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THE EFFECT OF THE TPACK MODEL ON DEVELOPING COGNITIVE AGILITY AMONG FIFTH –GRADE LITERARY FEMALE STUDENTS IN HISTORY

O EFEITO DO MODELO TPACK NO DESENVOLVIMENTO DA AGILIDADE COGNITIVA ENTRE ALUNAS DO 5º ANO DO ENSINO FUNDAMENTAL EM AULAS DE HISTÓRIA

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Abstract
Thus, the aim of the current study is to find out the impact of the TPACK model on the development of cognitive agility in the fifth-grade literary female students in history. The researcher used a quasi-experimental design with a post-test application. in two groups, namely an experimental group and a control group to achieve the research objective. The sample chosen for the experiment was deliberate through the Al-Tahrir Secondary School for Girls, which is affiliated with the General Directorate of Education in Diyala. Two classes in the same level were selected using simple random selection: Section (A) as the experimental group which taught based on TPACK model, and Section (B) as the control group which taught using the traditional method. Two groups had 30 students each; hence the sample of two groups of 30 female students, a total of 60 students. In this study, the researcher made the two groups equivalent in many variables such as Parents' educational level, students chronological age in term of months, history scores of previous grade (2024 - 2025), scores of mental ability test (Henmon-Nelson) and prior knowledge test. The implementation of the experiment occurred in the first semester of the academic session 2025–2026. The researcher had prepared the research tool symbolized by the cognitive agility scale that contained 30 items. Following confirmation of its validity and reliability, the scale was used on the research sample. The researcher used the SPSS software package to process the data for the purpose of statistical analysis. The results also showed that there was a statistically

Resumo
Assim, o objetivo do presente estudo é investigar o impacto do modelo TPACK no desenvolvimento da agilidade cognitiva em alunas do quinto ano do ensino fundamental II na disciplina de história. A pesquisadora utilizou um desenho quase-experimental com aplicação de pós-teste em dois grupos, a saber, um grupo experimental e um grupo de controle, para atingir o objetivo da pesquisa. A amostra escolhida para o experimento foi selecionada deliberadamente na Escola Secundária Al-Tahrir para Meninas, afiliada à Direção Geral de Educação em Diyala. Duas turmas do mesmo nível foram selecionadas por meio de amostragem aleatória simples: a Turma (A) como grupo experimental, que recebeu ensino baseado no modelo TPACK, e a Turma (B) como grupo controle, que recebeu ensino pelo método tradicional. Os dois grupos tinham 30 alunas cada; portanto, a amostra consistiu em dois grupos de 30 alunas, totalizando 60 alunas. Neste estudo, a pesquisadora tornou os dois grupos equivalentes em várias variáveis, tais como o nível de escolaridade dos pais, a idade cronológica das alunas em meses, as notas do ano anterior (2024–2025), as pontuações no teste de capacidade mental (Henmon-Nelson) e no teste de conhecimento prévio. A implementação do experimento ocorreu no primeiro semestre do ano letivo de 2025–2026. O pesquisador preparou a ferramenta de pesquisa representada pela escala de agilidade cognitiva, que continha 30 itens. Após a confirmação de sua validade e confiabilidade, a escala foi aplicada à amostra da pesquisa. O

significant difference between the mean scores of the experimental and control groups at the significance of 0.05 in the cognitive agility variable, in favor of the experimental group that studied history according to the TPACK model. Based on these findings, the researcher made some conclusions, recommendations, and suggestions. Conclusions 1. The TPACK framework increased cognitive agility, especially when creating flexible thinking and processing unique information through multiple strategies. 2. The application results showed that when technology is integrated into history lessons, students understand the concept more and do not just learn historical facts by heart. Recommendations 1. Providing a space for teachers to share their experiences with TPACK and best practices in professional learning communities. 2. Focusing more on making history curricula more interactive and part of the learner's digital ecosystem. Suggestions 1.Having further research that examines the effect of TPACK model in other dependent variables including creativity or critical thinking. 2. Implementation of the program at various stages of education to see its impact at different stages of education.

Keywords: TPACK Model. Cognitive Agility. History Education. Quasi-Experimental Design. Secondary School Students.

pesquisador utilizou o pacote de software SPSS para processar os dados com o objetivo de realizar a análise estatística. Os resultados também mostraram que houve uma diferença estatisticamente significativa entre as notas médias dos grupos experimental e controle, com um nível de significância de 0,05, na variável agilidade cognitiva, em favor do grupo experimental que estudou história de acordo com o modelo TPACK. Com base nessas descobertas, o pesquisador apresentou algumas conclusões, recomendações e sugestões. Conclusões 1. A estrutura TPACK aumentou a agilidade cognitiva, especialmente ao criar um pensamento flexível e processar informações únicas por meio de múltiplas estratégias. 2. Os resultados da aplicação mostraram que, quando a tecnologia é integrada às aulas de história, os alunos compreendem melhor o conceito e não se limitam a decorar fatos históricos. Recomendações 1. Oferecer um espaço para que os professores compartilhem suas experiências com o TPACK e as melhores práticas em comunidades de aprendizagem profissional. 2. Focar mais em tornar os currículos de história mais interativos e parte do ecossistema digital do aluno. Sugestões 1. Realizar pesquisas adicionais que examinem o efeito do modelo TPACK em outras variáveis dependentes, incluindo criatividade ou pensamento crítico. 2. Implementar o programa em vários estágios da educação para observar seu impacto em diferentes fases do ensino.

Palavras-chave: *Modelo TPACK. Agilidade Cognitiva. Ensino de História. Desenho Quase-experimental. Alunos do Ensino Médio.*

1 CHAPTER ONE: INTRODUCTION TO THE RESEARCH

1.1 First: research problem

The challenges posed by rapid transformations in contemporary societies are foreseeable; they call for the construction of educational systems and educational practices that respond to these transformations and that provide opportunities for the learning of such a type of knowledge that allows the learner to assimilate and perform with them. Traditional education based on memorization, in rote instruction and mental

conditioning are no longer able to equip learners who could be able to meet such development (Al-Obaidi & Alaa, 2016, p. 7).

History schools are also affected by issues in teaching practice and curriculum. These approaches often do not build students' knowledge sufficiently and therefore students' participation and responsiveness is very low. The frustration and the belief that studying the subject does not have any significant advantage, is stem from the fact that students tend to simply copy what the teacher has said (Al-Zubaidi, 2014, p. 66).

Consequently, it could be claimed that students' dislike of some subjects offered at schools, history in particular, and their diminishing academic performance is to a great extent caused by conventional pedagogical approaches which take for granted the teacher but disregard the student These practices restrict the interaction between the teacher and the students and also restrict the teacher from using recent instructional strategies and educational technologies suitable for the subject matter (Ali&Ahmed, 2005, p. 72).

The problem of underachievement is a worldwide educational problem that can be found in all societies and societies. The importance of academic performance lies in the fact it is what allows learners to move from one stage of education to another. As a result, the fall in achievement is a touchy issue as it directly impact students future and social and professional life. A few teachers and parents believe that low academic performance are due to the lack of intelligence among students. But there are numerous other causes for this issue, other than the intellectual capacity of the student through the approach to teaching and the rigorousness of the materials being instructed (Al-Khazraji 2016: 17)

When the researcher reviewed some researchers who studied the academic achievement of the students in the Iraq environment, they found that there is low achievement levels in the studies of Hussein 2009 & _ Al-Tamimi 2005. This is the main reason that these studies linked the issue to common teaching methods. This made the researcher to implement the TPACK model in teaching to see if it will help in enhancing students achievement toward history subject.

A few recent educational conferences said we also needed to update the methodology and practice of education to modern scientific understandings. The need to strengthen the educational system based on quality, digital transformation, innovation, modern teaching strategies, educational technology, the development of digital

infrastructure and the support of programs supporting digital transformation in the educational process were, in fact, the findings of the International Scientific Conference held at the University of Baghdad (Al-Jadriya) from 11–13 October 2025.

Similarly, the university, which hosted on 6–7 March 2024 the 4th International Conference on Development of Perspective& quality of Education & Academic Leadership and Teachers of Higher Education, which aimed to increase quality in higher education,quality of education in higher education, and Appropriate use technology, e-learning & innovative methods of university level teaching.

In light of these reasons, an exploratory survey was carried on to discover to what extent some teachers of fifth-grade literary classes resort to use teaching methods and models of instruction. It is done through a survey that includes ten female teachers in secondary schools, alongside thirty female students in the same academic level. (Hassan, 2024b)

The exploratory study revealed that 20 percent of the teachers neither made use of modern teaching methods nor an instructional model in the subject of Modern and Contemporary European and American History. Moreover, 30% have never heard of instructional models, and 10% reported never having heard of cognitive agility. Also, half responded that they had problems when teaching history and 70% stated that they were missing the necessary resources to apply a modern direction of teaching.

Of the female students who completed the questionnaire, 63.33 percent find Modern and Contemporary European and American History hard to study. Teacher mockery emerged as a notable finding, with approximately 70 percent saying that teachers sometimes mocked students for answering history questions incorrectly. Similarly, 66.6% stated facing problems in solving the questions asked in monthly examination while 77.66% referred to poor use of graphics such as maps, pictures, multimedia resources which adversely affect visual comprehension of historical material. In addition, 80% felt the subject bored them because of its theoretical aspect, 76.66% indicated the difficulties in differentiating between similar historical characters.

Hence, the analysis of the results of the survey determines that part of the teachers of the fifth literary grade do not apply modern instructional models and methods in teaching. Most of them also did not have any awareness on these models and on creating cognitive agility. The other challenge is visual learning aids, for instance maps, images,

and audiovisual used in the learning process reflect poor visual comprehension of events in history among the students. This makes it imperative to look for educational programs that can help achieve the goals of history teaching.

The researcher thinks it all comes down to applying the right teaching practices —courses, standards, strategies, or instructional models —that meets the students where they're at. These approaches allow students to go through mental processes that help them acquire the skills they need to scientifically use what they learn in different contexts.

Accordingly, the researcher has decided to design a TPACK program, and that the use of this program may help to find solutions for some of the difficulties and problems that he encountered while teaching history, and develop their cognitive flexibility, and increase their level of academic achievement among fifth-grade literary female students.

Hence the research problem is articulated in the form of question as follows:

What is the effect of the TPACK model on developing cognitive agility among fifth-grade literary female students in the subject of history?

1.2 Second: significance of the research

Cognitive agility makes students flexible in context to modify either decision-making or knowledge frameworks in order to realize what the environment requires at a certain time (Hurst, 2018). It allows the alignment, synthesis, and harmony of multiple capabilities under variable conditions and adaptive dynamic environments. This is an important aspect of education. Students who apply cognitive agility are also better at making decisions, and it helps in integrating intelligence because it comes with switching between narrower degrees of focus to broader degrees of external awareness. Cognitive agility training also activates self-regulation skills, allowing for better performance quality in learning places (DAN, 2010, p. 33).

Cognitive agility also aids in achieving equilibrium and integration in their strengths and assists in adapting and performing efficiently in non-familiar scenarios (Ross, 2018, pp.86–91). It really develops creative thinking and helps them in solving their problem in a positive and effective way. It also aids people in the regulation of their thoughts and mental perspective, enhances cognitive processing systems, enhances

personal effectiveness as well as self-image. In addition, it improves decision-making, raises standards of academic success, and increases the likelihood of success at school. At the same time, it curbs cognitive biases. People high on cognitive agility embrace and adopt new and different ideas and perspectives; are always searching for novelty; and are drawn to complex problems of thought. They switch between tasks with ease, fastness, and precision, adjust to the ever-changing situation without much hick-up and they exhibit great cognitive diversity and utter unpredictability in responses (Helmy 2020, pp 639–660)

A lesson also appears for learning development, on the way to developing cognitive agility. Although input has to be searched for in a task, attention is required to be directed to the input available in a task also by the learners themselves. Just as learners need openness to receive new information, they need a focused attention that steers their attention to information important for cognition and shields them from distractions. Clearly, students should not take the plunge into open-mindedness that makes them responsive to every distracting nugget of information and they should not take the plunge into narrow-mindedness either that tends to overlook good information that can facilitate them to do better if processed correctly. Finding this equilibrium requires learners to have a cognitive agility to switch repeatedly between the flexibility of cognitive openness and the focus of cognitive closure when completing tasks (Abu Arab, 2022, p. 666).

The significance of the present research can therefore be summarized in the following aspects:

1. Fifth-grade literary students need Modern and Contemporary European and American History to see how Europe and the United States forged their institutions, values and form of government. The latter is considered an important mental commodity that could help in the formation of the new Iraqi political experience.
2. Why it is important to not just focus on technology in the TPACK model. Above all, educators need to have grounded knowledge on the content that they are teaching and the right ways of imparting it. Technology does not supplant pedagogical knowledge or content knowledge; it layers another dimension on top of it. The best classroom teachers are those teachers who not only know about TPACK; they practice TPACK.

3. The significance of cognitive adaptability, as activating it by instructors helps effective learning and it is associated with students′ academic achievement (AA).

1.3 Third: research objectives

The research aims to examine the effect of the TPACK model on developing cognitive agility among fifth-grade literary female students in the subject of history.

1.4 Fourth: research hypotheses

1. The mean scores of the experimental group students, who study Modern and Contemporary European and American History based on the TPACK model, are not statistically significantly different in pre-test and post-test applications of the cognitive agility scale at the significance level (0.05).
2. H0-2: There is no statistically significant difference at the significance level (0.05) between the mean scores of the experimental group students who study Modern and Contemporary European and American History according to the TPACK model and the mean scores of the control group students who study Modern and Contemporary European and American History according to the traditional method in the post-test of the cognitive agility scale.

1.5 Fifth: delimitations of the research

1. **Spatial boundaries:** Governmental secondary and preparatory day schools for girls affiliated with the General Directorate of Education in Diyala Governorate, Baqubah Center.
2. **Human boundaries:** Fifth-grade literary female students enrolled in governmental secondary and preparatory day schools for girls affiliated with the General Directorate of Education in Diyala Governorate, Baqubah Center.
3. **Temporal boundaries:** The first semester of the academic year 2025–2026.

4. **Scientific boundaries:** The first four chapters of the textbook *Modern and Contemporary European and American History*, prescribed by the Ministry of Education for fifth preparatory grade students for the academic year 2025–2026.

1.6 Sixth: definition of terms

1.6.1 Cognitive agility

Good (2009) defines cognitive agility as "a cognitive structure that is a reflection of the level of coherence among three cognitive abilities while an individual is performing dynamic tasks which requires the individual to alter his or her response to the changing demands of the dynamic task. (Good, 2009, p. 19).

1.6.2 Operational definition

Cannot Add to Basket Cognitive Agility– The Aggregate Score of students in both research groups (Experimental and control) on the cognitive agility scale comprising three dimensions: cognitive openness, cognitive flexibility, and focused attention.

2 CHAPTER TWO: THEORETICAL FRAMEWORK

2.1 First: the TPACK model

The TPACK model describes the areas of knowledge relevant to the nature of the age we live in which includes its related technology and education (Koehler, 2014). The following model explains how each of the domains interact and integrate with each other:

a. **Content Knowledge (CK)** This is the teacher's comprehension about the content area knowledge, concepts and relationships occurring in the subject area of specialization. Teachers should be transparent to these elements and they should use them effectively in various teaching contexts.
b. **Pedagogical Knowledge (PK)** These are referred to as the teaching skills that teachers ought to have. The competencies of teachers identified through this

evaluation framework are mapped to the skills needed for planning, implementing and evaluating lessons and other sub-skills that are applied in classroom and learning environment.

c. **Technological Knowledge (TK)** It refers to the quality of the teacher to handle the technological innovations, applications, and tools. It also requires staying perpetually up-to-date with emerging tech since technology itself does not stand still

b. **Pedagogical Content Knowledge (PCK)** This domain represents a teacher's insight into the interactions between teaching strategies and content knowledge. The choice of pedagogy and classroom management strategies shouldn't be random but rather congruent with the content. There are various required teaching approaches for the different objectives of each discipline as it relates to specific contexts found in education. Teaching style might differ with the subject matter within the same discipline. As such, this domain focuses on what teachers know about appropriate methods to use to teach the particular content of a lesson.

c. **Technological Content Knowledge (TCK)** Domain (d) emphasizes this relationship between technological applications and subject content (Mishra&Koehler, 2006). Educational technology tools are plentiful and varied, with the proliferation of different tools meaning teachers must learn to better choose the most suitable tech-based applications available for their subject discipline and lesson content. The topic may need the use of internet in teaching while another may not, it may need educational videos and documentaries. So, there is no best tech tool; instead there is a tech tool best at teaching a given content.

d. **Technological Pedagogical Knowledge (TPK)** This domain focuses on the teacher’s knowledge of the interplay between technology and pedagogy. The IKON content is closely associated with teaching models and classroom management approaches that differ from traditional instruction, and address issues arising from the implementation of educational technology applications, which may or may not be defined in advance. All these developments have paved way for tactics like e-learning and learning management systems.

e. **Technological Pedagogical Content Knowledge (TPACK)** It conveys the seventh and last domain of TPACK model. The Content Pedagogy This focuses on merging three core domains — content knowledge, pedagogical knowledge, and knowledge around technology. It describes how educators can path from a broader understanding in these domains to an integration rooted effectively to maximize teaching efficiency. In actuality, teachers choose technological tools that fit the type of academic content they are teaching, and apply suitable pedagogical strategies whereas other appropriate pedagogical strategies are demonstrated as used based on the same education context to accomplish some predetermined learning outcomes. This level of integration necessitates a teacher-first understanding of each domain separately and then a breaking down of these walls through teaching practice (Koehler, 2014, pp. 102–103).

2.2 Second: cognitive agility

Cognitive agility is a high-level cognitive construct that an individual utilizes on a temporary basis to modify performance when engaged in dynamic tasking environments — when multiple and often rapid changes in their content needs to be responded to within a specified time frame (Good, 2009, p. 15). This contrasts with the behavioral and emotional changes individuals incur in response to real (or expected) changes in their environment, manifestations of the broader process of adaptation (Lepine et al., 2006, pp. 563–566).

Cognitive agility describes an individual's ability to adapt their performance based on two aspects: 1) the type of task and 2) time. An individual can adapt instantly to some types of tasks, but adaptation to other tasks takes much longer. In the same way, rather simple tasks than complex tasks, especially those dictated by ever-changing technological forces (pp. 483–484) will probably take less time to adapt (Canas et al, 2003)

Cognitive agility can also be described as self-monitoring and self-regulatory of thoughts and behaviors. It improves the ability to adapt in real time and adds the ability to display cognitive flexibility, cognitive openness, and sustained attention (Jocko et al., 2019, p. 12).

Cognitive agility is a good place to start for movement and form of adaptation in action-based environments. People with cognitive flexibility learn how to become decision makers, separation instructions and information and recognize an array of social and emotional abilities (White, 2017, p. 10).

2.3 Components of cognitive agility

The components of the cognitive agility scale adopted in this study are based on the conceptual framework and elements identified by Good (2019), as follows:

First Component: Cognitive Openness Cognitive openness is the ability of the individual to sense to look for additional information in the task environment. This is enabled by expanding perceptual attention and conceptual attention, which allows the individual to pick up cues signaling new information and integrate it into cognitive processing.

Second Component: Cognitive Flexibility Cognitive flexibility is, in other words, the person's ability to redirect mental activity to the information that is most relevant to the task at hand even as the elements in the task are continuously changing. This is done by stabilizing a specific cognitive strategy when processing the familiar features of the task

Third Component: Focused Attention In the context of someone working on a task, focused attention is the extent to which the person is able to ignore distractions (mind wander or otherwise). Such capacity arises from contracting perceptual locus such that senses focus on a unit of information and contracting conceptual locus such that the individual focuses on a singular information type present within the task environment (Good, 2019, p. 15).

3 CHAPTER THREE: RESEARCH METHODOLOGY AND PROCEDURES

3.1 First: research method

Researcher had used experimental method because it is appropriate to achieve the aims of the study. An experimental approach is dependent on observing and testing the

relationships between a small number of variables that are included in the experiment. This is done through the organization of the conditions in which the experiment is conducted, along with the procedures and instruments used. Thus, it has the correlation of descriptive research which describes (here the phenomenon being studied) and causal research which experiments with the phenomenon to determine the impact of independent variables on dependent variables. (Mustafa et al., 2010, pp. 4–5).

3.2 Second: experimental design

This question is one of the key issues a researcher must address when setting up an experiment, which is whether or not you have control over all other variables, other than an experimental variable. A researcher should also need to prepare tests and measurement devices for the quantitative evaluation of changes. Once the validity of the design procedures has been determined, the researcher starts the implementation of the experiment. This stage of implementation goes hand in hand with the design phase because any mistakes made in execution can invalidate the design and thus affect the accuracy and reliability of the results (Obeidat et al. 1984 p. 257).

For this purpose, the researcher used a quasi-experimental design consistent with the study type, and instrumented through two equal groups; one experimental group and one control group with a post-test..

Table 1

Experimental Design Used in the Study

Post-test	Dependent Variable	Independent Variable	Pre-test	Group
Cognitive Agility Scale	Cognitive Agility	TPACK Model	Cognitive Agility Scale	Experimental Group
Cognitive Agility Scale	Cognitive Agility	Traditional Method	—	Control Group

3.3 Third: research population

Population or research population are the entire groups of individuals or elements who are the subject of the research problem. It encompasses all aspects pertaining to the

study issue to which the researcher aims to generalize the findings of the study (Abbas et al., 2006,, p. 217).

The research community in this study is represented by the fifth-grade literary female students in governmental secondary and preparatory day schools for girls supported by the General Directorate of Education in Diyala Governorate. Baqubah District during the first semester of the academic year 2025–2026. The research population comprised twenty-one schools.

3.4 Fourth: research sample

Choosing the sample research is one of the important steps and stages of the study. This is because once the research problem and objectives are identified, the researcher starts thinking about the sample; so the implementation procedures, the nature of the study together with its hypotheses and plan govern the procedures of implementation along with choosing tools such as the sample, questionnaires and required tests (Obeidat et al., 1984, p. 109).

The researcher assigned the study population after intentionally picking Al-Tahrir Secondary School for Girls, It is because the school administration was cooperative and the school accommodates two sections for the fifth literary cycle. Section A was chosen for experimental by simple random selection and learned Modern and Contemporary European and American History based on TPACK Model, while Section B was chosen for control by using conventional model (lecturing method).

The total number of students in both groups were (N: 60) whereby 30 students in the experimental group and 30 in the control group. The final research sample consisted of students (60 students) anyone who did not 3 failed in the previous academic year table (1) as possessor of the expertise that may affect on results.

Table 2

Number of Students in the Two Research Groups Before and After Exclusion

Number of Students After Exclusion	Number of Repeating Students	Number of Students Before Exclusion	Section	Group
30	2	32	A	Experimental
30	1	31	B	Control

60	3	63	—	Total

Fifth: Equivalence of the Two Research Groups

Task 3: The researcher systematically adjusted the factors that would interfere with the experiment and the outcomes of the research in the experiment before the experiment. Thus, the two research groups were statistically equivalent, in order, in the following variables: parents' educational attainment, students' chronological age calculated in months, history scores for the previous academic year (2024/2025), scores on the mental abilities test (Henmon-Nelson), and the prior knowledge test. Results showed equivalence across all of these variables. (Hassan, 2023)

3.5 Sixth: research requirements

Achieving the objective of the research and testing its hypotheses required the preparation of a number of requirements, including the following:

1. **Determining the instructional material:** The researcher identified the instructional material in accordance with the curriculum prescribed by the Ministry of Education. It included the first four chapters of the textbook *Modern and Contemporary European and American History* prescribed for fifth literary grade students during the first semester of the academic year 2025/2026.
2. **Formulating the behavioral objectives:** A behavioral objective is a statement that indicates the kind of performance expected of the learner when the teaching of a specific instructional unit is completed. Or, it indicates the end behavior or the degree of achievement that was reached by the learner more than it indicates the method or methods used to reach that behavior (Dakhl Allah, 2015, p. 20). The 173 behavioral objectives were categorized and distributed across the six levels of Bloom’s cognitive taxonomy (1956): remembering, understanding, application, analysis, synthesis, and evaluation. These aims were approved by a panel of experts in history teaching, as well as in educational and psychological sciences. So, the last number was 173 objectives see you.
3. **Preparing the teaching plans:** Planning of the lessons is said to be one of the most significant responsibilities of the teacher. Lesson preparation is an

intellectual activity that takes place prior to the instructional practice and that is intended to develop a mental image of the expected behavior for both the teacher and the students (Salama, 2009, p. 98). For this reason, the researcher designed the teaching plans using the conventional method for the control group while for the experimental group it was designed according to the TPACK model. Sample plans were presented to a panel of specialists for their views and comments on their usefulness definiti on-wise.

4. **Research instrument:** The psychometric literature emphasizes the need to show the relevant theoretical rationales and construct definitions at the foundation of methods used to develop psychological measures/scale (Cronbach, 1970, p. 530). To achieve one of the aims of the current study, a scale consistent with that in literature, the theoretical framework of the study, and the nature of the research population was essential. To this end, the researcher to develop a cognitive agility scale. We then provided the primary reasons for building this scale. According to Al-Jabri (2011), scale construction is a careful and methodical process that Allen and Yen (1993) in Al-Jabri (2011) refer to as a series of necessary steps, and those steps summarized by the researcher in the following:

First: Planning the scale (general description of the scale) This includes:

1. Determining the concept to be measured
2. Determining the objective of the scale
3. Determining the components of the scale
4. Formulating the items of the cognitive agility scale
5. Determining the response alternatives of the cognitive agility scale

Second: Preparing the scale instructions, including response instructions and scoring instructions.

Third: Logical analysis of the scale items through face validity.

Fourth: Testing the clarity of the items and instructions.

Fifth: Statistical analysis of the items of the cognitive agility scale.

Sixth: Psychometric properties of the scale (Al-Jabri, 2011, p. 179).

First: Planning the Scale (General Description of the Scale)

This phase was established by reading and revising the literature, studies and literature that determine the sense of cognitive agility as well as the items covered by the scale and the items related to each component. In order to carry out this procedure, the researcher conducted the following procedures in this step.

4 DETERMINING THE CONCEPT OF COGNITIVE AGILITY

In the outset of his study, the researcher utilized within a section a very integrative theoretical framework of cognitive agility and adapted the definition of Good (2009), which described cognitive agility as a complex cognitive schema that represents the harmony of three major cognitive components within the person in each other while the task environment demands dynamic type of task performance, and the schema it reflects supports the ability to adjust performance to every change in the response demands of such type of task (Good, 2009, p. 19).

4.1 Objective of the scale

This study hopes to measure cognitive agility through a scale applied to the research sample, comprised of fifth literary grade students.

Input: In this paper, the researcher examined the idea of cognitive agility and the underlying theories of dual-processing theory and multiple intelligences theory, as well as models associated with cognitive agility such as experiential learning and mental models. Informed by this review, the researcher opted to employ a plausible integrative theoretical framework of these theories and models for developing the cognitive agility scale.

4.2 Determining the components of the cognitive agility scale

The elements of cognitive agility adopted in the present study are mirrored in the definition of this concept and its elements by Good (2019) and, as follows.

The first is cognitive openness. It refers to how much the person can observe and seek new information in the task environment in which the person functions. It does this

by being capable of broadening perceptual attention and conceptual attention so that one is able to pick up signals that point to novel information and map it into existing understanding and processing.

Second is cognitive flexibility. It points to how the person can steer mental activity toward information that is directly relevant to the task being accomplished despite the fact that its elements are constantly changing. This is accomplished by keeping the same mental strategy in the familiar parts of the task.

Attention focused attention is the third part of the equation. This Alludes To The Ability Of Individual Not Getting Distracted While Carrying Out A Task. This ability is exhibited in the narrowing of perceptual attention so that our senses are attuned to certain information, and in the narrowing of conceptual attention so that he/she focuses on a specific type of information from the task environment. (Good, 2019, p. 15).

4.3 Formulating the items of the cognitive agility scale

After determining the components of the scale and an explicit definition of the definition of each component, based on the definition proposed by Good (2009), the researcher formulated the items for each component of the cognitive agility scale, which was carried out considering the following:

It should belong to the component — not first-person.

This item must not include any indication of a desired answer.

It should be clear what the wording and meaning is and negative expressions should be avoided.

Avoid statements containing more than one idea.

The statements should not be confusing to the members of the sample, and there should be no confusing purpose of statements.

To avoid respondents getting tired of answering long statements should be avoided as much as possible (Al-Jabri&Sabri, 2015, p.76)

The researcher created a battery of items from the verbal situations. In each scenario, there were three alternatives, where each alternative represented a level of cognitive agility. The first alternative received three points, the second one two points, and the last three points. The scale consisted of thirty items with ten items in each domain

of the scale: cognitive openness (cognitive openness), cognitive flexibility, and focused attention (focused attention).

4.4 Determining the response alternatives of the scale

Three response alternatives were determined for each item of the scale written in verbal form. The first verbal situation represents the trait at a high level, the second verbal situation represents the trait at a moderate level, and the third verbal situation represents the trait at a low level, as shown in Table 2.

Table 3

Components, Items, and Response Alternatives of the Cognitive Agility Scale

Alternative	Number of Verbal Alternatives	Number of Items	Component	No.
High – Moderate – Low	3 alternatives	10	Cognitive Openness	1
High – Moderate – Low	3 alternatives	10	Cognitive Flexibility	2
High – Moderate – Low	3 alternatives	10	Focused Attention	3

4.5 Fifth: statistical analysis of the items of the cognitive agility scale

Statistical analysis scale items is one of the basic steps of constructing the scales. Choose items with good psychometric properties, such as Anastasi (1988, p. 192) suggests, to enhance scale validity and reliability. The main goal of item statistical analysis is to derive item discriminative power and validity coefficients, as these two indices reflect the two core indicators of the accuracy of the item as well as its accuracy in measuring the intended target (Al-Kubaisi, 2001, p. 32).

Thus, it is more important for items to be checked against statistical analysis because statistical analysis checks against content of the item and the content claims it is measuring against specific statistical indicators, rather than logical analysis which does not have a direct verification link to the content but rather relies on how an analysis user interprets proficiency constructs and how they are assessed more broadly, especially if the item lacks sufficient quality. The indicators are its discriminating power and its validity coefficient as an item (Al-Kubaisi, 1995, 5). Statistical analysis of empirical scores reflects the accuracy with which the items measure the construct they are designed

to assess (Ebel, 1972, p. 406), while the appropriateness or truth of an item may sometimes be hidden from logical analysis.

Thus, the researcher performed the statistical analysis as follows.

A. Sample for Statistical Item Analysis

According to Al-Masri (1999, pp. 91-92), experts in psychological testing unanimously accept that one of the most significant psychometric properties that needs to be validated in psychological scales is the item discrimination and the validity coefficients. The scale, comprising 30 items, was applied to 200 students on Wednesday and Thursday, 24–25 September 2025 in order to measure these variables for the items of the cognitive agility scale.

This sample size was suitable to analyze the items of the cognitive agility scale according to Nunnally (1978), who considered the sample size for item statistical analysis adequate by utilizing a ratio of five and ten individuals for each item of the scale to reduce the effect of chance. (Nunnally, 1978, p. 262).

B. Statistical Indicators of the Cognitive Agility Scale

To verify the statistical indicators of the scale, the researcher used the Statistical Package for the Social Sciences (SPSS) to extract the required statistical measures.

C. Calculation of the Psychometric Properties of the Items

When a composite scale is used to operationalize a latent variable, the psychometric properties of its items determine the ability of the composite scale to accurately measure that latent variable (Holden et al., 1985, pp. 386–389). This includes item discrimination, and item validity coefficients, which are among the important properties that must be examined (Al-Zibari, 1997, p. 75).

By choosing items with acceptable psychometric properties, a scale with good measurement properties can be created. Hence, the need to test the items for their statistical properties to identify appropriate items and amend or eliminate inappropriate items (Ghiselli et al., 1981, p.

Hence, the author computed the psychometric characteristics of the items through the following; 1- obtained the discriminatory index for each item, 2- computed the correlation between each item in the test and the composite score of the test and 3- computed the correlation between each item in the same domain and the composite score, thus obtained the internal matrix of correlation.

4.6 Sixth: psychometric properties of the scale

More recently, researchers in psychological measurement have devoted a considerable amount of attention in evaluating methods for enhancing the precision of psychological scales by delineating certain psychometric properties which indicate how closely a given scale measures the psychological constructs it was designed to measure and the extent of measurement error (Al-Masri, 1999, p. 36). Validity and reliability), are the most crucial property which modern psychologist focus on, as the nature and the faithfulness of data or scores which are almost totally derived from psychological scales will be invariably determined by these two properties (p. 227, rahman, 1997). The researcher then established the measurement properties of the scale as shown below, after previously demonstrating the psychometric properties of the scale items.

4.7 First: Validity of the scale

Validity: It is the extent to which a scale measures what it is intended to measure. A valid scale is defined as one which accurately measures the function that it is supposed to measure and does not measures the something else either as alternative or along with it (Abdul Hafiz and Mustafa, 2000, p. 173). The validity analysis enables the researcher to estimate the ratability of the scale with regard to the purpose it serves in its development (Odeh, 1998, pp. 333–335). Based on the above, three types of validity (face, construct, and factorial) were computed for the current scale.

A. **Face Validity**

Face validity is the degree to which the scale covers all the elements, or domains, of the ability or function it is supposed to measure. It further expresses the balance of these on the domains so that the content of the scale adequately measures the domain of the construct to which it has been given logically (Abdul Rahman, 1998, p. 150).

For face validity of the cognitive agility scale, the researcher described what cognitive agility was and what its domains are and developed items within each domain. Next, the scale was put in front of a panel of judges specializing in educational sciences, psychological measurement, teaching methodologies (experts). According to their decisions on whether the scale is appropriate for the purpose, the researcher assumed that

the percentage of concordance equal to or above 80 per cent or more among the judges for chi-square criterion as the acceptance. This percentage was exceeded in the level of agreement, which confirmed the presence of face validity of the cognitive agility scale.

B. **Construct Validity**

Construct validity is a term used to refer to what a scale is measuring based on its theoretical definition (Cronbach, 1984, p. 120). Construct validity was confirmed with the help of multiple statistical indicators (the three hypotheses to be used in this study and relevant hypothesis).

Discrimination around polar groups was considered.

Item–total correlation coefficients were assessed between the score of each item and the scale total score.

We computed the correlation of the score by each item and the score within the domain to which the item belongs.

Internal correlation matrix of scale entire items.

C. **Factorial Validity**

Factorial validity of the scale was verified through factor analysis using both exploratory and confirmatory approaches.

5 EXPLORATORY FACTOR ANALYSIS

Exploratory factor analysis (EFA) to explore the factorial structure of the cognitive agility scale and to discover the factors that make up the construct. Step 1: This Step is related to one type of construct validity evidences (Abu Hatab, Othman, and Sadiq, 2008).

A sample of 200 students attempted to check the conditions (principal components method, Kaiser criterion) before performing factor analysis.

First, the researcher computed means, standard deviations, skewness coefficients and kurtosis for the cognitive agility scale items. The skewness coefficient (−0.002) suggested that this distribution was very close to normality. As per Al-Sayyid (2005) distribution is said to be normal if coefficient of skewness are closer to zero. This output shows that the sample is homogeneous and that the scale is appropriate for the study population.).

5.1 Confirmatory factor analysis

The factorial validity was then tested for through confirmatory factor analysis in the same sample of two hundred students through Amos 24 software. The model hypothesized that the three factors of the scale (cognitive openness, cognitive flexibility, and attentional focus) would load onto one latent factor that depicts cognitive agility.

5.2 Reliability of the scale

Reliability means the scale is consistent or stable. A scale is said to be highly reliable when an individual scores similarly, or only slightly different each time the same scale or an equivalent set of questions is given on more than one occasion (Abu Allam, 2011, p. 481). Reliability is calculated to provide an estimate of measurement error and also to offer ways of attempting to eliminate this error (Murphy, 1998, p. 63),

There are multiple ways to apply test verification to establish the reliability of psychological tests. External consistency is assessed by some methods and for instance, according to stability across time, test–retest method is used and the equivalent forms method is based on preparation of two equivalent forms of the scale with equivalent characteristics of items (Ebel, 1972, p. 412). Other approaches quantify internal consistency (i.e., e.g. split-half method, Cronbach's α).

6 METHODS RELIABILITY WAS CALCULATED USING TEST–RETEST AND CRONBACHS ALPHA IN THIS STUDY

6.1 Test–retest method

Test–retest method is one of the more straightforward processes for estimating the reliability of a scale. Where you administer the test at two points in time and then correlate the scores that you have on the same subjects between those two administrations. The purpose of this procedure is to assess the stability of scale scores across different test conditions. Higher reliability suggests that the scores are less vulnerable to random, daily

fluctuations and variations in testing conditions. The choice of time window used in reliability estimation is also important (Allam, 2015, pp. 121–122).

Two weeks later we administered the scale again for estimating reliability to a reliability sample of 30 students. The retest window over which reliability is determined should not exceed two weeks after the first given, Adams said.

Next, we used Pearson's correlation coefficient to calculate the relationship between the scores acquired in the first and second administration. For the scale, the correlation coefficient was as high as 0.91. This score showcases a good measure for stability in the responses from respondents over time. Al-Issawi (1985, p. 58) gave this fact that when the correlation coefficient between the first and second administrations is 0.70 or higher it is considers good reliability in educational and psychological tests.

It would give us a wonted coefficient that reflects temporal stability that indicates a low probability that the scores are representative chance daily variation in illness or testing environment (Anastasi, 1976, p. 110).

6.2 Cronbach's alpha method

This method is distinguished by having high internal consistency and reliability of the results, as it calculates the correlations between the scores of all items of the scale assuming that all items represent independent measurements. The coefficient describes the degree of consistency among an individual response and the degree of homogeneity among the items of the scale (Odeh, 2000, p. 254). The procedure calculates the variances of the reliability sample scores across all scale items based on the concept that each item provides an independent measurement unit. The items in the scale are conceptually divided into a number of equal parts equal to the number of its items (Odeh and Al-Khalili, 1988, p.

Reliability by this method has been calculated based on the responses from a larger sample including 200 students. Cronbach alpha equation showed that the reliability coefficient is 0.88 with a level of significance of 0.01, thus confirming a good reliability level and indicating the scale is valid for research.

6.3 Description of the scale in its final form

In its final form, the cognitive agility scale consists of 30 items. Each item includes three response alternatives. The scores assigned to the alternatives are 3, 2, and 1 respectively. Therefore, the highest possible score on the scale is 90, while the lowest possible score is 30.

6.4 Implementation of the experiment

On Monday, 6 October 2025, the experiment was implemented for the two research groups. Groups were experimental group (TPACK model) and control group (traditional method) methods in this study, thus using the model group taught TPACK, and control group conventional teaching model. The post cognitive agility scale given a week later on 14 January 2026 as research instrument and the first semester of the history course based on the teaching of the four chapters was completed. In this phase, the researcher performed the procedures related to the execution of the experiment.

6.5 Ninth: statistical methods

Statistical Approach The statistical analyses were carried out with the Statistical Package for the Social Sciences (SPSS).

Independent samples t test

The equivalence of the experimental and control groups was tested using this test. It was also be used to compare the mean scores of students who received the experimental treatment and a control group, in order to test the research hypothesis. Also, it was applied to determine the discriminative power of the items of the cognitive agility scale.

Paired samples t test

Paired sample t-test was used to compare the mean score of the experimental group in pre test and post test of cognitive agility scale.

Pearson correlation coefficient

The coefficient was used to calculate the correlation of each item and the total score of the cognitive agility scale, inter-item correlation matrix of the scale, the correlation of each item and the score of its domain, and test–retest reliability coefficient.

Chi square test of independence

Independent-Samples T-Test: This test was used to test the assumption of the variable that parents' educational attainment was similar.

Cronbach's alpha equation

The following equation was used in computing estimates of internal consistency reliability of the cognitive agility scale.

Exploratory factor analysis

The factorial validity of the cognitive agility scale was determined with this method.

AMOS software

Confirmatory factor analysis was used to estimate factorial validity and this program was used for this analysis.

6.6 Chapter four: presentation and interpretation of results

This chapter presents and interprets the results of the research according to the objective of verifying the research hypothesis.

6.7 First: presentation of results

After administering the post test of cognitive agility to the students of both research groups and scoring their responses, the results were obtained based on statistical significance indicators as follows.

6.8 First hypothesis

The results of scientific analysis shows that at 0.05 level of significance, there are statistically significant differences between the mean score of the students of experimental group that study Modern and Contemporary European and American

History for the fifth literary grade in the first semester using TPACK model and the mean score of the students of control group of the same subject matter based on conventional method and their scores in the post test for cognitive agility scale.

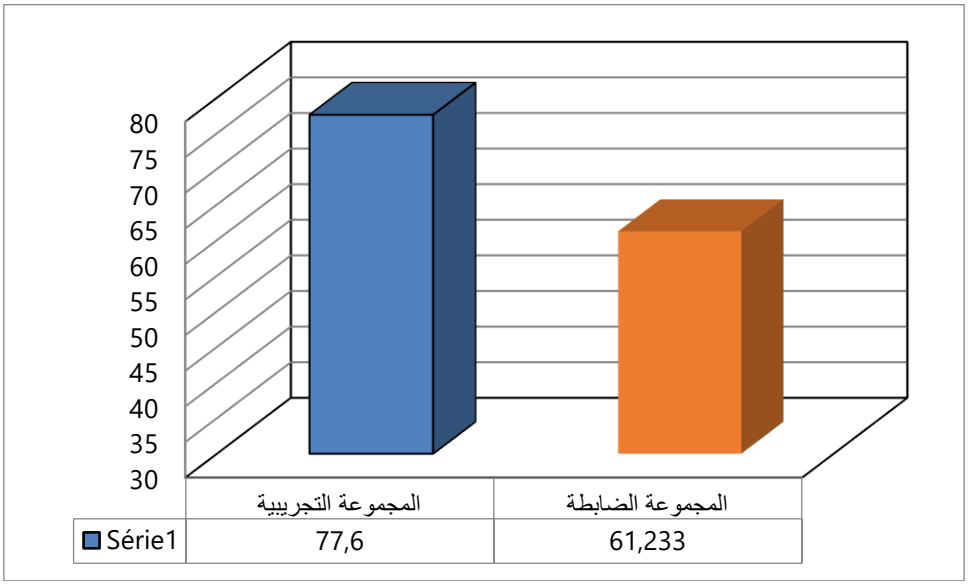
Once the cognitive agility scale was developed and all of its psychometric properties were validated, the scale was used to assess cognitive agility in both of the research groups. The independent samples t test was used to find out the difference in cognitive agility between the two groups after administering the scale in both groups and scoring the students cognitive agility response. Results are presented on Table 3 and Figure 2.

Table 4

Significance Level (0.05)	t-value (Tabulated)	t-value (Calculated)	Degrees of Freedom	Standard Deviation	Mean	Sample Size	Group
Statistically significant	2.00	13.224	58	4.352	77.600	30	Experimental
				5.197	61.233	30	Control

Figure 1

Mean Scores of the Two Research Groups on Cognitive Agility



Descriptive analysis of cognitive agility of students in the experimental group in terms of mean, standard deviation as evidenced in the table and figure above was 77.600 ± 4.352. The average score of the control group was 61.233 (SD 5.197).

The calculated t value is 13.224. This value is then higher than the tabulated value of 2.00 for the significance level of 0.05 and 58 degrees of freedom. This difference between control and treatment holo groups is statistically significant for cognitive agility. This terminus is in favor of the experimental group.

The null hypothesis that there is no difference between the two groups is rejected. Reject null hypothesis that there is no difference between two groups in cognitive agility. Output 2 : The students of the experimental group dominate.

6.9 Second hypothesis

At the significance level of 0.05, there is no statistically significant difference between the mean scores that the students of the experimental group who run the Modern and Contemporary European and American History for the fifth literary grade based on TPACK model received in the pretest and posttest of the cognitive agility scale.

In order to verify this hypothesis, the paired samples t test was applied to find differences between the mean scores of cognitive agility in the pretest and posttest of the experimental group. Table 4 presents the results.

Table 5

Mean, standard deviation, calculated t value, and tabulated t value for the scores of the experimental group in the pretest and posttest of the cognitive agility scale

Significance Level (0.05)	t value (Tabulated)	t value (Calculated)	Degrees of Freedom	Standard Deviation of Differences	Mean Difference	Standard Deviation	Mean	Measurement
Statistically significant	2.045	11.168	29	9.514	19.400	8.422	58.200	Pretest
						4.352	77.600	Posttest

The table shows that the calculated t value for the difference between the pretest and posttest of the cognitive agility scale reached 11.168. This value is greater than the tabulated t value of 2.045 at the significance level of 0.05 with 29 degrees of freedom. The result indicates a statistically significant difference between the pretest and posttest in the cognitive agility scale in favor of the posttest

6.10 Interpretation of the results

The results of the study showed that the experimental group performed better than the control group. Various reasons can be cited to explain this superiority.

TPACK model is effective in teaching and learning process for the thorough combination of Subject content, Pedagogy and modern Educational technologies. These results suggest that utilising the educational program did not merely consist of applying technological tools. Rather, technology was used and embedded into such a pedagogical structure that had an overall positive effect on how students learn.

Furthermore, this supremacy could be ascribed that learning environment, formed with the TPACK model, endowed the students with more opportunities to engage with the material. It taught a wide range of subject content using several instructional strategies suitable for individual differences. It transformed students from passive information recipients to active players in the learning process. This interaction contributed to students' understanding and provided a more detailed organization of knowledge.

Another possible explanation for the experimental group's dominance is how the TPACK framework integrates pedagogy, subject content, and technology into one model. Such integration simplified and ordered "historical concepts"; it tied them directly to illustrative examples, and it tied the examples together with a body of supporting evidence. This enables the student to understand the subject better. The collaborative nature of the model permitted the content to be prepared in a sequential and coherent manner, as opposed to pursuing a fragmented or ad hoc approach.

TPACK model presented different tools either for displaying presentation or testing, data found. This variety of events and activities helped engage students and kept them interested in the process of learning. Your constant feedback also aided in correcting errors and reinforced positive learning. The differences in these factors made the experimental group achieved better than control group as the control group only undergone the traditional/normal teaching methods.

Similarly, the results may also be interpreted with respect to the compatibility of TPACK model with specific characteristics of fifth grade preparatory students. The model considered their level of cognition and learning requirements. How closely the content was presented matched to their intellectual capabilities The correspondence between the

program and the stage of development of the learners promoted better learning results with more stability and this probably contributed to the positive results obtained by the experimental group.

TPACK Effect on Cognitive Agility In case of cognitive agility, findings show that the TPACK model for developing cognitive agility in students is that it was effective compared to not only the pretest results, but also the control group. Cognitive agility means the capability of the learner to adapt their mental strategies in problem-solving and modify cognitive strategies according to the needs of different learning contexts. Such cognitive flexibility comes when learners interact with rich learning environments that provide various media and demand analysis and scaffolding of thought. These settings existed within a TPACK learning environment, where traditional instruction was interwoven with technology in an environment conducive for continual and analytical thinking.

Cognitive agility development could further be viewed through the lens of the data presented by Martin (2011) and underpinnings of Cognitive Flexibility Theory delineated by Spiro (2011). Such views stress that the variability of interactive learning environments given by providing multiple representations of knowledge can enhance learners in terms of very basic skills such as better cognitive adaptation and re-organization of knowledge

7 CHAPTER FIVE CONCLUSIONS, RECOMMENDATIONS, AND SUGGESTIONS

7.1 First: conclusions

The researcher found the following conclusions from the results of the study.

While technology integration in teaching history does not yield in rote memorization of facts while learning rote history, it can yield sustained learning that gives students both a deep understanding of the subject itself and how they process the world they live in.

Based on this experiment, the application of the TPACK model can be one of the effective frameworks in improving teaching methods on the humanities department and sustainable quality education.

7.2 Second: recommendations

Depending of the obtained results in this study, the researcher suggest that

The history curriculum needs greater attention to make it more experiential and more integrated with the digital learning environment of students.

Professional learning community should encourage a switching experiences and best practice among teachers about the implementation of the TPACK model.

7.3 Third: suggestions for future research

Based on this study the researcher is able to propose the following studies for further future research.

Innovate assessment instruments which determine cognitive agility holistically and in a manner relevant to the needs of the 21st century.

Analyze further studies as for the cognitive mediator role of the teacher in TPACK-based learning environments.

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Authors' Contribution

All authors contributed equally to the development of this article.

Data availability

All datasets relevant to this study's findings are fully available within the article.

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