

Framing a personalized online tutorial instruction: Cognition and metacognition considerations

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Abstract: *Current research interest in technology-driven learning instructions is acknowledged to have a specific emphasis on personalized learning. Since the twenty-first century teaching and learning strategies have shifted from student-centered learning to student-directed learning in a culture where technology is widely used. The development of online tutorials is one of the initiatives that addresses pandemic crisis. This study focuses on the investigation of online tutorials in a post-pandemic context which contributes to online learning modulation concerning personalized instructional design in Malaysian elementary schools. This study investigates the instructional personalization through learners' cognition and metacognition practices when experiencing online tutorials, in order to discover learners' learning needs and preferences. 14 learners (aged 9) from a Malaysian elementary school were included in this study. An observational and interview-based qualitative case study was adopted. Thematic analysis was employed to generate codes, categories, and themes. As a result, a personalized online tutorial instruction was framed by including the features such as freedom in task and activity selection and planning on the basis of explicit instructional goals, complexity of information input and capacity of resources or materials for different learners' needs, suitability of task difficulty level for various learners, multiple intelligence consideration, and differentiated peer scaffolding and teacher feedback. This study draws attention to the significance of cognition and metacognition considerations to suggest online tutorial instruction that underpins personalization.*

Keywords: *Personalized learning, instructional design, online tutorials, elementary education*

1. INTRODUCTION

Our world has altered in every conceivable way and more due to technology, particularly computer-based technology. The number of classrooms utilizing digital technologies is increasing and it is projected to continue growing in the years to come. According to Mercer et al. (2019), using technology to support classroom teaching and learning (T&L) yields benefits that lead to the development of twenty-first century skills, pedagogies, and practices. In the context of Malaysia's educational technology policy, Malaysia aims to develop a community with technology literacy and critical thinking to fully engage in and contribute to the global economy of the twenty-first century. Josephine and Rajendran's (2019) study supports the assertion which contends that it is crucial for Malaysia's educational system to concentrate on teaching methods that place a certain amount of significance on using technology. According to recent researches that reported the use of technology in Malaysian schools, most Malaysian learners and instructors perceive the use of technology favorably (Arumugam et al., 2019; Idarwana Hasin & M. Khalid M. Nasir, 2021).

Technology now serves more purposes than just providing access to information, according to Zawacki-Richter and Latchem (2018), who further pointed out that technology is crucial for individualized and communicative learning as well. In fact, in a technologically advanced culture, the twenty-first century T&L approach has evolved from student-centered learning to student-directed learning (Fadli & Irwanto, 2020). The concept of student-directed learning is comparable to the notion of ownership since it gives individuals the freedom to make their own decisions regarding interests and preferences (Buchem et al., 2011). This situation highlights the significance of the personalized learning approach in the technological-enhanced learning context, which is supported by recent studies that showed personalizability of online learning increases learners' perceived sense of value and positive learning behavior (Ha & Im, 2020; Ingkavara et al., 2022). In brief, personalized online learning seeks to customize learning instruction according to learners' learning needs as well as to tailor learners' preferences that helps enhance their ability to monitor their own learning progress towards learning goals (Zhang et al., 2020).

According to the current functioning of technology in education, along with the pandemic crisis which has accelerated the transition from traditional classroom instruction to online learning, online tutorials have been developed due to the initiative to bridge the gap between physical and virtual learning. Consequently, online tutorials improve learners' digital competency by enabling them to independently discover knowledge and take part in digital communicative activities on digital learning platforms. However, instructors nowadays struggle with recognizing and handling learners' online learning demands, in which learners' preferences is an issue to consider serving personalized T&L. To elaborate further, we would say young learners significantly underperformed in directing their learning when interacting with online tutorials compared to adult learners because of their lack of maturity; in contrast, we could also say that the instructional design of online tutorials may not meet learners' maturity and learning demands which eventually retard learners' learning. Young learners were given greater attention during the "panicgogy" application throughout the epidemic because of their poor self-directed performance in that circumstance (Kanyakumari, 2020; Wan, 2020). Additionally, it was noted that young learners' online learning performance was undesirable even before the pandemic (Lee, 2019; Mohd Fadzly Wasriep & Lajium, 2019). Instead of blaming young learners' maturity as a trait that distinguishes children from adults, this study sought to scientifically examine young learners' learning preferences from cognition and metacognition aspects to frame online tutorial instruction with personalization considerations. This study contributes to the investigation of post-pandemic online learning modulation concerning personalized instructional design in Malaysian elementary school online learning, which is still understudied at present.

2. PURPOSE OF THE STUDY

The purpose of this study was to frame a personalized online tutorial instruction for Malaysian elementary teaching and learning by considering the cognition and metacognition practices of learners. The following research questions were addressed in this study:

1. What are the cognitive strategies applied by the elementary school learners when experiencing online tutorials?
2. What is the metacognitive awareness of the elementary school learners when experiencing online tutorials?

3. LITERATURE REVIEW

Personalized learning

According to Niknam and Thulasiraman (2020), a personalized learning approach that adapts instruction to fit learners' learning needs and preferences has long been a goal of the contemporary educational system. DeMonte (2019) defined personalized learning as a student-centered strategy that gives learners flexibility and ownership in order to master their own competence. Hughy (2020) stated that the core concepts of personalized learning should incorporate Ryan and Deci's (2000) Self-Determination Theory which was founded on the psychological demands of autonomy, competence and relatedness, and Gardner's (2011) Theory of Multiple Intelligences which advocates human beings' various ways of information or knowledge processing. In short, personalized learning employs a variety of student-centered environments and T&L methodologies to address different learners' unique characteristics. Personalized learning empowers learners to take charge of the decision-making and goal-setting processes which stimulates their intrinsic motivation for achievement.

In fact, the mediums and opportunities for serving the needs of learners have increased through the advent of technology. According to FitzGerald et al. (2018), personalization is a significant area of current research interest in technology-driven learning instructions because it is in demand due to the rich digital resources and technologies involving big data. A personalized learning approach gives learning support across different learners to overcome the drawbacks of one-size-fits-all approaches in technological-enhanced learning circumstances. Precisely, through online learning, each learner can be uniquely identified, content and teaching methods can be better adapted to each learner's individual learning style, and learners' progress can be easily monitored, assisted and evaluated (Bachari et al., 2011).

Online tutorials

Online learning empowers learners' self-learning skills, thinking skills, and communication skills. Apropos of this, online tutorials are a kind of web-based tutorials that optimize the online learning initiative. Digital tools, materials, and resources are frequently utilized in online tutorials. For instance, Google Classroom is a useful tool that encourages learners

to actively engage in knowledge discovery, problem solving, critical and creative thinking, and discussion (Izwan Nizal Mohd Shaharane et al., 2016); gamification materials drive learners' engagement and motivation with personalized instruction and constructive feedback based on evaluations or assessments (Welbers et al., 2019); wide-ranging resources and practical brainstorming tools enable remote collaboration (Panagiotis & Triantaphyllia, 2020); feedback-sharing between instructors and peers is facilitated by discussion forums designed for learners to engage in question-and-answer sessions (Fatia Fatimah et al., 2012); and so on. Consequently, online tutorials improve learners' digital competency by enabling them to independently locate material, take part in digital learning activities, discuss and exchange ideas with peers on digital learning platforms (Alkahtani, 2019).

Conceptual background: Cognitive and metacognitive

Dr. Benjamin Bloom, an educational psychologist, developed Bloom's Taxonomy in 1956 with the goal of fostering more advanced ways of thinking in learning. Originally, Bloom's Taxonomy consisted of six distinct levels: knowledge, understanding, application, analysis, synthesis, and evaluation. Then, Anderson and Krathwohl (2001) altered each level's terms and reversed the order of the top two levels in Bloom's Taxonomy. At all events, knowledge and cognitive processes are the focus of each level in both Bloom's Taxonomy versions. In the domain of cognition functions, learners are expected to remember and retrieve information, comprehend, select, interpret, manage and apply information, make critical comparisons, and generate ideas. Anderson and Krathwohl (2001) further conceptualized the cognitive levels with various knowledge domains, which brings up the concept of metacognition. To elaborate further, cognition functioning attributes metacognitive awareness in terms of declarative knowledge which refers to knowledge about oneself and knowing "what" influences one's performance in learning, procedural knowledge that focuses on "how" to solve a problem, and conditional knowledge that implies understanding "when" and "why" to put cognitive actions into practice (Schraw & Moshman, 1995).

To put it simply, metacognition is a process of thinking about thinking which involves regulatory practices that promote control over one's learning according to preferences. Metacognition was described by Paris

and Winograd (1990) in terms of self-management and self-evaluation of cognition. Self-management is a mental process that aids learners in planning by helping them allocate appropriate resources, identify useful strategies, make logical predictions, allocate pace and time, and so on (Miller, 1985). Self-evaluation is the process of self-monitoring and self-assessing that is informed by individual reflection on one's abilities, level of mastery, and affective states (Paris & Winograd, 1990). This study investigates learners' cognition and metacognition components that convey their learning needs or preferences during the online tutorial process. Eventually, this study frames a personalized online tutorial instruction in Malaysian elementary education on the basis of elementary learners' cognition and metacognition to assist education modulation in a post-pandemic context.

4. METHOD

Research design and setting

Along with implementing student-centred instruction in an instructional setting, the Malaysian educational system employs online tutorials to incorporate technology into traditional learning circumstances in the form of blended or flipped learning. This study focused on the personalised aspect within the context of elementary school learners' online tutorial learning experiences. A range of educational tools and resources which were available on the online learning platform, supported the online tutorials instruction. Simple to complex materials and resources were distributed in a sequential order to meet the demands of learners with varying levels of learning, and some of the items included a self-evaluation function that encouraged personalized self-discovery initiatives. The online learning setting enabled learners to take accountability for their own learning actions to accomplish the learning goals.

This study sought to discover elementary learners' cognition and metacognition through their engagement in online tutorials. Therefore, a method that enables experiences discovery was required for this investigation. Merriam's (2009) qualitative case study methodology was adopted since it is an appealing research design for education to gain a comprehensive and in-depth description of an experience.

Participants

A school which is undergoing the School Transformation Programme 2025 (TS25) with assistance from the Malaysian Collective Impact Initiative (MCII) for twenty-first century and active learning training was specifically chosen. 14 age 9 learners (Year 3) were chosen to participate in this study, with performance levels ranging from 3 to 5 (with a maximum performance level of 6). Only learners who scored in the middle of the performance level range were chosen because they represented the average learner population; learners who scored above 5 may lower the credibility of generalising the study’s findings, while learners who scored below 3 may be experiencing difficulties in learning. In order to promote generalizability, the distribution of male and female learners was balanced, as shown by the demographic data for participants in Table 1. The considered inclusion criteria were: (1) learners who participated in a school-initiated twenty-first century and active learning training programme; (2) learners who experienced educational changes; and (3) learners who showed an interest in participating. These participants were expected to inevitably provide this study with rich data. The required number of participants depended on when saturation was attained.

Participants	P01	P02	P03	P04	P05	P06	P07	P08	P09	P10	P11	P12	P13	P14
Age	9	9	9	9	9	9	9	9	9	9	9	9	9	9
Gender (F/M)	F	F	M	F	M	M	M	M	F	M	M	F	F	F
Performance level	3	3	3	3	3	4	4	4	4	4	5	5	5	5

Table 1: Transformation ODL for studio-based architectural design courses.

Data collection

Merriam (1998) provided thorough guidelines for the data gathering process for qualitative case studies by emphasizing the importance of undertaking attentive observation, efficient interviews, and detail document mining. To gather data, this study employed observation and semi-structured interviews. Instead of using a checklist or formatting, the observation protocol in this study applied “free writing” to record any significant events that were likely to provide information for the research questions over the course of the three-month investigation, including participants’ actions and reactions,

verbal and nonverbal expressions, interactions, and context-related factors. The researcher recorded as much information as they could without being constrained by a set period of time until information saturation was reached (Merriam, 2009). The researcher told the participants that there would be observations made during the study but did not tell them when or how long it would take. This was done to eliminate any sensitivities that might have emerged from being observed.

After the observations, semi-structured interviews were carried out to cross-check the information gathered from subjective aspects. If additional information was needed, follow-up questions were posed to the participants. The duration of the interviews was ranged from 45 to 60 minutes depending on the semi-structured interview questions, time-paced, and syllabus. The interviews were performed in the participants' mother tongue. Interviews were recorded with the consent of participants in order to be transcribed and analyzed subsequently. Overall, the interview process followed Merriam's (1998) case study interview protocol, which calls for asking insightful questions, creating an interview guide, using probes, and effectively interacting with the respondents. The validity of the interview data was verified via respondent validation. Participants were given a copy of the study reports' final draughts and asked to confirm their accuracy and offer any necessary additional comments.

Data analysis

The codes, categories, and themes were all interpreted using a thematic analysis to assure interpretive validity and triangulation. Initial coding was carried out concurrently with ongoing reflection, with an emphasis on ensuring the data could address the research questions. In order to clearly illustrate the connections between each code, this study applied the code mapping technique (Saldana, 2015) to generalize code patterns and categories. Consequently, the most prevalent or significant codes that produce the most crucial categories were shown. Central themes were identified by carefully analyzing the significance of units within the holistic context. After analyzing the themes, the researcher came up with a broad summary of the case. Eventually, the researcher developed a qualitative narrative by interpreting the significance of the data and describing advanced themes.

Results and Discussion

This section discusses the applied cognitive strategies and metacognitive awareness of elementary school learners when experiencing online tutorials. The discussion looks into the correlation between cognition and metacognition features which play crucial roles to reveal learners' learning needs and preferences in the online learning context and suggests features that frame effective personalized online tutorial instruction.

Initial approach to online tutorial instruction: Instruction, task, and activity management In the most basic sense, cognitive strategies refer to the application of the thought process to a problem-solving or task-accomplishing activity. Learning goals and instruction are critical guidelines that adequately explain topics and procedures so that learners can engage in learning at their own pace and orientation. Learners' subsequent learning and methods of knowledge acquisition are consciously facilitated by explicit and orderly instruction (Zhu et al., 2019). Therefore, learners normally conduct their learning to "perfectly" align with the requirement of the instruction and learn "sequentially" by following the tasks or materials that are organized in an orderly manner. As highlighted in Mohd Fadzy Wasriep and Lajium's (2019) study, Malaysian elementary school learners hold beliefs about "following the rules" and "reaching goals". Learners performed high preferences in accomplishing instructional-oriented and goal-oriented tasks or activities as they were motivated by purpose and results. Furthermore, this situation meets Piaget's (1950) cognitive theory as well, in which young learners have a basic mental structure that all learning and knowledge acquisition methods are based.

However, differentiation occurs when it comes to learners' tasks and activities rearrangement and selection based on the given instructions. For instance, learners with cognition fixation tendency preferred to learn in a conventional way:

I usually follow instructions and begin my learning with the first one. If I do number two, proceed on to number three, and then return to number one, it is confusing. (P06/Interview/219)

As a matter of fact, learning goals help to increase learners' desire for ownership (Froiland, 2021). Learners who were more adept in managing and controlling their learning orientation reorganized their learning in a way that was thought to increase their chances of achieving their learning goals, for example:

Since completing the main task is an essential requirement for accomplishing the lesson's objective, I will start over there. Then, I move on to other additional works for that lesson. (P07/Interview/251-255)

This situation is similar to Rogers et al.'s (2021) "best-worst scaling" decision-making procedure, in which learners made decisions about which tasks or activities would ensure them to achieve learning goals through assessing the merit of those tasks and activities.

Meanwhile, learners took full responsibility for their learning pace and time as if "I spend shorter time and learn at faster pace for some works, but sometimes I need more time to think about certain works, so, I spend longer time and learn at slower pace" (P11/Interview 02/34-35). Regarding this matter, from the learners' self-management perspective, learners allocated pace and time in accordance with the difficulty of normative items (Hoffman-Biencourt et al., 2010; Tullis & Benjamin, 2011). By considering learners' focus time of learning, the appropriateness of self-management can easily impact learners' mental development, emotional outcome, and confidence to complete tasks (Zakharova et al., 2020). Therefore, learners prefer online tutorials that allow flexible planning, for instance, "if there are ten resources provided, you can start by referring to five of them before moving on to the remaining five... Do not rush and take your time studying" (P05/Interview 01/377-381).

Figure 1 shows a summary of how learners' cognitive strategies and metacognitive awareness interrelation were applied throughout the online tutorial encounters during instruction, task, and activity management, which eventually frames the personalized considerations in the context.

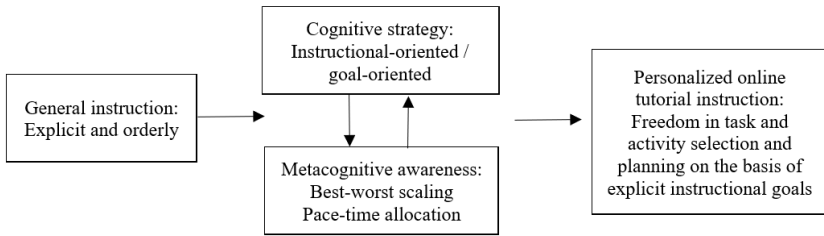


Figure 1. Cognitive strategies and metacognitive awareness during instruction, task, and activity management

In the course of learning: Learning from materials and tasks or activities accomplishment

According to Sariyatun et al. (2021), digital learning tools are effective at enhancing learners' knowledge exploration because digital materials are easier to access and typically offer rich content and resources. This study discovered that elementary learners have more interest to learn with songs, videos, and quizzes, which Lauc et al. (2020) highlighted, are digital learning resources which help stimulate young learners' preferences for learning through visual, aural, and kinesthetic domains. However, some learners were unable to fully comprehend the information presented in the materials or resources.; they expressed, "I thought the answer is correct, I write it down...but sometimes it is wrong" (P06/Interview/298) and "it is too difficult, I can't even find any answer from the textbook ... I give up" (P01/Interview/410-412). Learners who faced similar problems were those with average performance level or those with lower self-learning capabilities. The situation became worse when a significant number of materials were provided to be referred. In contrast, high learning capability learners performed well in the context with systematic planning and desirable outcomes, for example:

I learn by myself...I do the tasks, quizzes, and learn from the materials by myself. Most of the projects are being done by me...I feel that I have improved...I have learnt many things. (P09/Interview/436-440)

I think my learning management is very good because I learn accordingly to the materials. The materials are suitable for me, and I think my planning is very good. (P08/Interview/481-486)

Hence, personalized online learning inevitably requires consideration towards complexity of information input and capacity of the resources or materials.

Undeniably, the difficulty level of tasks and activities influences learners' learning achievement and motivation (Marita et al., 2019; Westlin et al., 2019). In this study, learners' responses towards tasks and activities vary depending on the level of difficulty. Based on Tomlinson and Kalbfleisch's (1998) study, appropriate challenge of tasks can pique learners' learning interest and motivation to engage in critical thinking and acquire new knowledge. One of the participants expressed that, "I hope the teacher will assign us more difficult tasks so that I can take on new challenges" (P14/Interview/400). Evidently, highly capable learners are compelled to accomplish challenging tasks, mirroring Bruner's (1961, pp. 2-4) assertion that "enjoyment is obtained from being able to overcome the obstacles". Contrarily, challenging tasks might retard certain learners' learning effort due to a mismatch between learners' ability and tasks difficulty (Center et al., 1982). Consider the following situation:

I don't like something that is too difficult for me...I don't know how to do it and I don't have the confident to do it as well. So, I gave up. (P01/Interview/569-577)

Although the self-evaluation procedure gives learners a basic understanding of their learning capacity, young learners still found it challenging to anticipate their strengths and shortcomings accurately, which is consistent with Keane and Griffin's (2018) study. Consider the following situation:

I thought I can learn something tougher. However, when I confront with a difficult task, I feel compelled to return to something simpler...I am not sure what am I looking for. (P13/Interview/577-583)

Power (2019) argued that it would be preferable to set the task difficulty at an average level—not too easy nor too difficult—in order to take learners' different personal learning needs into account.

Furthermore, different personal demands of different learners lead to different learning behaviors and learning styles, which can be related to Gardner's (2011) Theory of Multiple Intelligences. For example, linguistic intelligence learners expressed that:

I feel more confidence to learn from texts compared to pictures...because texts make it easier for me to recall the knowledge. I enjoy learning through text. (P03/Interview/174-181)

Visual-spatial intelligence learners expressed that:

Drawings are more instructive to me than reading from texts. I can name every part of the house according to the drawings. (P08/Interview/81-86)

Intrapersonal intelligence learners expressed that:

I learn more effectively when I am learning alone... I enjoy learning on my own... I don't feel the urge to discuss with anyone because I feel more at ease learning alone. (P05/Interview/24-30)

In relation to learners' learning differentiation in terms of multiple intelligence and personal learning preferences, consideration of learners' personalities peculiarities in online learning is crucial on par with conventional learning. Failure to satisfy learners' intelligence preferences invariably had a negative influence on their learning. One of the intrapersonal intelligence learners stated that, "I can't keep up when joining the peer discussions... If I study by myself using the materials, I can learn effectively" (P05/Interview 02/24-30). Figure 2 shows a summary of how learners' cognitive strategies and metacognitive awareness interrelation were applied throughout the online tutorial encounters when acquiring input from materials or resources and accomplishing tasks and activities with the knowledge gained, which eventually frames the personalized considerations in the context.

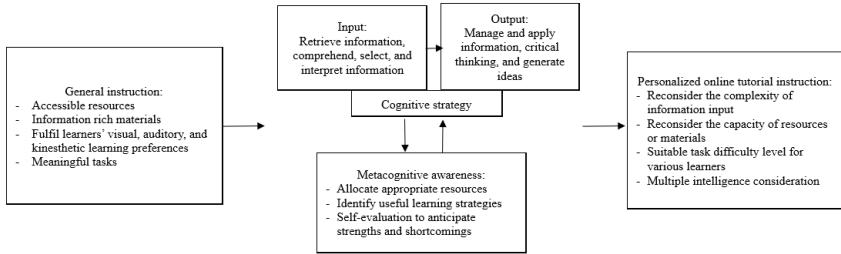


Figure 2. Cognitive strategies and metacognitive awareness during knowledge acquisition and application

Additional support for cognition and metacognition functioning

Based on the previous discussion of learners' cognitive strategies and metacognitive awareness, learners occasionally require additional support for cognition and metacognition practices due to personality and capability variations among learners. On the cognition aspect, we previously indicated that some learners, especially those with lower learning capability, found it challenging to accomplish their learning or had trouble properly acquiring and comprehending knowledge input. One of the participants expressed the need for support for his cognition practice:

When I don't know how to read, I call one of my friends to teach me to read. I read after him and I know how to read at last... Sometimes, I ask my friends to solve two questions and show me the way. Then, I know how to do it. (P05/Interview 01/226-238)

Although the higher learning capability learners were expected to perform effective cognition functioning, they occasionally required assistance as well. For instance:

Sometimes, I will learn with my friends. It is because I feel a little bit confused, or the work is too difficult for me to comprehend. However, if I learn alone, that means I know how to solve it by myself. (P11/Interview 02/48-50)

Applebee (1986) and Wood et al. (1976) argued that young learners might not have attempted to solve problems on their own without adult scaffolding; however, the participants in this study showed a preference for peer scaffolding, which is consistent with Piaget's and Vygotsky's theories on social cognitive development (Tudge, 1993; Tudge & Winterhoff, 1993). To correspond to personalized instruction, scaffolding in the context of online learning should be applied in phases and in varied amount depending on the learners' competencies.

On the metacognition aspect, one's self-evaluation may lead to an increase in self-esteem or lead to negative self-judgement. Learners with high self-esteem are fully reinforced by their intrinsic motivation. Nonetheless, when their self-esteem is decreasing, learners are more likely to seek support from external stimuli such as feedbacks, rewards, or praises. By considering learners' differences, high learning capability learners seek support in terms of their capability affirmation. For example:

I don't feel accomplished even though I am capable to complete my work nicely... I am not expecting too much from teacher... but I feel a little bit sad, a little bit angry, and not proud...when teacher doesn't give me anything or teacher doesn't say anything. (P11/Interview 01/358-375)

Whereas lower learning capability learners seek support from external stimuli to retain their self-esteem and learning motivation from negative self-judgement resulting from self-evaluation. For instance:

I am aware that my learning performance is not as good as others...but I just want a few feedback from teachers. I don't want much, just a little bit...I will learn a little bit more if teacher praises me. (P01/Interview/485-490)
To correspond to personalized instruction, feedback differentiation should be used in response to each learner's unique needs in order to support positive metacognitive development (Newman, 2015).

5. CONCLUSION

When online learning deliberates to develop educational experiences according to the needs, preferences, and differentiation of the learners, personalized instruction occurs. This study investigated elementary school learners' online tutorial experiences from their cognition and metacognition practices in order to frame a personalized online tutorial instruction. This study proposes features that frame effective personalized online tutorial instruction that mainly considers freedom in task and activity selection and planning on the basis of explicit instructional goals. In the course of learning, personalized instruction must consider the complexity of information input and capacity of resources or materials for different learners' needs, suitability of task difficulty level for various learners, and multiple intelligence consideration. In addition to personalization consideration, learners' cognition variation can be supported by different phases or amount of peer scaffolding; whereas learners' metacognition functioning can be assisted by differentiated feedback. This study contributes to Malaysian elementary school post-pandemic online learning modulation considering personalized instructional design in the field of online learning, particularly online tutorials. Future studies should be conducted to empirically verify the personalized features framed by this study. Longitudinal studies that enable personalized online tutorial instruction research in post-pandemic contexts over a longer time span are required. It would be useful to consider other socio-demographic factors such as learning context, learners' age, school type, and so on.

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