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Digital Media-based Quantum Learning: Improving Students' German Writing, Critical Thinking and Learning Motivation

Wilma Akihary * & Patresia S. Apituley
Universitas Pattimura, Maluku, Indonesia
wilamq@yahoo.com

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ABSTRACT

The quantum learning model is a combination of various interactions that occur during the learning process. This learning model can be combined with the Assoziogram technique or also with audio-visual media as learning media. This research aims at investigating the implementation of a digital media-based quantum learning model with the *Assoziogramm* technique/concept map to improve students' German writing, critical thinking, and learning motivation. This research uses one group pre-test and post-test experimental research design with a total sample of 20 students. The research data were collected using test and non-test (questionnaire) instruments. The research data were analysed using descriptive statistics and paired t-tests. The study results show an increase in the ability to write German, critical thinking, and learning motivation after the implementation of the digital media-based quantum learning model with *the Assoziogramm* technique. This study contributed to showing how variations in learning are crucial in providing a more engaging learning climate than the conventional learning done by lecturers.

1. Introduction

Technology literacy is one of the required abilities in Industrial Revolution 4.0 to prepare students to face the challenges in the working world. The use of technology for teaching and learning purposes needs to be prepared and improved (Slavin, 2009; Chaaban & Moloney, 2016; Murati & Ceka, 2017). Teachers need to adapt and develop their digital technology skills in order that they can creatively and innovatively make use of technology for the development of science. As confirmed by Al Kodri (2020), the use of digital technology can overcome online learning problems. One of the uses of technology in learning is digital media in the implementation of learning models.

Students have already been accustomed to using computers, tablets, and smartphones to access information from the internet. Therefore, teachers need to guide the students in using these media. Research results showed that 95.3% of the students tended to use digital media to support their learning (Subekti, 2016). Suana (2018) reports that based on gender, female students are better at using the internet to study physics, while male students use the internet for entertainment and access physics videos and animations. In this digital era, teachers can make use of a variety of applications accessible through digital media for learning activities, such as Google Classroom, Google Meet, or Moodle. Several applications that can be used for quizzes are Mentimeter, Kahoot, QR Code, Quiziz, Quizlet, and Learning Apps. Moreover, several applications that can be used for communication are WhatsApp, Facebook, Instagram, and Twitter.

In recent years, education research has also been reported using learning models with digital media. Hastutiningsih et al. (2021) explained that learning models in the digital era are divided into several types: blended learning, distance learning, mobile learning, and virtual learning environments. Ramkissoon et al. (2020) reported that 68.4% of students use WhatsApp, while 23.6% use the e-learning platform Moodle for online learning. Putri et al. (2020) reported that learning with the Moodle application effectively improves EFL learning for Indonesian university students compared to conventional lecture-style learning. In addition, the use of the CALL application provides a positive perspective in teaching English and can increase student motivation (Talpur et al., 2021).

Learning German in Indonesia in the 21st century also uses digital media. Tjakrawadhana (2017) reports that the use of learning videos in learning German can

increase student motivation. Andayani et al. (2021) also reported that using the Quizizz application could help students learn German to improve their understanding. The applications of digital learning media can make the learning activities or the transfer of knowledge more fun, and the students can understand the learning materials more efficiently. Appropriate learning models are necessary to make the process of the transfer of knowledge more successful (Gardner & Korth, 1997; Iskandarwassid & Sunendar, 2009; Turkich et al., 2014). The learning models for digital media-based learning are primarily successful because they are interactive and engaging to the students. One of the learning models that can be implemented when applying digital-based learning media is the quantum learning model.

A quantum learning model is a combination of various interactions that occur during a learning process. In this sense, the implementation of the quantum learning model can sum up the items of learning that have existed and turn them into a concept that is beneficial to oneself and others (DePorter & Hernacki, 2011; Sujatmika et al., 2018; Suryani, 2013). The implementation of the quantum learning model in Indonesian is abbreviated as *TANDUR*, which stands for *Tumbuhkan, Alami, Namai, Demonstrasikan, Ulangi, dan Rayakan*, meaning grow, experience, name, demonstrate, repeat and celebrate (Agustina, 2018; Martini et al., 2014). The implementation of the quantum learning model brings joy to learning and improves students' learning results (DePorter & Hernacki, 2011), it also increases students' creativity and memory (Sujatmika et al., 2018), and this learning is not abstract but learning becomes more effective and efficient (Rumapea et al., 2017).

Moreover, quantum learning combines "work" and "play", thus creating an exciting and fun learning environment through interactions in the classroom, which can increase learning results (DePorter & Hernacki, 2011; Wijaya, 2012). Previous studies have reported the use and implementation of the quantum learning model. Martini et al. (2014) reported that 31 students gave a positive response of 96% after the application of the quantum learning model. Sariah et al. (2018) reported that the implementation of the quantum learning model with the mind map technique had a positive effect on students' English writing skills, with the average score of the students' writing skills has increased by 10% in the first cycle to 76.53 in the second cycle. Altin et al. (2019) report that implementing the quantum learning model in learning English can attract students' attention, increase student activity in speaking and asking questions, and make learning fun.

Moreover, several other kinds of research also showed that by implementing the quantum learning model, teachers could develop and organise the learning activities to create a pleasant learning environment, and students can obtain life skills experience (Rumapea et al., 2017; Lenny et al., 2018). Nunggalina et al. (2018) explained that audio-visual media-based quantum learning could increase students' motivation and learning results. The quantum learning model is more effective in improving students' critical thinking skills when combined with student worksheets (Ramadhani & Ayriza, 2019; Putri & Irwan, 2019). In addition to the combination of the quantum learning model with audio-visual, this learning model can also be combined with the *Assoziogramm* technique.

Assoziogramm is a concept map preparation technique that is very suitable for learning German to arrange students' thinking directions in a theme to help them learn writing outcomes. Learning using this concept map can help students think about choosing the right words and connecting them with other words to form meaning for the concepts being studied. Concept maps are also a visual learning pattern that stimulates students' senses in learning to remember word for word so that it helps them find vocabulary and can be used for essay writing skills. German language learners are accustomed to using this technique at the beginning of the meeting as a technique for brainstorming students' ideas (Junaedi & Wahyuningsih, 2021; Firmansjah, 2017; Rosyiidah & Soesetyo, 2019). Akihary et al. (2021) added that this *Assoziogramm* technique could help students train logic and increase creativity.

Previous research has shown that the quantum learning model can be combined with learning media. So that this research appears to combine quantum learning models, which are usually done conventionally and can be modified into digital media-based quantum learning. This digital-based quantum learning model uses a digital media meter and WhatsApp application. The use of the Mentimeter website in this study is beneficial for students because one of the features "Create Live Word Clouds" that can be used by them (audience) is to add words from the lecturer (presenter) so that many words are formed. Many of these words can then be used to construct an *Assoziogramm*. Meanwhile, the use of WhatsApp helps in online learning. This application coordinates lecturers and students in one group to discuss without face to face.

The quantum learning implementation model has also been proven to be able to improve student learning outcomes, motivation, and critical thinking. However, research on the implementation of digital media-based quantum learning models combined with the *Assoziogramm* technique in the *Schriftlicher Ausdruck* (Writing) course has not been carried out. Even though the digital-based quantum learning model is very suitable to be implemented in the current RI 4.0 era learning. It is because lecturers can design fun digital-based learning to improve student's writing skills, motivation, and critical thinking skills.

Therefore, the research on the implementation of the quantum learning model combined with the *Assoziogramm* technique based on Mentimeter and WhatsApp applications on digital media is essential to be conducted. This research aims to investigate the implementation of a digital media-based quantum learning model combined with the *Assoziogramm* technique to improve students' writing skills, motivation, and critical thinking skills in the Study Program of German Education Pattimura University. The results of this study are expected to be the basis for applying a digital-based quantum learning model using the *Assoziogramm* technique in other language skills.

2. Literature Review

2.1 Digital Media-based Quantum Learning

The quantum learning model consists of several stages: Grow, Experience, Name, Demonstrate, Repeat, and Celebrate. The six stages are shortened to one term, namely TANDUR. This learning model was developed by Bobbi de Porter and Mike Hernacki (DePorter & Hernacki, 2011). According to Abidin (2018), the quantum learning model can provide right and left-brain theory suggestions, emphasise the triune brain theory, and lead to visual, auditory, and kinesthetic learning modes.

Currently, the quantum learning model can be combined with digital media to differentiate it from conventional quantum learning. Quantum learning models can be combined with digital media to make chemistry learning fun and help students understand concepts (Astuti et al., 2021). Muga (2017) also reports that video-based quantum learning can improve student learning outcomes in the psychomotor realm. Suwarno (2016) also reports that quantum learning can be combined with "mathematical" motivational media to increase students' motivation in learning mathematics. Some of these studies show that the combination of the quantum learning model with learning media has been carried out in science subjects but has not been carried out in language learning, especially German language learning. Therefore, this research focuses on quantum learning based on digital media with the *Assoziogramm* technique.

RI 4.0 era learning focuses on digital learning. One of the learning implementations in the Ri 4.0 era is the use of digital media Mentimeter and WhatsApp. Mentimeter is a website that is employed to help lecturers as presenters and students as audiences to find many words in a Schriftlicher Ausdruck (writing) course. Meanwhile, WhatsApp is used as an accessible digital communication medium. According to Erlidawati (2016), quantum learning is a comprehensive learning model because it combines the concepts of suggesting, accelerated learning, and neurolinguistics with learning theory so as to empower students' learning motivation, self-confidence, and student learning outcomes. Meanwhile, according to Huda et al. (2018), quantum learning is a learning model that can be used in learning writing and can motivate students to be active and creative. Sa'adah & Doyin (2019) add that learning using quantum learning is very effective for empowering kinesthetic learning styles so that they can contribute to students' writing skills.

In order to provide variations in the stages of the quantum learning model, educators (lecturers) can use learning media so that they can support the smooth delivery of information in the learning process. According to Janzen et al. (2011), the quantum learning model is not limited to classrooms but can be developed in virtual classrooms so that virtual learning can add advantages to quantum learning. Oktavia & Hulu (2017) found that the use of interactive media in quantum learning can improve student achievement in learning the language.

2.2 Writing Skill with *Assoziogramm*

In writing, one must express ideas and feelings and express information clearly and precisely so that the writing can be understood. So, one must master the language structure, vocabulary, and orthography.

Writing is notoriously considered a difficult skill to master by many students. It was found by Farooq et al. (2012) that students experienced difficulties in writing related to lack of vocabulary, first language interference, orthography, and grammatical problems. Ahmed (2016) added that students make mistakes in their writing performance because of several factors such as mother tongue disorders, insufficient basic technical activities, and exercise.

One of the techniques that can be used to practice writing skills is the *Assoziogramm*. *Assoziogramm* is a visualisation of words associated with a specific term. Another name for *Assoziogramm* is concept map (Lornsen, 2010). Found that concept maps are knowledge representations that connect these concepts, making it easier for students to assemble sentences into a discourse (Al Naqbi, 2011). The *Assoziogramm* technique trains students to write words into a concept map with meaning. After they are able to write a concept map correctly and have a meaning, then their writing ability can be empowered when writing an essay on the semester exam.

One way to find out if students can write well is to do a preliminary test (initiation test) and a final test of learning (to find out if students practice well). The measurement of this test is based on students' answers to correct or incorrect essays with a score determined by the lecturer. Shaziya et al. (2015) also have the same opinion that the stages in the learning process can develop students' abilities, and then the results can predict the results of the semester exams.

2.3 Critical Thinking

Critical thinking is one of the higher-order thinking skills important to be empowered. Pramonojati et al. (2019) explained that critical thinking serves to direct students to understand how to think in generating ideas, questions or problems and convey logical opinions. In addition, Rezaei et al. (2011) explained that debate, media analysis, problem-solving tasks, self-assessment, and peer assessment could encourage improving critical thinking skills in language classes. Some experts define critical thinking and detail more about the stages in critical thinking. Changwong et al. (2018) mentioned that the key steps in critical thinking include describing, reflecting on, analysing, riticizing, reasoning, and evaluating. Changwong et al. (2018) even conclude that the ability to analyse and creatively adapt to new situations is at the heart of critical thinking. Rohayati (2017) details in her research that the elements of critical thinking consist of details of problems, claims, arguments, reasons, evidence, and opinions. According to Kusuma et al. (2018), critical thinking consists of Interpretation, Analysis, Explanation, Evaluation, and Conclusion. Zubaidah et al. (2015) detail the aspect of critical thinking as a rubric consisting of five points (Table 2.1).

Table 2.1. Critical thinking rubric

Explanation	Points
If there is no answer or there is no correct answer;	0
If the student's answer contains the wrong concepts and reasons	1
If the student's answer contains an incorrect concept, the reasons used are not related to the concept, and the flow of thinking is not correct	2
If students' answers contain slightly correct concepts, but the reasons and arguments are not clear, the flow of thinking is quite good, and some concepts are interrelated	3
If the students' answers are mostly correct, the concept is straightforward but lacks focus, the flow of thinking is good, and all concepts are related and integrated	4
If students' answers contain correct, clear, and specific concepts that are also supported by strong, correct, and clear arguments, a good flow of thinking with all related and integrated concepts	5

There are several thoughts from experts to measure students' critical thinking skills. However, in this study, the opinion that is relevant to scoring students' essays based on critical thinking is Zubaidah et al. (2015).

Research by Alidmat & Ayassrah (2017) reports that critical thinking skills can be developed through writing activities. According to Setiawati & Corebima (2017), the factors that affect students' critical thinking skills are reading, asking, and seeking information. In addition, Gandimathi & Zarei (2018) reported that learning English that focuses on the use of students' critical thinking has an influence on increasing English mastery. Wijayati & Lestari (2021) reported that the critical thinking skills of German students in preparing their thesis were excellent in the aspects of analysis, synthesis, and evaluation. According to Schicker (2018), critical thinking helps students write and learn German grammar. Arndt et al. (2019) report that Turkish citizens can master German in the dimensions of hypothesis testing, verbal reasoning, assessment, argumentation, and problem-solving through critical skills.

The Implementation of digital-based quantum learning using the *Assoziogramm* technique can improve student'' critical thinking because this implementation stage collaborates with digital media (Mentimeter and WhatsApp) and the *Assoziogramm* technique at the natural, name, and demonstration stages. The lecturer brainstorms words using a Mentimeter (natural), then continues with the students designing the *Assoziogramm* (name and demonstration). This stage is the empowerment of student'' critical thinking. Furthermore, critical thinking can be developed at every stage of digital-based quantum learning using the *Assoziogramm* technique.

2.4 Motivation

Motivation is an impetus for empowering individuals to achieve high-performance levels and overcome obstacles (Tohidi, 2012). Motivation plays a vital role in learning and achievement (Schoor, 2010). Learning motivation is an effort or encouragement made from within and from outside the student. This motivation can be manipulated through certain learning practices (Lai, 2011). Emda (2017) describes the characteristics of students who have learning motivation: being diligent, not giving up quickly in the face of difficulties, and overcoming boredom in learning. The existence of motivation is an integral part of the learning process so that students can achieve maximum learning achievement. Gunobgunob-Mirasol (2019) explained that reading motivation could increase students' vocabulary size.

The indicators of learning motivation adopted by Keller (2010) are attention, relevance, self-confidence, and satisfaction. Research by Mali (2015) reports that the factors that influence motivation are students themselves, creative educators, inspirational classmates, parents who support children, and a class atmosphere that is conducive to supporting the learning process. In this case, the implementation of digital-based quantum learning using the *Assoziogramm* technique uses a motivational assessment that includes attention, relevance, confidence, and satisfaction. Attention to the learning process, the relevance of student activities to the learning process, confidence in carrying out activities, and student satisfaction with the results achieved.

Gillet et al. (2012) added that the intrinsic motivation that comes from within students is influenced by gender, maturity level, and age of the students themselves. Meanwhile, according to Masni (2015), students' intrinsic motivation is determined by their psychological factors. Hassandraa et al. (2003) that factors that influence intrinsic motivation are socio-environmental factors, including appearance, family, and goals for learning. Based on this statement, the student's intrinsic motivation includes their self-will and awareness to learn German using a digital-based quantum learning implementation using the *Assoziogramm* technique.

In addition to intrinsic motivation, there is also extrinsic motivation. Zaccone & Pedirini (2019) explained that extrinsic motivation could cause students to be affected by factors from outside themselves. Liu (2020) explains that extrinsic motivation depends on the variety of motivational strategies used by the teacher. Tokan & Imakulata (2019) also explains the same thing, namely extrinsic motivation indicators are the selection of strategies, models, methods, and learning techniques is a need to attract students' attention to learning. In this case, the implementation of digital-based quantum learning using the *Assoziogramm* technique can be one of the extrinsic motivational factors for students in learning German. Ryan & Deci (2020) added that intrinsic and extrinsic motivation factors are interrelated and influence because intrinsic factors are influenced by psychology and competence, while the family environment and family support influence extrinsic factors.

3. Method

3.1 Research Design

This study aimed to determine the application of a digital media-based quantum learning model combined with the *Assoziogramm* technique to improve the writing skills, motivation, and critical thinking skills of students at the Study Program of German Education Pattimura University.

This experimental research used one group pre-test post-test research design. However, this research did not use a control class as a comparison. Using a digital media-based quantum learning model, it only compared the initial conditions (before treatment) and the final conditions (after treatment). The details of the research design are presented in Figure 3.1, as follows.

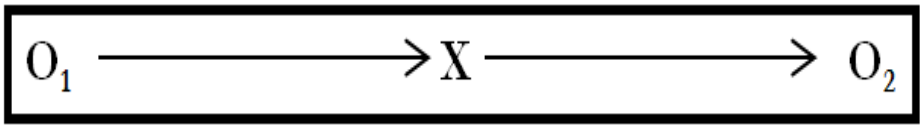

Figure 3.1. Research design (Mishra et al., 2019)

O_1 : Pre-test
X : Implementation of digital-based quantum learning using the *Assoziogramm* technique
O_2 : Post-test

3.2 Participants

This research was conducted at the German Language Education Study Program, Pattimura University, in the odd semester of the 2019/2020 academic year. The research subjects were 20 students who were enrolled in the Schriftlicher Ausdruck (writing) course. The research was conducted from March 18 to April 08, 2019. The research was conducted in 4 face-to-face meetings. Besides that, lecturers and students can have group discussions using the WhatsApp application.

3.3 Research Procedure

A pre-test was administered to the students before the implementation of the digital media-based quantum learning model with the *Assoziogramm* technique. The syntax of the quantum learning model is described in Table 3.1 as follows.

Tabel 3.1. The syntax of the quantum learning model

	Name in Indonesian	Name in English	Explanation	Syntax
T	*Tumbuhkan*	Grow	Teachers grow students' learning motivation and create a fun and enjoyable learning environment.	Lecturers use instrumental music (downloaded from the youtube application) to help focus students' minds.
A	*Alami*	Natural	Encourage students' curiosity to learn.	Teachers used Mentimeter digital media to stimulate students' curiosity and prior knowledge about the learning material "*Reisen/Berpergian Dalam Negeri*" and explore students' comprehension of the sub-themes, namely time, destination, transportation, and activities carried out while students are travel
	ling. *N* *Name*	Name	Process gives meaning	✓The students obtained information about the Reisen either directly or via WhatsApp. ✓The students made notes and keywords, and then they made *Assoziogramm* based on the information obtained.
D	*Demonstrate*	Demonstrate	The process of delivering student work	✓The students wrote the information using their own words based on the *Assoziogramm* they had already made. ✓Here, the students had the opportunity to associate their experience with the information obtained. ✓The students then submitted the results of their work via WhatsApp.
U	*Ulangi*	Repeat	The process of repeating through discussion	✓The results of the students' work were then discussed in the class and discussed privately via WhatsApp chat. ✓The students' work that had been checked and corrected by the teachers was sent to the students via WhatsApp chat.
R	*Rayakan*	Celebrate	The process of appreciating student work	The students celebrate their success for each achievement of one main topic discussion.

3.4 Research Instrument

The instruments used in this research were a test (essay) and a questionnaire to measure students' motivation. The tests were given before (pre-test) and after (post-test) the implementation of the digital media-based quantum learning model. The tests were used to measure students' writing and critical thinking skills.

The test question for students is to write an essay at level B1 (Intermediate). An essay written by a student relates to the theme of "Reisen" (Traveling Abroad). The test questions are used to assess students' writing skills as well as to assess students' critical thinking skills. However, there are differences in the rubric of the assessment of students' writing skills (Table 3.2) and critical thinking (Table 2.1).

Table 3.2. Writing ability assessment rubric

Explanation	Points
Fulfilment (content, scope, language features, text type, sociocultural appropriateness)	25
Coherence (text structure linking sentences, parts of sentences)	25
Vocabulary (range, proficiency)	25
Structures (mastery (morphology, syntax, orthography)	25

Furthermore, the motivation questionnaire was given to the students during the implementation of the digital media-based quantum learning model. The total number of questions on the motivation questionnaire is 25 items (Table 3.2). The scale used is a Likert scale with a scale of 1-4. Measurement of student motivation was adapted from Keller (2010) in Table 3.3, as follows.

Table 3.3. Indicators of learning motivation

Indicator	Descriptor
Attention	1. Enjoyment in studying the material "Reisen."
	2. Active in problem-solving
	3. Attention to the task
	4. Punctuality in completing tasks
Relevance	1. Understand Reisen's theme
	2. The relevance of Reisen's material with what has been learned
	3. Reisen material is in accordance with the wishes and has a use-value
	4. Relate Reisen's material to everyday life
	5. The suitability of the learning model in improving critical thinking skills
	6. Feeling driven to learn
Confidence	1. Confidence in success in achievement
	2. Confidence in Reisen's learning materials
	3. Confidence in being able to understand Reisen's lesson material
	4. Have ideas
	5. Ability to work hard
	6. Confidence in the use of other literature that can support learning activities
	7. Confidence in doing the test
Satisfaction	1. Satisfaction with learning outcomes
	2. Satisfaction with reinforcement
	3. Willingness to help friends who have not succeeded
	4. Satisfaction with participating in a series of learning activities/attendance in class
	5. Desire to achieve
	6. Fun in learning
	7. Satisfaction with every lesson
	8. Feel satisfied with every test

In addition to using this motivational questionnaire, the lecturer also conducted short interviews with open-ended questions to determine student responses to learning. The question in question: "Is the implementation of quantum learning based on digital media using the *Assoziogramm* technique interesting?" Both instruments were validated by education experts and had been tested for their reliability (Table 3.4).

Table 3.4. Results of the reliability analysis of the instrument

	Reliability	Category
Learning results	0.742	Reliable
Critical thinking	0.726	Reliable
Learning Motivation	0.893	Reliable

3.5 Data Analysis

The research data were quantitatively analysed using descriptive statistics and paired t-tests to describe students' learning results. Descriptive statistics were used to describe the research data in frequency and percentage. Furthermore, the paired t-test was performed to determine the difference between the conditions before and after the implementation of the digital media-based quantum learning model. The paired t-test was performed using SPSS for Windows version 18 software.

4. Results

4.1 Learning Results of Writing Skills

The research results (Table 4.1) show that the distribution of the pre-test scores of the students' writing skills was in the range of 33-47 (100%), while the distribution of the post-test scores was in the range of 69-98 (100%).

Table 4.1. The distribution of writing skill test scores

Pre-test			Posttest		
Interval	**F**	**RF**	**Interval**	**F**	**RF**
33-35	6	30	69-74	1	5
36-38	3	15	75-80	5	25
39-41	7	35	81-86	9	45
42-44	3	15	87-92	4	20
45-47	1	5	93-98	1	5
	20	100		20	100

(Note: F= Frequency, RF= Relative Frequency)

These results indicate that the pre-test scores of students' writing skills are below 47%, but after treatment, the students' post-test scores are above 69%. It means that there is an increase in student writing skills learning outcomes before and after students are taught using digital media-based quantum learning models with the *Assoziogramm* technique. It happens because the students have been trained to write during the learning process. They were trained to write using a Mentimeter at the natural, name, and demonstration stages.

4.2 Critical Thinking

The research results (Table 4.2) show that the distribution of the pre-test scores of the student's critical thinking skill test was in the range of 28-42 (100%), while the distribution of the post-test scores of the student's critical thinking skill test was in the range of 71-95 (100%).

Table 4.2. The distribution of students' critical thinking skill test scores

Pre-test			Posttest		
Interval	**F**	**RF**	**Interval**	**F**	**RF**
28-30	2	10	71-75	1	5
31-33	3	15	76-80	4	20
34-36	4	20	81-85	8	40
37-39	4	20	86-90	5	25
40-42	7	35	91-95	2	10
	20	100		20	100

(Note: F= Frequency, RF= Relative Frequency)

These results indicate that the pre-test scores of students' thinking skills are below 42%, while the scores of students' post-test scores are above 71%, indicating an increase. This happens because the students have been trained in thinking processes at the growth stage using instrumental music. The music helps focus students' minds on the learning process, followed by a natural stage where students are trained to think about the right words to write on the meter media, and then students are trained to think at the naming and demonstration stages to make an *Assoziogramm* correctly.

4.3 Student's Learning Motivation

The research results (Table 4.3) show that the distribution of the initial scores of the students' learning motivation was in the range of 39-44 (100%), while the distribution of the final scores of the students' learning motivation was in the range of 79-94 (100%).

Table 4.3. The distribution of the scores of the students' learning motivation

Interval	Frequency	Relative Frequency
79-82	6	30
83-86	10	50
87-90	3	15
91-94	1	5
	20	100

These results indicate that score of students is above 94%. Learning using digital media-based quantum learning implementation utilising the fun *Assoziogramm* technique helps students learn to write well. This learning also helps students experience a different learning climate than usual.

4.3 Hypothesis Testing

4.3.1 Prerequisite test

Before the research hypothesis was tested, the normality of the data was analysed.

Table 4.4. The results of the normality test

Test	Shapiro-Wilk		
	Statistics	**df**	**Sig.**
Initial learning results	.908	20	.057
Final learning results	.964	20	.622
Initial motivation	.921	20	.103
Final motivation	.978	20	.798
Initial critical	.908	20	.059
Final critical	.958	20	.506

The results of the normality test (prerequisite test) indicated that the scores of the learning results, motivation, and critical thinking skills both in the pre-test and post-test were normal, with the sig value > α = 0.05 (Table 4.4). It shows that the data of the pre-test and post-test were normally distributed.

With the normality of the data confirmed, the results of the paired t-test on the students' writing skills, motivation, and critical thinking skills are presented in Table 4.5.

Table 4.5. The results of paired t-tests

	Paired t-test	**Mean**	**N**	**t**	**df**	**Sig. (2-tailed)**
Pair 1	Learning results	-12.3	20	-13,195	19	.000
Pair 2	Motivation	34.50	20	16,249	19	.000
Pair 3	Critical thinking	-47.45	20	-41,081	19	.000

The results of the Paired t-test analysis show a significant difference between the students' writing skills, critical thinking skills, and learning motivation before and after the digital media-based-quantum learning model with the *Assoziogramm* technique. It can be seen from the significance value of 000 <α = 0.05 (Table 4.5). The difference before and after applying digital media-based quantum learning using the *Assoziogramm* technique shows that these learning stages encourage students to learn to write well, arrange the stages of thinking towards critical thinking, and motivate themselves to learn about Reisen's theme well.

5. Discussion

5.1 Learning Results of Writing Skills

The students taught by using a digital media-based quantum learning model had better writing skill learning results (Tabel 4.1), with the results of paired t-test (Table 4.5) showing significant results (P<0.05). Darmanah (2020) also reports that quantum learning can improve students' writing learning outcomes. Ojima (2006) also found that concept mapping helps students uniquely enhance their writing skills based on personal experience, motivation, and task conditions.

During the learning process, the lecturer generates interest in students in the learning material's topic. The lecturer also creates an enjoyable and fun learning atmosphere, such as using instrumental music to make the students feel more relaxed and help them focus on learning. According to Paquette Rieg (2008), music in language learning can improve students' writing skills. Students became relaxed listening to the learning materials or reading online reading texts. They made *Assoziogramm*, wrote them down based on their comprehension, and then retold and associated them with their experiences. For example, with the theme Reisen (travelling). They can practice independently using their digital media (Mentimeter) and create keywords described in the *Assoziogramm*. And then, the students associated their own experience and the experience they obtained from the reading texts. The association between the students' own experience and the new experience obtained from reading texts can help train their language skills, both receptive skills and productive skills. Such learning activities provide meaningful learning experiences for the students, which can help students understand the learning materials more efficiently. The research conducted by Wong & Yunus (2020) found that Mentimeter is a platform that can be used in online learning that can improve students' vocabulary and writing skills. The research shows that Mentimeter can be helpful as a digital media in learning.

In this study, it can also be seen that WhatsApp digital media plays an essential role in helping students convey the results of writing *Assoziogramm* at the demonstration stage. WhatsApp digital media positively affects student learning outcomes in learning German (Pattiselanno et al., 2022; Perdamean, 2019). The repetition of new experiences also strengthens the students' comprehension of new knowledge. While participating in digital media-based quantum learning using the *Assoziogramm* technique, students experience a different learning experience than usual. Furthermore, the lecturer rewards the students for the efforts they have made, either in the form of praises or gifts to celebrate their success. An award is a form of appreciation from the lecturer for students' achievements during their learning. Appreciation from the lecturer can set an example for students. The students are also trained to recognise their abilities and appreciate their achievements to have more respect for themselves. The research results by Arini et al. (2017) found that there was an increase in students' learning results and metacognitive abilities after they were taught by using the quantum learning model. Kusuma et al. (2018) also reported that the problem-based quantum learning model could be used as an innovative learning model to develop students' cognitive and non-cognitive abilities.

5.2 Students' Critical Thinking

Descriptive analysis shows that students' critical thinking improves after the lecturer applies the digital media-based quantum learning model using the *Assoziogramm* technique. Learning with stages in collaboration with digital media and the *Assoziogramm* technique can empower students' critical thinking well. It shows that students' thinking skills depend on the learning model (Pravita and Kuswandono, 2021). On the other hand, the paired t-test was performed to determine the effect of executing the digital media-based quantum learning model with the *Assoziogramm* technique on students' critical thinking. The results of the paired t-test (Table 4.5) show a significant result (two-tailed) ($P < 0.05$). It means that there was a significant difference in the students' critical thinking before and after the implementation of the digital media-based quantum learning model with the *Assoziogramm* technique. According to Iman (2017), critical thinking skills help students analyse and evaluate their thoughts.

In addition, Kusuma et al. (2018) reported that students who have good critical thinking skills would be able to make *Assoziogramm* systematically, make decisions, solve problems, or investigate problems of everyday life. On the other hand, Marni et al. (2020) explained that all students in the gender group (male and female) and knowledge group (humanity students and science) need critical thinking skills in language learning. However, language teachers must allow students to think for themselves during the learning process so that students' critical thinking can develop (Winch, 2019).

5.3 Students' Learning Motivation

The students taught by using a digital media-based quantum learning model had better learning motivation (Tabel 4.1), with the results of paired t-test (Table 4.5) showing significant results ($P<0.05$). The initial stage of the quantum learning model is the Grow stage. At this stage, the teacher uses music to make students feel relaxed and comfortable learning. Music can help increase the desire to learn, directly increasing students' learning motivation (MacIntyre et al., 2018). If the students already feel comfortable learning, the learning activities using the digital media-based quantum learning model can be preceded (Natural). The research conducted by Kao and Oxford (2014) shows that the use of music in language learning can increase students' learning motivation, and it also provides cultural experiences to students.

In addition, growing students' interest in the learning materials and creating a positive learning climate can improve students' extrinsic motivation. This is one of the characteristics of implementing the quantum learning model. The use of the quantum learning model can increase students' learning motivation because it creates a fun learning climate (Windarti et al., 2020). The results of this research are in line with the research results conducted by Wahyudi et al. (2019) that there is a significant difference in the students' learning motivation before and after the implementation of the music-based quantum learning model. In addition, Batubara et al. (2020) confirm that student learning motivation is influenced by the teacher's presence, personal attitude, Montessori material, class conditions, and the influence of friends.

Teachers can also combine learning models with digital media-based applications, such as Mentimeter and WhatsApp, to increase students' learning motivation. The use of Mentimeter in this research helped encourage students' curiosity, identify students' initial knowledge, and identify students' general understanding of the learning material. Moreover, the students can also give feedback more quickly because their feedback can be directly displayed at the Mentimeter. Mentimeter is also easy to use by students because it can be accessed using their respective cellphones. In addition, Rudolph (2018) explains that the use of Mentimeter in learning can make students feel happy and comfortable because the application can be used on a smartphone, which the students can access easily. Several research results have reported that the Mentimeter is a digital tool that can substitute conventional learning (Paquette & Rieg, 2008; Lin & Lin, 2020). The use of this digital media can have an effect on the students' motivation to learn German.

In addition to the digital media-based Mentimeter application, WhatsApp is a typical digital media-based application that students often use to communicate daily. According to the students, WhatsApp is a very practical communication application. It can be used to provide information and transfer assignments among students or between students and lecturers as much as 100%. Since WhatsApp can be downloaded on both handphones and computers/laptops, the lecturer can easily download the files of the students' assignment results sent via WhatsApp and upload the correction results of the students' assignments. And then, the students can immediately improve their work based on the correction given by the lecturer and then send it back via WhatsApp. In addition, all of the students (100%) stated that WhatsApp is safer because only those who save their phone numbers can interact with each other.

Moreover, 100% of the students also stated that they felt less embarrassed when they made mistakes and received feedback from the lecturer because they could send the feedback via private messages. Similarly, Sukrillah et al. (2017) and Utomo & Ubaidillah (2018) also state that WhatsApp enables teachers and students to communicate by sending texts, images, videos, voice notes, and even links related to the learning material. In this case, WhatsApp is used to interact with each other and to disseminate information as well as a means to solve problems found in learning. WhatsApp is also convenient to use in teaching and learning activities.

Therefore, WhatsApp is a favourite application used in the lecture learning model (Gon & Rawekar, 2017). Other research results also reported that the use of the WhatsApp application in learning could develop students' motivation in learning grammar, vocabulary, reading, and writing (Ahmed, 2019; Awada, 2016). In addition, Plana et al. (2013) argued that most students liked and showed an interest in using the WhatsApp application to improve their reading habits and self-confidence in language learning. The biggest obstacle to using the WhatsApp application in learning is when the students do not have sufficient mobile data (35%). The same opinion was conveyed by Talpur et al. (2021) that technology can increase students' motivation and various skills in learning German. This study shows that the combination of the quantum learning model and digital media can increase students' learning motivation and critical thinking. Finally, the quantum learning model based on digital media can be used as a variation in German language learning to support a pleasant learning atmosphere.

6. Conclusions

The results showed that the application of the digital media-based quantum learning model syntax with the *Assoziogramm* technique helped lecturers in growing students' learning motivation; using the Mentimeter to cultivate curiosity; guiding students to create keywords and associations; controlling students in discussions, teaching students to celebrate their success in learning and had a positive effect on the students' German, critical thinking, and learning motivation. In addition, there were significant differences in writing skills, critical thinking skills, and student motivation before and after the application of the digital media-based quantum learning model with the *Assoziogramm* technique.

The stages in the digital media-based quantum learning model using the *Assoziogramm* technique can empower students' writing skills, critical thinking, and student motivation. It is because the resulting learning is fun and different from the usual learning carried out by lecturers. The concept of this research is to combine digital media with the stages of the learning model with quantum learning and relate it to the *Assoziogramm* technique. It makes conventional quantum learning prisons modern, with various digital media and techniques. The teacher must pay attention to how each stage is explained to students because the different stages of learning that students usually experience can confuse them.

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References

Abidin, M. Z. (2018). Islamic education based on quantum learning: Conceptual and methodological perspective. *Madania: Jurnal Kajian Keislaman*, *22*(2), 159-172. https://doi.org/10.29300/madania.v22i2.1264

Agustina, D. A. (2018). Pengembangan buku ajar konsep sains berbasis quantum learning. [Development of quantum learning science concept textbook]. *Jurnal Pendidikan*, *7*(2), 77–84.https://doi.org/10.21070/pedagogia.v7i2.1571

Ahmed, S. T. S. (2019). Chat and learn: Effectiveness of using WhatsApp as a pedagogical tool to enhance EFL learners' reading and writing skills. *International Journal of English Language and Literature Studies*, *8*(2), 61–68. https://doi.org/10.18488/journal.23.2019.82.61.68

Ahmed, F. E. Y. 2016. An investigation of writing errors of Saudi EFL University Students (A case study of College of Science & Arts- Tanumah, King Khalid University). *International Journal of Social Science and Humanities Research*, *4*(2), 189-211. https://doi.org/ 10.13140/RG.2.2.22379.18725

Akihary, W., Apituley, P. S., Lestuny, C., & Soumokil, P. (2021). Pelatihan peningkatan keterampilan menulis dengan menggunakan *assoziogramm* bagi guru Bahasa Jerman. *Gaba-Gaba: Jurnal Pengabdian Kepada Masyarakat dalam Bidang Pendidikan Bahasa dan Seni*, *1*(3), 110-114.

Alidmat, A. O. H., & Ayassrah, M. A. (2017). Development of critical thinking skills through writing tasks: Challenges facing maritime English students at Aqaba College, AlBalqa Applied University, Jordan. *International Journal of Higher Education*, *6*(3), 82–90. https://doi.org/10.5430/ijhe.v6n3p82

Al Kodri, M. N. (2020). The role of digital technology in sustaining online learning during the pandemic Covid19. *UHAMKA International Conference on ELT and CAL*, 21-31.

Al Naqbi, S. 2011. The use of mind mapping to develop writing skills in UAE schools. *Education, Business and Society: Contemporary Middle Eastern Issues*, *4*(2), 120-133, https://doi.org/10.1108/17537981111143855

Altin, M., & Saracaoğlu, A. S. (2019). The effect of Quantum learning model on foreign language speaking skills, speaking anxiety and self-efficacy of secondary school students. *Journal of Language and Linguistic Studies*, *15*(3), 1083-1104.

Andayani, W., Andriani, R., Amelya, S. R., Octavia, H. I. A., & Debora, M. (2021). Indonesian students' experiences in studying foreign language using technology. *Wacana: Jurnal Penelitian Bahasa, Sastra dan Pengajaran*, *19*(2), 38-45.

Arndt, S., Ceylan, A. Ö., Gülbetekin, E., & Elliott, M. A. (2019). Critical thinking in first (Turkish) and second (German/English) language. *FECHNER DAY 2019: 35th Annual Meeting of the International Society for Psychophysics*, pp. 63.

Arini, I., Salmanu, S. I. A., & Sangur, K. (2017). The effect of learning model quantum learning to improve the learning outcomes of the cognitive and metacognitive ability of virus concepts in the students of Class XMIA1 State Senior High School 10 Ambon. *The 2nd International Seminar on Education Faculty of Teacher Training and Education Science Pattimura University*, 49–52.

Astuti, S. R. D., Sari, A. R. P., & Amelia, R. N. (2021). Chem is fun: Animation learning media based on quantum learning on atomic structure. *Journal of Educational Chemistry*, *3*(1), 45-52.

Awada, G. (2016). Effect of WhatsApp on critique writing proficiency and perceptions toward learning. *Cogent Education*, *3*(1), 1–25. https://doi.org/10.1080/2331186X.2016.1264173

Batubara, F., Derin, T., Putri, N. S., & Yudar, R. S. (2020). Five factors influencing the students' motivation to learn English as a foreign language: A closer look into Montessori classroom environment. *REiLA: Journal of Research and Innovation in Language*, *2*(2), 76-84. https://doi.org/10.31849/reila.v2i2.3165

Chaaban, Y., & Moloney, R. (2016). Educating pre-service teachers in technology use: A Study of provision at Lebanese Universities. *International Journal of Education*, *8*(2), 14–31.

Changwong, K., Sukkamart, A., & Sisan, B. (2018). Critical thinking skill development: Analysis of a new learning management model for Thai high schools. *Journal of International Studies*, *11*(2), 37–48. https://doi.org/10.14254/2071-8330.2018/11-2/3

Darmanah, D. (2020). Increasing students' writing skill on poetry through quantum learning strategy: A classroom action research. *Journal of English Language Teaching and Cultural Studies*, *3*(2), 89-96.

Dayu, D. P. K. (2018). Project-based learning model to increase the writing skill toward German language. *Proceedings von International Seminar Recent Language, Literature, and Local Cultural Studies*, *19*(20), 179-183.

DePorter, B., & Hernacki, M. (2011). *Quantum learning: membiasakan belajar nyaman dan menyenangkan [Quantum learning: Making learning comfortable and fun]*. Kaifa.

Emda, A. (2017). Kedudukan motivasi belajar siswa dalam pembelajaran [Position of student motivation in learning]. *Lantanida Journal*, *5*(2), 172–182.

Erlidawati, E. (2016). Quantum Learning In Learning Reading Comprehension. *ITQAN: Jurnal Ilmu-Ilmu Kependidikan*, *7*(1), 37–50.

Farroq, M. S., Ul-Hasan, M. U., & Wahid, S. (2012). Opinion of second language learners about writing difficulties in English language. *A Research Journal of South Asian Studies*, *27*(1), 183-194.

Firmansjah, F. R. (2017). Stereotype dalam pengajaran Bahasa Jerman. *Seminar Nasional Pengajaran Bahasa* 2017, 175-188.

Gardner, B., & Korth, S. J. (1997). Classroom strategies that facilitate the transfer of learning to the workplace. *Innovative Higher Education*, *22*, 45–46. https://doi.org/10.1023/A:1025151609364

Gandimathi, A., & Zarei, N. (2018). The impact of critical thinking on learning the English language. *Asian Journal of Social Science Research*, *1*(2), 1-11

Gillet, N., Vallerand, R. J., Lafreniere, & Marc-Andre, K. (2012). Intrinsic and Extrinsic School Motivation as a Function of Age: The Mediating Role of Autonomy Support. *Social Psychology Education*, *15*(1), 77–95. https://doi.org/10.1007/s11218-011-9170-2

Gon, S., & Rawekar, A. (2017). Effectivity of E-learning through WhatsApp as a teaching-learning tool. *MVP Journal of Medical Sciences*, *4*(1), 19–25. https://doi.org/10.18311/mvpjms/0/v0/i0/8454

Gunobgunob-Mirasol, R. (2019). Vocabulary size, reading motivation, reading attitudes and reading comprehension performance among Filipino college learners of English. *International Journal of Evaluation and Research in Education*, 8(1), 64-70. https://doi.org/10.11591/ijere.v8i1.15335

Hassandraa, M., Goudasa, M., & Chron, S. (2003). Examining factors associated with intrinsic motivation in physical education: A qualitative approach. *Psychology of Sport and Exercise*, *4*(3), 211–223.

Hastutiningsih, A. D., Sugiyono, Suyanto., & Wibowo, U. B. (2021). Digital learning is the new of education face: Practice from many countries. *Advances in Social Science, Education and Humanities Research, 640*, 148-153

Huda, W., Mardikantoro, H. B., & Haryadi, H. (2018). Quantum Learning Model Influence using Series of Drawings Towards The Fifth Grade Students' Narrative Writing Skill. *Journal of Primary Education*, *7*(3), 332–341.

Iman, J. (2017). Debate instruction in EFL classroom: Impacts on the critical thinking and speaking skill. *International Journal of Instruction*, *10*(4), 87–108.

Iskandarwassid, & Sunendar, D. (2009). *Strategi pembelajaran bahasa [Language learning strategies]*. PT Remadja Rosdakarya Offset.

Janzen, K. J., Perry, B., & Edwards, M. (2011). Aligning the quantum perspective of learning to instructional design: Exploring the seven definitive questions. *International Review of Research in Open and Distributed Learning*, *12*(7), 56–73.

Junaedi, I. M. R. S., & Wahyuningsih, F. (2021). Lirik lagu lass uns gehen sebagai media pembelajaran keterampilan membaca Bahasa Jerman SMA. *E-Journal Laterne*. 10(3), 1-14.

Kao, T., & Oxford, R. L. (2014). Learning language through music: A strategy for building inspiration and motivation. *System*, *43*(1), 114–120. https://doi.org/10.1016/j.system.2014.01.003

Keller, J. M. (2010). *Motivational Design for Learning and Performance*. Florida State University.

Kusuma, E. D., Gunarhadi, & Riyadi. (2018). The development of problem-based quantum learning model in elementary schoolin. *International Journal of Educational Research Review*, *3*(3), 9–16. https://doi.org/10.24331/ijere.412267

Lai, E. R. (2011). *Motivation: A Literature Review*. http://www.pearsonassessments.com/research.

Lornsen, T. (2010). Online assignments: Free web 2.0 tools in German Language classes. *Die Unterrichtspraxis/Teaching German*, *43*(2), 194-204. https://doi.org/10.1111/j.1756-1221.2010.00080.x

Lenny, Z., Firman, F., & Desyandri, D. (2018). The effect of using quantum teaching and motivation in learning toward students achievement. *Jurnal Aplikasi IPTEK Indonesia*, *2*(3), 9–15. https://doi.org/10.24036/4.32143

Lin, X., & Lin, C. (2020). Communication Theories applied in mentimeter to improve educational communication and teaching effectiveness. *In 4th International Conference on Culture, Education and Economic Development of Modern Society*, 870–875. https://doi.org/10.2991/assehr.k.200316.191

Liu, I. F. (2020). The impact of extrinsic motivation, intrinsic motivation, and social self-efficacy on English competition participation intentions of pre-college learners: Differences between high school and vocational students in Taiwan. *Learning and Motivation*, *72*, 101675. https://doi.org/10.1016/j.lmot.2020.101675

MacIntyre, P. D., Schnare, B., & Ross, J. (2018). Self-determination theory and motivation for music. *Psychology of Music*, *46*(5), 699–715. https://doi.org/10.1177/0305735617721637

Mali, Y. C. G. (2015). Motivational factors in the Indonesian EFL writing classroom. *Jurnal Pendidikan Bahasa Dan Sastra*, *15*(1), 1–11.

Marni, S., Aliman, M., Suyono., Roekhan., & Harsiati, T. (2020). Students' critical thinking skills based on gender and knowledge group. *Journal of Turkish Science Education*, *17*(4), 544-560. https://doi.org/10.36681/tused.2020.44

Martini, N. M., Rasna, I. W., & Artawan, G. (2014). Implementasi model pembelajaran quantum learning dalam pembelajaran menulis karangan deskripsi pada siswa kelas X SMKN 1 Abang [Implementation of the quantum learning model in learning to write descriptive essays in class X SMKN 1 Abang]. *Journal Program*

Pascasarjana Universitas Pendidikan Ganesha, *3*(1), 1–8.

Masni, H. (2015). Strategi meningkatkan motivasi belajar mahasiswa [Strategies to increase student motivation]. *Jurnal Ilmiah Dikdaya*, *5*(1), 34–45. https://doi.org/10.33087/dikdaya.v5i1.64

Mishra, P., Singh, U., Pandey, C. M., Mishra, P., & Pandey, G. (2019). Application of student's t-test, analysis of variance, and covariance. *Annals of Cardiac Anaesthesia*, *22*(4), 407-411. https://doi.org/10.4103/aca.ACA_94_19

Muga, W. (2017). Video-assisted quantum learning design to improve psychomotor learning achievement. *Journal of Education Technology*, *1*(1), 30-36.

Murati, R., & Ceka, A. (2017). The use of technology in educational teaching. *Journal of Education and Practice*, *8*(6), 197–199.

Nunggalina, O. C., Muhari, M., & Setyowati, R. R. N. (2018). Quantum teaching-learning model to increase motivation and learning outcomes (Application audio-visual media to increase understanding symbols of Pancasila principles). *Atlantis-Press.Com*, 125–128. https://doi.org/10.2991/icei-18.2018.27

Ojima, M. (2006). Concept mapping as pre-task planning: A case study of three Japanese ESL writers. *System*, *34*(4), 566–585. https://doi.org/10.1016/j.system.2006.08.003

Oktavia, Y., & Hulu, F. (2017). Pengaruh metode quantum learning berbasis media interaktif terhadap prestasi belajar Bahasa Indonesia Mahasiswa di Universitas Putera Batam. *KEMBARA: Jurnal Keilmuan Bahasa, Sastra, Dan Pengajarannya*, *3*(2), 255–269. https://doi.org/10.22219/kembara.v3i2.5133

Pattiselanno, C. M., Marantika, J. E., & Kunu, G. H. (2022). Influence of the use of WhatsApp social media on the results of learning German of students of SMA Negeri 20 Maluku Tengah. *Jurnal Tahuri*, *19*(1), 47-54.

Paquette, K. R., & Rieg, S. A. (2008). Using music to support the literacy development of young English language learners. *Early Childhood Education Journal*, *36*, 227–232.

Perdamean, A. S. (2019). WhatsApp as a German Language learning media. *International Seminar and Annual Meeting BKS-PTN Wilayah Barat*, *1*(1), 51-56.

Plana, M. G., Opkins, J. E., Plana, M. G., & Appel, C. (2013). Improving learners ' reading skills through instant short messages : A sample study using WhatsApp Global perspectives on Computer-Assisted Language Learning Improving learners ' reading skills through instant short messages : A sample study using WhatsApp. *IV World CALL Conference*, 1013. https://doi.org/10.2307/40130800

Pramonojati, S., Fitriyah, W. D., Carella, D. N., & Sari, I. Y. K. (2019). Students' critical thinking in writing background of research. *Advances in Social Science, Education and Humanities Research*, *434*, 304–308.

Pravita, A. R., & Kuswandono, P. (2021). Critical thinking implementation in an English education course: Why is it so challenging?. *EduLite: Journal of English Education, Literature, and Culture*, 6(2), 303-313

Putri, W. F., & Irwan. (2019). Validity of learning devices mathematical based on quantum teaching and learning model for improving critical thinking. *IOP Conf. Series: Journal of Physics*, *1317*(012137). https://doi.org/10.1088/1742-6596/1317/1/012137

Putri, S. E., Hamuddin, B., Nursafira, M. S., & Derin, T. (2020). Discourse analysis in e-learning-based course using moodle platform: An experimental design. *REiLA: Journal of Research and Innovation in Language*, *2*(1), 19-26. https://doi.org/10.31849/reila.v2i1.3960

Ramadhani, M. I., & Ayriza, Y. (2019). The effectiveness of quantum teaching-learning model on improving the critical thinking skills and the social science concept understanding of the elementary school students. *Jurnal Prima Edukasia*, *7*(1), 45–47. https://doi.org/10.21831/jpe.v7i1.11291

Ramkissoon, P., Belle, L. J., & Bhurosy, T. (2020). Perceptions and experiences of students on the use of interactive online learning technologies in Mauritius. *International Journal of Evaluation and Research in Education*, *9*(4), 833–839. https://doi.org/10.11591/ijere.v9i4.20692

Rezaei, S., Derakhshan, A., & Bagherkazemi, M. (2011). Critical thinking in language education. *Journal of Language Teaching and Research*, *2*(4), 1798–4769. https://doi.org/10.4304/jltr.2.4.769-777

Rohayati, D. (2017). Students' Critical Thinking in Writing An English Exposition Text. *Advances in Social Science, Education and Humanities Research*, *82*, 228–232.

Rosyiidah, F., & Soesetyo, B. H. (2019). Dongeng die sterntaler sebagai pembelajaran keterampilan membaca Bahasa Jerman SMA. *Laterne*, *8*(2), 1-9.

Rudolph, J. (2018). A brief review of Mentimeter – a student response system. *Journal of Applied Learning & Teaching*, *1*(1), 35–37. https://doi.org/10.37074/jalt.2018.1.1.5

Rumapea, G., Syahputra, E., & Surya, E. (2017). Application of quantum learning model to improve student learning outcomes. *International Journal of Novel Research in Education and Learning*, *4*(2), 118–130.

Ryan, R. M., & Deci, E. L. (2020). Intrinsic and extrinsic motivation from a self-determination theory perspective: Definitions, theory, practices, and future directions. *Contemporary Educational Psychology*, *61*, 101860.

Sa'adah, N., & Doyin, M. (2019). Learning Short Story Writing by Quantum Model For Eleventh Graders based on Learning Styles. *Seloka: Jurnal Pendidikan Bahasa Dan Sastra Indonesia*, *8*(3), 1–7.

Sariah, Rasyid, Y., & Herlina. (2018). Improving writing skills of recount text through quantum learning model with concept map technique. *Journal of English Language Studies*, *3*(1), 101–112. https://doi.org/10.30870/jels.v3i1.2822

Schicker, J. (2018). Teaching writing and grammar through critical thinking in a genre-based upper-level undergraduate German class. *Die Unterrichtspraxis/Teaching German*, *51*(1), 63-75.

Schoor, C. (2010). *Die Bedeutung von Motivation für Wissenserwerbsprozesse beim computerunterstützten kooperativen Lernen*. Berlin: Logos.

Setiawati, H., & Corebima, A. D. (2017). Empowering critical thinking skills of the students having different academic ability in biology learning of Senior High School through PQ4R-TPS Strategy. *The International Journal of Social Sciences and Humanities Invention*, *4*(5), 3521–3526.

Shaziya, H., Zaheer, R., & Kavitha, G. (2015). Prediction of students performance in semester exams using a Naïve Bayes classifier. *International Journal of Innovative Research in Science, Engineering and Technology*, *4*(10), 9823-9829. https://doi.org/10.15680/IJIRSET.2015.0410072

Slavin, R. E. (2009). *Psikologi pendidikan [Education pshycology]*. Indek.

Suana, W. (2018). Students' Internet Access, Internet Self-Efficacy, And Internet For Learning Physics: Gender And Grade Differences. *Journal of Technology and Science Education*, *8*(4), 281–290. https://doi.org/10.3926/jotse.399

Subekti, H. (2016). Representasi penggunaan media digital dan pembelajaran berbasis penelitian: Sebuah survei untuk mengukur perilaku pada mahasiswa baru di Program Studi Pendidikan Sains Unesa. *Jurnal Penelitian Pendidikan IPA*, *1*(1), 7–12. https://doi.org/10.26740/jppipa.v1n1.p7-12

Sujatmika, S., Hasanah, D., & Hakim, L. L. (2018). Effect of quantum learning model in improving creativity and memory. *IOP Conference Series: Journal of Physics Conference*, *1006*, 1–5.

Sukrillah, A., Ratnamulyani, I. A., & Kusumadinata, A. A. (2017). Pemanfaatan media sosial melalui whatsapp Group Fei sebagai sarana komunikasi [Use of social media through Fei Group's WhatsApp as a means of communication]. *Jurnal Komunikatio*, *3*(2), 95–104. https://doi.org/10.30997/jk.v3i2.919

Suryani, N. (2013). Improvement of student's history learning competence through quantum learning model at senior high school in Karanganyar Regency, Solo, Central Jawa. *Journal of Education and Practice*, *4*(14), 55–63.

Suwarno, M. (2016). Kombinasi quantum learning dan media motivasi "mathemagic" untuk meningkatkan minat dan hasil belajar matematika siswa. *Jurnal Posiding Seminar Nasional Pendidikan Matematika*, 2(1), 128-137.

Talpur, N., Kalwar, T., & Talpur, M. J. (2021). Computer-assisted Language Learning in Pakistani Context During COVID-19 Pandemic. *REiLA: Journal of Research and Innovation in Language*, *3*(3), 210-225.

Tjakrawadhana, V. R. K. (2017). German language learning through video to improve student motivation and introduce German culture. *English Language and Literature International Conference (ELLiC) Proceedings*, 1, 267-272.

Tohidi, H. (2012). The effects of motivation in education. *Procedia - Social and Behavioral Sciences*, *31*, 820–824.

Tokan, M. K., & Imakulata, M. M. (2019). The effect of motivation and learning behaviour on student achievement. *South African Journal of Education*, *39*(1), 1-8.

Turkich, K., Greive, S., & Cozens, P. (2014). Transferring educational theories and knowledge using a co-teaching mentor model: A discipline-appropriate approach. *Journal of University Teaching and Learning Practice*, *11*(3), 1–19.

Utomo, S. W., & Ubaidillah, M. (2018). Pemanfaatan aplikasi whatsapp pada pembelajaran berbasis masalah untuk mata kuliah akuntansi internasional di Universitas PGRI Madiun. *Jurnal Teknologi Pendidikan*, *6*(2), 199–211. https://doi.org/10.31800/jtp.kw.v6n2.p199--211

Wahyudi, R., Neviyarni, N., & Irianto, A. (2019). The effectiveness of information service with quantum learning models using music to improve student learning. *Journal of Counseling and*

Educational Technology, *2*(1), 12–18. https://doi.org/10.32698/0311

Wijaya, M. (2012). Pengembangan Model pembelajaran e-learning berbasis web dengan prinsip e-pedagogy dalam meningkatkan hasil belajar. *Jurnal Pendidikan Penabur*, *19*(11), 20–37.

Wijayati, P. H., & Lestari, F. A. (2021). Critical Thinking ability of german literature Department's Students of Universitas Negeri Malang in writing thesis. *Journal of Development Research*, *5*(2), 164-173.

Winch, J. (2019). Does communicative language teaching help develop students' competence in thinking critically?. *Journal of Language and Education*, *5*(2), 112-122. https://doi.org/10.17323/jle.2019.8486

Windarti, E., Budiwibowo, S., & Rifa'i, M. (2020). The application of quantum learning to improve self–learning motivation and learning outcomes of the 8th Grade Students of State Junior High School 2 Balerejo Madiun. *Social Sciences, Humanities and Education Journal*, *1*(1), 18–25. https://doi.org/10.25273/she.v1i1.5854

Wong, P. M., & Yunus, M. M. (2020). Enhancing writing vocabulary using Mentimeter. *International Journal of Learning, Teaching and Educational Research*, *19*(3), 106–122. https://doi.org/10.26803/ijlter.19.3.7

Zaccone, M. C., & Pedrini, M. (2019). The effects of intrinsic and extrinsic motivation on students learning effectiveness. Exploring the moderating role of gender. *International Journal of Educational Management*, 33(6), 1381-1394. https://doi.org/10.1108/IJEM-03-2019-0099

Zubaidah, S., Corebima, A. D., & Mistianah. (2015). Asesmen berpikir kritis terintegrasi tes essay. *Symbion: Symposium on Biology Education*, 200–213.

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