discuss two fundamental assumptions of the framework. Drawing on specific studies reported to strongly support the ICAP framework and current educational research questioning the validity of the framework the research highlights the importance of systematically monitoring and assessing students' implicit learning processes rather than explicit behaviors to achieve a particular learning goal.

When the relevant literature was analyzed, no study was found that evaluates the studies related to the ICAP Framework. In fact, analysis of conducted scientific studies in a field, may give some information of the depth of the subject, or reveal the general appearance of the analyzed field. (Turan, Karadağ, Bektaş, & Yalçın, 2014). This study is considered important in terms of demonstrating the general tendency in Turkey and the world regarding the ICAP framework and the studies carried out on the cognitive engagement of learners, revealing the deficient aspects, providing ideas on designing and implementing learning processes more effectively and productively; and thus, serving as a source to future studies. In line with this importance, the fundamental aim of the study is to evaluate articles based on or supported by the ICAP Framework. In accordance with this aim, answers to questions below were sought.

1. What are the general characteristics of studies related to the ICAP Framework?
2. What are the characteristics of the methodologies of studies related to the ICAP Framework?
3. What are the thematic characteristics of studies related to the ICAP Framework?
4. In which has ICAP been addressed in studies related to the ICAP Framework?

Limitations

-This study, conducted by using the Anadolu University Library Search Engine and databases where full-access articles related to ICAP Framework have been published, is limited to;
-The articles published in Turkish and English languages,
-The keywords: "ICAP Taxonomy", "ICAP", "ICAP Theory", "Interactive Constructive Active Passive", "ICAP Framework", "ICAP Model", "ICAP HYPOTHESIS", "ICAP TAXONOMY", "ICAP FRAMING", "ICAP THEORY" used in the search of the Anadolu University Library Search Engine and databases between the dates: 01.12.2023- 31.01.2024.

METHODOLOGY

Research Model

The study is a descriptive study designed in the survey model. In the data collection, document analysis technique was utilized. Document analysis, covering the analysis of written materials containing information about the phenomenon or phenomena aimed to be studied; enables the analysis of documents produced within a certain period of time about a research problem, or documents produced by multiple sources and at different intervals on the relevant subject based on a wide period. (Yıldırım & Şimşek, 2006). Through document analysis, it is aimed to analyze the general tendencies of qualitative and quantitative research and to guide researchers in planning their own research (Selçuk, Palancı, Kandemir, & Dündar 2014). On the other hand, content analysis technique was adopted in the analysis of the data. The main aim of content analysis is to arrive at concepts or correlations that can explain the collected data (Yıldırım & Şimşek, 2016). Çepni (2014), states that the operation carried out in content analysis is to interpret similar data by gathering them together within the frame of certain themes and understandably arranging them. Through the content analysis used in the study, it is desired to provide broad, detailed, and reliable information to the field researchers.

Data Collection and Analysis

In the first stage of the document analysis, national and international articles based on or supported by the ICAP Framework between 01.12.2023 and 31.01.2024 were accessed from the Anadolu University Library Search Engine and databases. As a result of the search 740 articles with keywords: “ICAP Çerçevesi”, “Aktif, Pasif, Yapıcı, Etkileşimli”, “ICAP Çerçevesi”, “ICAP Modeli”, “ICAP Hipotezi”, ICAP Taksonomisi”, “ICAP”, “ICAP Teori" and "Interactive Constructive Active Passive", "ICAP Framework", "ICAP Model", "ICAP HYPOTHESIS", "ICAP TAXONOMY" "ICAP FRAMING", "ICAP THEORY", in the keyword, title, abstract or in the text were found. No Turkish article related to the ICAP Framework was encountered among these articles. After the exclusion of duplicates, studies without full article access, book chapters, and irrelevant studies, 71 articles based on the ICAP Framework were included in the research. In this study, no date constraints were applied in order for the data to be broader and more detailed. To collect data from the included studies, the data collection form in Table 1 was used.

Table 1: Data Collection Form

M	Year	Country	Discipline Area	İnstruction Mode	Study Group	Participant Level	Method	Data Collection Tools	Research Strategies	Research Themes	ICAP Context

Each adressed study is enrolled and analyzed according to the criteria in the data collection using a seperaate code name (M1, M2,… M71). The criteria addressed in the data collection form were determined to be related to the four research questions of the study:

Criteria related to the first research question are the year of publication, country, study group, participant education level, discipline area, and instruction mode.

Criteria related to the second research question: research method, research strategies, data collection methods

Criteria related to the third research question: research themes.

Criteria related to the fourth research question: ICAP Framework context.

The data obtained regarding the research themes were collected and evaluated in six (6) categories, and the data obtained regarding the ICAP context were collected and evaluated in four (4) categories. The data were represented with frequency and percentage values. Open coding was utilized in the content analysis process for the first and second research questions. In analyzing the data related to the third and fourth research questions, the two researchers separately conducted coding, and the consensus-disagreement formula (Miles & Huberman, 1994) was used to ensure reliability between coders.

To increase the validity and reliability of the research, both the literature and the opinions of academicians working in the field were used in determining the themes. In qualitative research, since the observations should be conducted by not only one, but more than one person to increase validity, and prevent the impact of the authors’ prejudices on the research; (Büyüköztürk, Çakman, Akgün, Karadeniz, & Demirel, 2018) the form, categories, and coding were examined by two experts in communication, distance education, and education technology. Findings obtained as a result of content analysis, are presented and discussed in the ‘findings’ section of the study.

Ethical Dimension of the Study

Ethics committee approval was not required since the study used a literature review model, did not involve direct effects on humans or animals, and academic studies that were allowed open access by the authors were reviewed.

FINDINGS

In this section of the study, in line with the sub-objectives of the research, findings on the general characteristics, methods, thematic characteristics, and ICAP context of the articles are presented.

I-General Characteristics of the Studies

General characteristics of the reviewed studies are addressed in six sub-headings: year of publication, country, study group, participant level, discipline area, and instruction mode.

Distribution of Articles by Year

As presented in Table 2, as a result of the search in the databases, the publication year of the first article related to the subject is 2009. No article regarding the subject was found in the years 2010, 2011, 2012, and 2015. 34 of 71 articles were published in 2022 and 2023. In 2024, only one article was found, which is thought to be because the review of this year only covered the month of January.

Table 2: Distribution of Articles by Year

Year	Frequency	Percentage(%)
2009	1	1,40
2013	2	2,80
2014	1	1,40
2016	1	1,40
2017	7	9,85
2018	1	1,40
2019	8	11,25
2020	7	9,85
2021	8	11,25
2022	14	19,71
2023	20	28,16
2024	1	1,40
Total	**71**	**100.0**

Distribution of Articles by Country

When the distribution of articles by country is examined, it is seen that articles from 16 countries and 1 article with an unspecified country were published. The majority of the studies (n=31) carried out in the 16 countries were conducted in the USA. The second highest contribution came from Germany with a total of 9 articles (%12,60). China and Australia follow with 5 and 4 articles, respectively. The total number of publications from South Korea, Taiwan and Switzerland is 3.

Table 3: Distribution of Articles by Country

Countries	Number of Articles	Percentage (%)
USA	31	43,40
Germany	9	12,60
China	5	7,00
Australia	4	5,60
Taiwan	3	4,20
Switzerland	3	4,20
South Korea	3	4,20
Unspecified	2	2,80
Spain	2	2,80
Norway	1	1,40
Indonesia	1	1,40
Canada	1	1,40
Denmark	1	1,40
Israel	1	1,40
South Africa	1	1,40
The Netherlands	1	1,40

Serbia	1	1,40
Germany-Switzerland	1	1,40
Total	**71**	**100.0**

Distribution of Articles by Study Group

Distribution of articles by study group given in Table 4 concludes that students (n=46) have been studied more frequently than the other study groups. This is followed by Unspecified (n=7), Teachers (n=9), Other (5=), Students/Teachers (n=4).

Table 4: Distribution of Articles by Study Group

Study Groups	Frequency	Percentage (%)
Students	46	64,40
Teacher	9	12,60
Unspecified*	7	9,80
Other*	5	7,00
Students/Teachers	4	5,60
Total	**71**	**100.0**

*Other (Curriculum, paid participants, mixed group, web-based digital educational resource editors)
*Unspecified (Articles approaching education and teaching theoretically with general definitions)

Distribution of Articles by Participant Level

As seen in Table 5, it is seen that the target study groups of the articles are mostly undergraduate (n=39) study groups among the educational levels of the participants. This is followed by K12 (n=14), Graduate (n=2), Unspecified (n=9) and Other (n=3) study groups.

Table 5: Distribution of Articles by Participant Level

Participant Level	Frequency	Percentage (%)
Undergraduate	39	54,60
Undergraduate/Master's	1	1,40
Graduate	2	2,80
Undergraduate/Graduate	1	1,40
K12	16	22,40
Other*	3	4,20
Unspecified	9	12,60
Total	**71**	**100.0**

*Other (mixed-group, pregnant women, participants aged 18-65)

Distribution of Articles by Discipline Area

For the analysis of discipline areas in the articles, each subject area* was identified and then grouped into four general areas: social sciences, medicine, science and engineering, and language education. It should be noted that some studies covered more than one subject area.

Table 6 shows that the vast majority (n=42) of the disciplinary area of the articles is Social Sciences. It is seen that Science and Engineering (n=18) was the next popular subject that adopted the ICAP Framework approach and was studied in the field of education. Studies in Medicine (n=9) and lastly Language (n=2) were also the subject of publications.

Table 6: Distribution of Articles by Discipline Area

Article Subject Area	Frequency	Percentage (%)
Social Sciences	42	58,80
Science and Engineering	18	25,20
Medicine	9	12,60
Language	2	2,80
Total	**71**	**100.0**

***Disciplinary areas for each of the articles are given in Anex2.

Distribution of Articles by Instruction Mode

When analyzing the distribution of articles by instruction mode, two instruction modes were encountered: face-to-face and online. As can be seen in Figure 1, 66% (n=47) of the articles were related to face-to-face learning, in other words, traditional methods, while 34% (n=24) were focused on online learning.

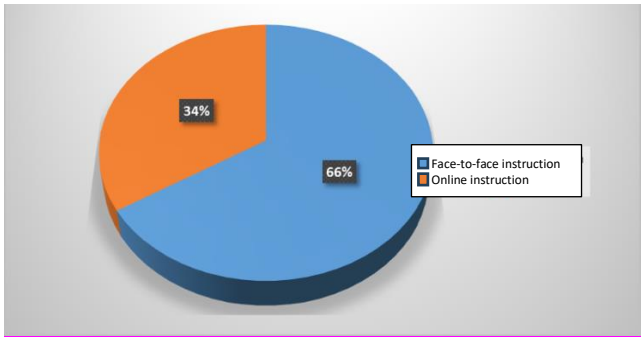

Figure 1: Distribution of Articles by Instruction Mode

Table 7 presents the Disciplinary Areas and Instructional Mode Cross Table. Accordingly, the disciplinary field of the majority (n=23) of the articles using ICAP Framework-based, face-to-face teaching mode is social sciences. Science and Engineering (n=13) ranked second, Medicine (n=9) third and Language (n=2) last. The disciplinary field of the majority (n=19) of the articles using the online teaching mode is again social sciences. Of the articles in the online teaching mode, 4 were in the field of Science and Engineering (n=4) and 1 was in the field of Medicine (n=1). As a result of the review conducted within the scope of the research, no article in the field of language was found in the online teaching mode.

Table 7: Disciplinary Areas and Instruction Mode Cross Table

Number	**1* Social Science**	**2* Medicine**	**3* Science and Engineering**	**4* Language**
Online Instruction (24)	19	1	4	
Face-to-face Instruction (47)	23	9	13	2
Total	42	10	17	2

*Research Subject Areas:(1) Social Sciences, (2)Medicine, (3)Science and Engineering, (4)Language

II- Characteristics of the Methodology of Studies

In this section of the study, findings related to the methodology, research strategies, and data collection methods of the studies are presented.

Distribution of Articles by Methodology

The framework used to classify research methods and inquiry research strategies was developed by Creswell (2009). Accordingly, there are three main research methods: qualitative, quantitative, and mixed. In this study, three research methods, qualitative, quantitative, and mixed were coded in the articles addressed in the research. When Table 8 is examined, it is seen that the most commonly used research method among the 71 articles is mixed method (n=30). This is followed by qualitative method (n=27) with 37,80%. The number of articles where quantitative methods are practices is 13. On the other hand, in 1 out of 71 articles, no research method is specified.

Table 8: Distribution of Articles by Methodology

Method	**Frequency**	**Percentage (%)**
Mixed	30	42,00
Qualitative	27	37,80
Quantitative	13	18,20
Unspecified	1	1,40
Total	**71**	**100.0**

Distribution of Articles by Research Strategy

As a result of the analysis of research strategies used in articles, exploratory case study (n=36) is determined to be the most adopted strategy among the 71 articles. The next research strategy was followed by all types of experimental studies, which were employed in a total of 24 articles. The number of articles using theoretical review was reported be n=8, and quasi-experimental and meta-analysis/comparative curriculum analysis/content analysis approaches as one publication each (n=1). The distribution of articles by research strategy is given in Table 9.

Table 9: Distribution of Articles by Research Strategy

Article Research Strategies	**Frequency**	**Percentage (%)**
Exploratory Case Study	36	50,40
Experimental	24	33,60
Theoretical Review	8	11,20
Meta-analysis/Comparative Curriculum Analysis/Content Analysis	1	1,40
Quasi-experimental	1	1,40
Total	**71**	**100.0**

Distribution of Articles by Data Collection Method

As a result of the analysis of data collection methods used in the articles, eight main data collection methods were tabulated. There is a clear indication that the researchers adopted more than one data collection method. As seen in Table 10, the researchers respectively used Documents (n=40), Tests (34), Questionnaires (n=32), Videos (n=27), Scales (n=16), Open-ended questions (n=8), Observations (n=7) and Interviews (n=2) as data collection methods.

Table 10: Distribution of Articles by Data Collection Method

Data Collection Methods	**Frequency**	**Percentage (%)**
Document	40	56,00
Test	34	47,60
Questionnaire	32	44,80
Video	27	37,80
Scale	16	22,40
Open-ended Question	8	11,20
Observation	7	9,80
Interview	2	2,80
Total	**166**	**100.0**

III- Thematic Characteristics of Studies

As stated in the methodology section, research themes extracted from 71 articles were classified in six main research theme. A brief explanation of each theme is presented as below:

Theme 1: Student Characteristics: Research focusing on student dialogues, student self-regulation, cognitive engagement, interaction, explicit behaviors, achievement, and use of technology.

Theme 2: Teacher Characteristics: Research focusing on teacher's professional development, training, technology acceptance, implementation skills, and henceforth approach.

Theme 3: Design – Development – Evaluation: Research regarding the design and development for lifelong learning, and online or face-to-face learning programs, technology integration, lesson material design, learning community design, web-based media design, and online tools and assessment system development.

Theme 4: Theory and Research: Research to explain, interrogate, and put ICAP Framework into practice.

Theme 5: Instruction and Communication Technologies: Research focusing on online video lectures, interactive engagement, computer-assisted instruction, web-based digital education, and interactive web and virtual environments.

Theme 6: Teaching and Learning Approaches: Research on active learning, collaborative learning, small group interaction, self-regulated learning, agent-based models, modes of cognitive engagement, peer learning, self-directed learning, instructional self-efficacy, video-based learning, flipped classroom, and reinforcement learning.

Table 11: Distribution of Articles by Research Theme

Research Themes	Frequency	Percentage (%)
Teaching and Learning Approaches	26	34,60
Design – Development - Evaluation	20	28,00
Student Characteristics	8	11,20
Instruction and Communication Technologies	8	11,20
Theory and Research	5	7,00
Teacher Characteristics	4	5,60
Total	**71**	**100.0**

As seen in Table 11, “Teaching and Learning Approaches” is the most commonly addressed theme among the research themes of articles. This theme is followed respectively by “Design – Development – Evaluation” (n =20), "Student Characteristics” (n=8), “Instruction and Communication Technologies” (n=8), “Theory and Research” (n=5), and “Teacher Characteristics” (n=5).

In Table 12, Research Themes and Instruction Modes Cross Table is given. Accordingly, in both face-to-face (n=19) and online learning (n=8), it is seen that studies addressing teaching and learning approaches are predominant. Studies on Design/development/evaluation ranked second in face-to-face (n=14) and online (n=5) learning.

Table 12: Research Themes and Instruction Mode Cross Table

Number	1*	2*	3*	4*	5*	6*
Online Instruction (24)	3	2	5	1	5	8
Traditional – Face-to-face Instruction (45)	4	2	14	2	3	19

*(1) Student Characteristics, (2) Teacher Characteristics, (3) Design/Development/Evaluation, (4) Theory and Research, (5) Instruction and Communication Technologies, (6) Teaching and Learning Approaches

IV. ICAP Context of Studies

In this section of the study, the findings related to in which context the articles reviewed within the scope of the study address ICAP are given under the following four categories:

Category 1; Use of ICAP Framework at theoretical level: Articles defining cognitive engagement within the conceptual ICAP Framework, using ICAP Framework as a theoretical framework that enables the development of active learning experiences, addressing ICAP theory as an alternative way to fill in the research-practice gap in education, explaining learning-teaching approaches based on the ICAP Framework, and use the ICAP theoretical framework in the analysis of learning environments.

Category 2; Use of ICAP Framework at analytical level: Articles utilizing ICAP Framework in determining the level of effectiveness of active learning and cognitive engagement, and analyzing student interaction and teacher presence, interrogating learning materials based on ICAP Framework, determining the extent of engagement according to the use of technology within the scope of ICAP, categorize the relationship between metacognitive study strategies and exam performance in accordance with the ICAP Framework, and examine learning environments under the ICAP activity structure

Category 3; Developing Models, modules, tools and scales based on the ICAP Framework: Articles determine the level of cognitive engagement in learning-teaching environments, observing cognitive engagement, developing interactive design, developing models, modules, tools, scales and systems for evaluating educational environments.

Category 4; Defining, Explaining and Questioning ICAP Framework at theoretical level: Theoretical articles that define, explain and question the underlying assumptions of the ICAP Framework on the basis of students' explicit behaviors.

As seen in Table 13, majority of the articles (n=45) used the ICAP Framework at analytical level. The second largest number of articles (n=17) were articles that developed models, modules, tools and scales based on the ICAP Framework. On the other hand, while 6 articles use the ICAP Framework at theoretical level, the number of theoretical articles related to defining and explaining ICAP is 3.

Table 13: Distribution of Articles by ICAP Context

ICAP Context	Frequency
K-1. Articles using ICAP at theoretical level	6
K-2. Articles using ICAP at analytical level	45
K-3. Articles developing models, modules, tools and scales based on ICAP Framework	17
K-4.Theoretical articles defining, explaining, and questioning ICAP Framework	3

According to Distribution of Articles by ICAP Context and Year Cross Table, articles that utilized ICAP at an analytical level started to predominate from 2019 onwards, and this number increased especially in 2022 and 2023. Articles that developed models, modules, tools and scales based on the ICAP framework also increased in the same date range.

Tab1e 14: Distribution of Articles by ICAP Context and Year Cross-Table

Year	K- 1	K-2	K-3	K-4
2009				1
2013	1	1		
2014				1
2016		1		
2017		5	2	
2018			1	
2019	2	6		
2020		5	2	
2021	1	5	2	
2022	1	11	2	
2023	1	10	8	1
2024		1		
Total	**6**	**45**	**17**	**3**

In Table 15, Research Themes and ICAP Context Cross-Table is given. Accordingly, in all of the articles focusing on student dialogues, student self-regulation, cognitive engagement, interaction, explicit behaviors, achievement, and use of technology (n=8), the ICAP Framework was utilized at analytical level. While three of the teacher characteristics themed articles (n=4) used the ICAP Framework at the analytical level; in one study, module development was carried out based on the ICAP framework. A vast majority (n=15) of the Design-Development-Evaluation themed studies (n=20) are articles on developing models, modules, tools and scales based on the ICAP framework. Under this theme, 4 studies utilized ICAP at the analytical level. Among the Theory and Research themed studies (n=5), the number of articles defining, explaining and questioning ICAP at the theoretical level is 3, while the number of articles making use of the ICAP at the theoretical level is 2. All the Instruction and Communication Technologies themed studies are articles using the ICAP at the analytical level. Under this theme, while 4 studies utilized the ICAP at the theoretical level, and one study was aimed at developing modules based on the ICAP Framework.

Table 15: Research Themes and ICAP Context Cross-Table

	ICAP CONTEXT CATEGORIES			
THEMES	**K-1**	**K-2**	**K-3**	**K-4**
1.Student Characteristics **(8)**		**8**		
2.Teacher Characteristics **(4)**		**3**	**1**	
3.Design-Development-Evaluation **(20)**		**4**	**15**	
4.Theory and Research **(5)**	**2**			**3**
5.Instruction and Communication Technologies **(8)**		**8**		

6.Teaching and Learning Approaches **(26)**	**4**	**23**	**1**	

RESULT AND DISCUSSION

In this study, it is aimed to evaluate national and international scientific articles based on or supported by the ICAP Framework from various aspects. In line with these main and sub-objectives, articles were reviewed in four categories: general characteristics, methodological characteristics, research themes, and ICAP context.

Findings on the General Characteristics of the Studies

When the studies related to the ICAP Framework are evaluated in terms of general characteristics, it is seen that the studies were mostly carried out between 2019 and 2023 and gained intensity, especially between 2022 and 2023. One study in 2009 and one study in 2014 are the studies of researchers (Chi, 2009; Chi & Wylie, 2014) who put forward the ICAP theoretical framework. These studies are aimed at defining the framework at the theoretical level, explaining it by comparing it with existing learning theories, and how the framework can be used as a tool. After this process, which can be regarded as the starting point of the scientific effort, an increase in the number of articles using the ICAP Framework at the analytical level is observed. With the increase of experimental and exploratory articles, studies that question the ICAP Framework have been carried out. For instance. Thurn et al. (2023) For example, Thurn et al. (2023) questioned whether explicit behaviors in instructional activities, such as reading a text, taking notes, or discussing it, are reliable indicators of students' cognitive engagement.

When the distribution of articles by country is examined, it is observed that 16 of the 71 articles involved in the study were conducted in 16 different countries. This can be interpreted as the international acceptance of the ICAP framework, which presents cognitive engagement in education on the basis of explicit behaviors. Despite the existence of studies on active learning and cognitive engagement in the national literature, the fact that no study based on or supported by the ICAP Framework is found, can be considered as a deficiency in this field. From this perspective, it is not possible to analyze the addressing of the ICAP framework in Turkey. One of the important reasons why most of the studies were conducted in the USA can be attributed to the fact that the studies that put forward the ICAP Framework are of US origin.

The results of the research on the study groups and participant levels revealed that the most intensively studied groups in the articles were students and teachers, respectively. The participant levels are undergraduate and K12, in that order. The fact that students are the most common study group can be linked to students being at the center of education and training activities. That "undergraduate" and K12 are at the top of the participant levels may be because the pioneering studies on ICAP are primarily evaluated at these levels.

In addition, as Chi and colleagues (2018) also state, the fact that active learning is mainly discussed in the post-secondary literature and especially at the undergraduate level in the context of flipped classrooms, online learning, educational technology and machine learning may have been effective in the high number of studies at the undergraduate level. The fact that K12 ranked second may be attributed to the fact that engagement, which is associated with academic achievement, is a construct discussed primarily in the K-12 education literature.

The fact that teachers ranked second among the study groups may have been influenced by Chi and colleagues' (2018) proposal of a project to teach ICAP cognitive engagement theory to K12 teachers. This also provided guidance for further research.

The predominance of studies in the field of social sciences in both face-to-face and online teaching mode among disciplinary areas may be because this field covers many sub-disciplines and especially includes ICAP-related fields such as teacher education, learning-teaching psychology, learning-teaching strategy, educational technologies, and cognitive activation. On the other hand, the widespread use of online education as a teaching method, particularly in 2010 and onwards, has led the ICAP framework to be addressed in the field of science and engineering, especially at the empirical level. The fact that the least number of studies in online teaching mode is in the field of medicine (n=1) may be a result from the fact that this field is mostly applied in face-to-face instruction mode. As a matter of fact, the only study carried out in this field in the research findings (Lim, Ko, Park, & Ihm, 2022) is related to the applicability of online active learning to dentistry education.

Findings on the Methodological Characteristics of Studies:

When the methodological characteristics of the articles within the scope of the research were examined, it was determined that mixed, qualitative, and quantitative methods were used respectively. The predominant use of mixed methods in the articles is supportive of the idea that research should not be dominated by only one research method due to the evolving nature of instructional systems (Driscoll, 1995, as cited in İnci & Kandır, 2017).

Whereas exploratory case and experimental studies were more preferred, the fact that theoretical analysis was the least used research strategy indicates that researchers are more oriented towards empirical studies. The diversity of data collection tools in the articles included in the research enabled access to more comprehensive findings.

Findings on Thematic Characteristics and ICAP Context of Studies

Among the research themes, articles on teaching and learning approaches and design-development-evaluation in both online and face-to-face education are predominant. In addition, 5 of the 24 articles in the online education mode are themed on instructional and communication technologies. When considering how the articles address the ICAP Framework, it is noticeable that ICAP is mainly utilized at the analytical level, and models, modules, tools, and scales are developed based on the ICAP framework, and the majority of these have gained momentum since 2019. Majority of the studies that utilized ICAP at the analytical level are themed on Teaching and Learning Approaches. A significant portion of the studies that develop models, modules, tools and scales based on ICAP are themed as Design-Development-Evaluation. It can be said that the intensive use of technology, and especially web-based applications in learning-teaching processes is effective in this. In the articles reviewed in this study, issues related to collaborative learning, agent-based models, video-based learning, flipped classrooms, reinforcement learning, etc., which gained momentum in this process, and how technology can be used in instructional design in the best way, were addressed within the scope of the ICAP framework. For instance, in articles that made analytical use of ICAP with the theme of Teaching and Learning Approaches; video-recorded instructional and learning activities were analyzed using the ICAP framework to determine the importance of group size during the learning of collaborative skills (Noerholk, Morcke, Kulasegaram, Nørgaard, Harmsen, Andreasen, ... & Tolsgaard, 2022); cognitive engagement in a reinforcement learning approach to adaptive remediation in online education was grounded on the ICAP framework (Spain, Rowe, Smith, Goldberg, Pokorny, Mott, & Lester, 2022).

In the Design-Development-Evaluation themed articles developing models, modules, tools and scales based on ICAP, for instance, an observation-based protocol (IONIC) that can be used in K-12 classrooms in different content and contexts was developed based on the ICAP theoretical framework (Chen & Terada, 2021); four chatbot interaction designs oriented towards active learning were developed based on the ICAP framework (Hobert, Følstad, & Law, 2023); the Real-Time Automated STEM Engagement Detection System (RASEDS), which identifies students' level of engagement and provides appropriate adaptive learning materials depending on the level of engagement, was developed using computer vision technology and the ICAP framework (Wu, Lee, Wang, Lin, & Huang 2023); The ICAP Technology Scale (ICAP-TS) to measure how teachers integrate technology into learning activities was developed based on the ICAP model (Antonietti, Schmitz, Consoli, Cattaneo, Gonon, & Petko 2023); the effects of four versions of a collaborative learning activity on learning were designed using ICAP and adapted PFL models (Lam & Muldner, 2017).

As a result, the process that was initiated with Chi's publication of a literature review on differentiated open learning activities in 2009, has now shifted towards the empirical studies on the applicability of ICAP as a theory of cognitive engagement to technology-supported learning activities. The key elements creating this shift are the introduction of research that explains the uses of the framework, the comparison of this theoretical framework with other frameworks, and the developments in information and communication technologies in instructional design.

Implications for the Future

- Most articles that utilized the ICAP framework as a guide for instructional design, for assessing student outcomes, and for determining the choice of control condition in research design were studies that empirically supported the validity of the framework. In contrast, few studies were found that questioned the validity of the ICAP hypothesis and hierarchy in formal and informal learning environments at different levels. This brings up the suggestion that future studies should be directed towards this inquiry.
- Instructional design in live lectures and instructional videos aimed to provide learner-teacher interaction in online learning can be evaluated in the context of ICAP.
- Such as the development of the student course cognitive engagement instrument (SCCEI) in engineering education (Barlow, Brown, Lutz, Pitterson, Hunsu, & Adesope, 2020); testing the ICAPD Framework for detecting student cognitive engagement in the classroom (Xu, Wei, Gao, Yao, & Liu 2023); Examination of active learning exercises of middle school students in virtual learning environments under the structure of active, constructive, and interactive activities (Hite, Jones, & Childers, 2024), studies that bring new perspectives to the ICAP framework can be carried out.
- The dimensions of using ICAP as a framework model for designing informal learning experiences in museums, exhibition halls, science centers, etc. can be analyzed in more depth.

- The correlations between the use of technology in ICAP learning activities and teachers' digital competencies, beliefs, and attitudes toward technology can be further studied to identify the most important predictors of high-quality technology integration.
- Research-based on different disadvantaged groups in terms of educational inclusiveness can focus on categorizing their forms of cognitive engagement using the ICAP Framework and designing learning activities.
- The implication of the research that is seen as the most important for the future is the necessity of conducting studies aiming to evaluate the articles, theses, etc. related to the ICAP Framework and hypothesis. Thus, researchers who will conduct studies on the ICAP framework, especially in Turkey, will be able to see the gap in the literature and plan their studies accordingly.

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