Understanding Latent Variables in EFL Contexts

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Abstract
Understanding latent variables is essential in EFL research. This article examines key latent variables, such as linguistic competence, cognitive ability and socio-cultural factors. These variables play a crucial role in shaping EFL learning experiences and outcomes. Researchers can use methods such as exploratory factor analysis (EFA), confirmatory factor analysis (CFA) and structural equation modeling (SEM) to uncover these variables. By combining theoretical findings with advanced statistical methods, such research provides an understanding of the complex processes involved in language learning. The article points to the need for longitudinal studies and mixed methods to capture the dynamic nature of EFL learning. This approach could contribute to the development of more effective educational strategies that improve teaching practices and learner outcomes. The article also emphasizes the importance of considering the sociocultural context and developing culturally sensitive teaching methods to create an inclusive learning environment. Moreover, this article serves as a guide for future research and practice in language learning.
Keywords: Latent Variables, EFL Research, Exploratory Factor Analysis (EFA), Confirmatory Factors, Structural Equation Modeling (SEM)

Introduction

Latent variables, which are often not directly observed but derived from other measurable variables, play a crucial role in educational research, especially in English as a foreign language (EFL) (Bae & Bachman, 1998). These variables, which encompass a wide range of constructs from linguistic competencies to sociocultural factors, provide deeper insights into learners' experiences and abilities that are not immediately visible. Understanding latent variables helps educators and researchers to develop more effective teaching strategies and assessment tools (Cai & Hansen, 2017).

In EFL studies, latent variables such as motivation, anxiety and competence are of central importance in understanding student learning and achievement (Niemivirta et al., 2019). Gardner (1985) emphasized the importance of motivation in second language acquisition. Similarly, Horwitz et al. (1986) emphasized the significant impact of anxiety on language learning. The identification and measurement of latent variables requires suitable methodological approaches. Exploratory factor analysis (EFA) is commonly employed to uncover the structure of a set of variables. According to Hair et al. (2018), EFA would be necessary in the early phases of research when the purpose is to identify potential latent constructs. In contrast,confirmatory factor analysis (CFA) allows researchers to test hypotheses about the structure of these constructs. Brown (2015) states that CFA provides a way to validate the factor structure identified by EFA. Meanwhile, structural equation modeling (SEM) is another advanced technique used in EFL research to examine the relationships between latent variables. Kline (2023) describes SEM as a comprehensive approach combining both multiple regression analysis and factor analysis, allowing researchers to investigate complex causal relationships. This method has been used extensively

to investigate the interplay between different latent variables in language learning contexts.

To develop a thorough understanding of latent variables in EFL studies, it is important to systematically review the existing literature. This literature review examines various studies in which latent variables in EFL contexts have been identified and measured (Cong & Li, 2022; Li et al., 2023; Zhu & Zhou, 2022). By synthesizing these studies, this review aims to provide an overview of the types of latent variables among EFL studies, identify gaps in current research and suggest new areas for exploration.

Types of Latent Variables in EFL Studies

Linguistic Competence

Linguistic competence is a fundamental aspect of language learning and a key latent variable in EFL studies. This competence includes knowledge of vocabulary, grammar and phonology, which are essential for effective communication (Vorwerg, 2015). Understanding linguistic competence helps educators to better tailor lessons to learners' needs. Knowledge of vocabulary is a critical component of linguistic competence. According to Nation (2001), vocabulary is the foundation of language proficiency as it enables learners to understand and produce language. Research by Schmitt and Schmitt (2020) has shown that the extent and depth of vocabulary are significant predictors of language performance. Therefore, the measurement of vocabulary knowledge is crucial for the assessment of language competence.

Moreover, grammatical knowledge is another important element. Ellis (2006) emphasized the importance of grammar in constructing meaningful sentences and ensuring correct communication. He stated that grammatical competence involves understanding the rules and patterns that govern language use. Larsen-Freeman (2014) has emphasized the role of explicit grammar instruction in improving learners' grammatical knowledge. Also, phonological awareness is also essential for linguistic competence. It refers to the ability to recognize and manipulate sounds in a language. Research by Yule (2010) has shown that phonological awareness is linked to better pronunciation and listening comprehension. This awareness helps learners to differentiate between similar sounds and improves their overall understanding of language.

Affective Factors

Affective factors are crucial latent variables in EFL studies that significantly influence learners' motivation, anxiety and attitudes towards learning English. Although these factors are not directly observable, they play a crucial role in language learning success (Heidari-Shahreza, 2014). Understanding and measuring affective factors can help educators develop strategies to support learners emotionally and psychologically.

Motivation is one of the most extensively studied affective factors in EFL research. Gardner (1985) noted that motivated learners are more willing to invest time and effort in learning. Dörnyei and Ushioda (2021) expanded on this by introducing the L2 motivational-self system. These concepts help to explain why learners are motivated to study English and how their self-perceptions influence their motivation. Additionally, anxiety is another important affective factor. Horwitz et al. (1986) created the Foreign Language Classroom Anxiety Scale to measure language anxiety. MacIntyre and Gardner (1994) investigated this relationship further and showed that high levels of anxiety can hinder language acquisition and performance. Reducing anxiety in the classroom can therefore improve language learning outcomes.

Attitudes towards learning English also have a significant impact on learners' success. Ajzen (1991) proposed the Theory of Planned Behavior, which includes attitudes as a key component in influencing behavior. In the EFL context, a positive attitude towards English can lead to greater effort and persistence in learning. Gardner and Lambert (1972) have shown that a positive attitude towards the target language and culture correlates positively with language proficiency.

Cognitive Abilities

Cognitive abilities are important latent variables in EFL studies that include abilities and mental processes such as working memory, critical thinking, and metacognitive strategies. These cognitive factors have a significant impact on how learners process,

retain and use language information (Motallebzadeh & Yazdi, 2016). Understanding these cognitive abilities can help educators develop more productive teaching methods and learning materials.

Working memory is a crucial cognitive ability in language learning. Baddeley (1992) defined working memory as the system responsible for the processing and temporary storage of information. In EFL contexts, the working memory plays a key role in tasks such as listening comprehension and language production (Namaziandost et al., 2018). Research by Gathercole and Alloway (2008) has shown that individuals with a stronger working memory tend to perform better in language learning.

Critical thinking is another important cognitive skill. In EFL contexts, critical thinking helps learners to better understand and analyze the structures and uses of language. Ennis (1993) has emphasized the need to promote critical thinking skills in order to improve language learning outcomes.

Metacognitive strategies relate to one's control of one's own learning processes and awareness. Flavell (1979) introduced the concept of metacognition and emphasized its role in effective learning. In EFL research, Wenden (1991) identified metacognitive strategies such as planning, monitoring and evaluation as essential for successful language acquisition. Learners who use these strategies are better able to control their learning and overcome difficulties.

Socio-Cultural Factors

Socio-cultural factors are crucial latent variables in EFL studies that encompass the social and cultural influences on language learning. These factors include intercultural competence, social identity and the learning environment, all of which have a significant impact on learners' attitudes and abilities (Alsamani, 2014). Understanding sociocultural factors helps educators to develop more inclusive and effective language teaching practices.

Byram (2021) defined intercultural competence as the ability to understand, respect and deal with cultural differences. In EFL contexts, developing intercultural competence is essential for learners who want to use English in a global environment. Deardorff (2006) emphasized that intercultural competence encompasses attitudes, knowledge and skills that enable individuals to engage in meaningful intercultural interactions.

Apart from intercultural competence, social identity is another important sociocultural factor. Tajfel (1981) described social identity as a person's sense of who they are from their group membership. In EFL contexts, learners' social identities can influence their motivation and attitudes towards learning English. Norton (2000) emphasized that language learners often negotiate their identities through their interactions, which can affect their language learning experiences and outcomes.

The learning environment also plays a critical role in socio-cultural factors. Vygotsky (1978) suggested that social interaction and cultural context are fundamental to cognitive development. Lantolf and Thorne (2006) extended Vygotsky's ideas to underline the importance of the social and cultural context in language learning. In EFL settings, the learning environment, including classroom dynamics, teacher-student relationships, and peer interactions, can significantly influence language acquisition (Tu, 2021).

Methods for Identifying Latent Variables

Exploratory Factor Analysis (EFA)

Exploratory factor analysis (EFA) is a widely used approach for identifying latent variables in educational research, including EFL studies. EFA helps researchers uncover the underlying structure of a range of observed variables, making it an indispensable tool for researching complex constructs such as language competence, affective factors, cognitive abilities, and sociocultural influences. According to Hair et al. (2018), EFA allows researchers to investigate how observed variables cluster to form distinct factors that represent the latent constructs. This method is critical for understanding the dimensions of different constructs in EFL studies.

The process of EFA involves several steps. First, researchers collect data using questionnaires or tests that measure various observed variables related to the construct of interest. Tabachnick and Fidell (2019) emphasize the importance of having a large enough sample to obtain reliable results. A general recommendation is to have at least 5 to 10

respondents per observed variable. Next, researchers should assess the suitability of their data for factor analysis. Kaiser (1974) introduced the Kaiser-Meyer-Olkin (KMO) measure, which assesses sampling adequacy, while Bartlett's test for sphericity can be used to test the hypothesis that the correlation matrix is an identity matrix (Bartlett, 1950). Both tests should provide favorable results to proceed with the EFA.

After the confirmed suitability of the data, researchers need to extract the factors using methods such as principal component analysis (PCA) or maximum likelihood estimation. Stevens (2009) found that these methods help to determine the initial factor structure by analyzing the correlations between the observed variables. The number of factors to be retained can be determined using criteria such as eigenvalues greater than one on the scree plot. After factor extraction, the factors are rotated to obtain a simpler and more interpretable structure. Varimax rotation, a common orthogonal rotation method, maximizes the variance of the squared loadings of each factor and then facilitates the interpretation of the factors. This emphasizes the importance of rotation to make the factor structure clearer and more meaningful.

Finally, researchers interpret the factors based on the factor loadings indicating the strength of the relationship between the observed variables and their corresponding factors. Comrey and Lee (1992) have established guidelines for the interpretation of factor loadings and recommend that item loadings of at least 0.32 and above be considered significant.

Therefore, exploratory factor analysis (EFA) is a powerful method for identifying latent variables in EFL studies. By applying a systematic process and using instruments such as KMO and Bartlett's test, researchers can uncover the underlying structure of complex constructs. This understanding is crucial for the development of reliable and valid measurement instruments, which ultimately improves the quality of educational research.

Confirmatory Factor Analysis (CFA)

Confirmatory factor analysis (CFA) is a powerful statistical method which can be used to test hypotheses about the structure of latent variables. In contrast to exploratory factor analysis (EFA), which attempts to uncover potential latent variables without prior assumptions, CFA is used to confirm whether a hypothesized factor structure fits the observed data. This makes CFA particularly valuable in the later stages of research, when researchers have a clear theoretical model based on previous studies.

CFA involves several important steps. First, researchers develop a measurement model based on theoretical and empirical foundations. This model specifies the number of factors and the relationships between the observed variables and their corresponding latent variables. Byrne (2016) emphasized the importance of grounding the model in theory to ensure its validity. Next, researchers collect data using instruments designed to measure the observed variables. These instruments must be reliable and valid because the accuracy of the CFA results depends on the quality of the data. Brown (2015) stated that careful development and validation of measurement instruments is crucial to successful CFA.

Once the data is collected, researchers use software such as AMOS, LISREL or Mplus to perform the analysis. The software estimates the parameters of the model, including factor loadings, error variances, and correlations between factors. Kline (2023) explained that these parameters indicate how well the observed data fit the hypothesized model. To assess model fit, researchers use several fit indices. The chi-square test is a basic measure, but it is sensitive to sample size. Therefore, additional fit indices are usually used, such as the Comparative Fit Index (CFI), the Tucker-Lewis Index (TLI) and the Root Mean Square Error of Approximation (RMSEA). Hu and Bentler (1999) recommend using a combination of these indices to comprehensively evaluate model fit. In general, CFI and TLI values above 0.90 and RMSEA values below 0.08 indicate a good fit.

However, if the original model does not fit well, researchers can modify it based on theoretical justifications and change the indices provided by the software. MacCallum and Austin (2000) cautioned against making changes based solely on statistical results, as this can lead to over fitting and reduce the generaliz ability of the model. Once a satisfactory model fit is achieved, researchers interpret the factor

loadings to understand the relationships among the observed variables and their respective latent variables. Stevens (2009) suggested that loadings above 0.50 are considered strong, meaning that the observed variables are good indicators of the latent construct.

Therefore, confirmatory factor analysis (CFA) is an important method for testing the validity of hypothesized factor structures in EFL studies. By using a theoretically grounded measurement model, collecting high-quality data, and employing robust statistical procedures, researchers can confirm the structure of latent variables in order to improve the reliability and validity of their findings. This rigorous approach helps to improve our understanding of complex constructs in language learning and increase the effectiveness of educational interventions.

Structural Equation Modeling (SEM)

Structural equation modeling (SEM) is a statistical technique combining factor analysis and multiple regression to analyze the structural relationships between latent variables. SEM is particularly valuable for EFL studies because it allows researchers to test complex models that include both direct and indirect relationships between variables. This comprehensive approach provides a deeper understanding of how different factors influence language learning outcomes.

The first step in SEM is to develop a theoretical model based on existing research and theory. This model specifies the relationships between the observed variables and the latent constructs, as well as the hypothesized pathways between these constructs. Kline (2023) emphasized the importance of basing the model on a solid theoretical foundation to ensure its relevance and accuracy. When the theoretical model has been established, researchers collect data using validated instruments. These instruments should reliably measure the observed variables that represent the latent constructs. Byrne (2016) stated that the quality of data is crucial to the accuracy of SEM analysis and emphasized the need for reliable and valid measurement instruments.

After data collection, researchers use software such as AMOS, LISREL or Mplus to estimate the parameters of the model. This includes the calculation of factor loadings, path coefficients and error variances. These parameters can be used to determine how well the observed data match the hypothesized model. Brown (2015) explained that SEM provides detailed information about both the measurement model (relationships between observed variables and latent constructs) and the structural model (relationships between latent constructs). To assess the fit of the model, the researchers use different fit indices. The chi-square test is often used but can be sensitive with large sample sizes. Therefore, additional indices such as the Comparative Fit Index (CFI), the Tucker-Lewis Index (TLI) and the Root Mean Square Error of Approximation (RMSEA) are often used. Hu and Bentler (1999) recommend using a combination of these indices to obtain a comprehensive assessment of model fit. In general, CFI and TLI values above 0.90 and RMSEA values below 0.08 are indicative of a good fit.

If the model does not fit well initially, researchers can make changes based on theoretical justifications and modification indices provided by the software. However, MacCallum and Austin (2000) cautioned against fitting the model too closely to the data, as this can affect its generaliz ability. Once a satisfactory model fit is achieved, researchers interpret the path coefficients to understand the relationships between latent constructs. Stevens (2009) argued that significant path coefficients indicate meaningful relationships that shed light on how different factors interact to influence language learning.

Hence, structural equation modeling (SEM) is a powerful method for identifying and analyzing latent variables in EFL studies. By combining factor analysis and regression, SEM allows researchers to test complex theoretical models and understand the intricate relationships between different factors. This method provides a comprehensive approach to the study of language acquisition processes and ultimately contributes to the improvement of educational practices and outcomes.

Reflections on Investigations of Latent Variables in EFL Research

The study of latent variables in EFL research requires careful consideration of several important methodological aspects to ensure reliable results. Latent variables, which are not directly observable

but are derived from other variables, provide deep insights into the complexity of language learning and teaching.

First, it is important to develop a clear theoretical framework. According to Byrne (2016), a solid theoretical foundation is the basis for identifying and measuring latent variables. This includes a review of the existing literature to understand how constructs such as motivation (Gardner, 1985), anxiety (Horwitz et al., 1986), and cognitive ability (Baddeley, 1992) have been previously conceptualized and measured. Secondly, the selection of appropriate measurement instruments is crucial. Instruments should be validated and reliable to ensure that they accurately capture the latent constructs.

Thirdly, data collection should be carried out carefully. Large samples are often required to ensure the stability of the results. Hair et al. (2018) recommend having at least 5 to 20 respondents per observed variable for exploratory factor analysis (EFA) to be effective. Fourth, the use of robust statistical procedures is crucial. EFA helps to identify the underlying structure of the latent variable, while confirmatory factor analysis (CFA) tests the validity of the hypothesized structure (Kline, 2023). Structural equation modeling (SEM) further examines the relationships between latent variables and provides a comprehensive analysis of their interactions (Byrne, 2016).

Finally, ethical considerations should not be overlooked. Researchers should ensure confidentiality and informed consent and maintain the integrity of the research process. Creswell (2014) emphasizes the importance of ethical practices in research that ensure the protection and respect of participants.

Thus, the study of latent variables in EFL research requires a systematic approach that includes a strong theoretical framework, validated instruments, careful data collection, robust statistical procedures, and ethical considerations. These steps, drawing on the work of renowned scholars, provide a solid foundation for exploring the hidden dimensions of language learning and teaching.

Suggestions for New Ideas Based on Related Studies

Proposing new ideas based on related studies means synthesizing existing research to identify gaps and opportunities for further investigation. This process is essential for the advancement of knowledge in EFL research and the development of innovative approaches to language learning and teaching. By critically analyzing the results of previous studies, researchers can propose new hypotheses, methods and areas of investigation that build on existing knowledge.

The first step in proposing new ideas is to conduct a thorough literature review. Hart (2018) emphasizes the importance of reviewing a wide range of studies to gain a comprehensive understanding of the current state of research. This includes identifying key themes, methods and findings in the literature. For example, a review of studies on latent variables in EFL research could reveal recurring themes related to linguistic competence, affective factors, cognitive abilities and socio-cultural influences.

After completing the literature review, researchers should identify gaps or inconsistencies in the existing research. These gaps may indicate areas where further research is needed. In identifying gaps, Mertens (2014) suggests looking for unanswered questions, methodological limitations, or contradictory findings in the literature. For example, while many studies have examined the effects of motivation on language learning (Dörnyei & Ushioda, 2021; Gardner, 1985), there may be little research on how motivation interacts with other affective factors such as anxiety (Horwitz et al., 1986). After identifying gaps, researchers can propose new research questions or hypotheses. These questions should address the identified gaps and contribute to a deeper understanding of the topic. Creswell (2014) recommends that new research questions should be specific, measurable and feasible. For example, a new research question could examine how different types of motivation (intrinsic vs. extrinsic) interact with language anxiety to influence language proficiency.

In addition to proposing new research questions, researchers should also suggest innovative methods. This may include combining qualitative and quantitative approaches, using advanced statistical

techniques, or applying new methods for data collection. Tashakkori and Teddlie (2010) highlight the benefits of mixed methods research, which can provide a more comprehensive understanding of complex phenomena. For example, a mixed methods study could use both surveys and interviews to investigate the interplay between cognitive abilities and language learning strategies.

Finally, researchers should discuss the potential implications of the ideas they propose. This includes considering how the new research might contribute to theory, practice and policy. Maxwell (2013) emphasizes the importance of discussing the practical applications of research findings. For example, new insights into socio-cultural factors that influence language learning could inform the development of more culturally sensitive teaching methods.

In summary, proposing new ideas based on related studies is a critical step in moving EFL research forward. By conducting a thorough literature review, identifying gaps, proposing new research questions, suggesting innovative methods and discussing potential implications, researchers can develop the continuous advancement of knowledge and practice in the field. This approach ensures that new research builds on established foundations and addresses the most pressing issues in language education.

Recommendations in EFL Research Contexts

To advance the field of EFL research, specific recommendations can help guide future studies in different contexts. These recommendations are based on the insights gained from examining latent variables such as language competence, affective factors, cognitive abilities and socio-cultural influences.

First, researchers should prioritize the development and validation of comprehensive measurement instruments. Nation (2001) and Schmitt and Schmitt (2020) emphasize the importance of accurate vocabulary assessment instruments, while Ellis (2006) and Larsen-Freeman (2014) highlight the need for grammar assessment methods. The use of reliable and validated instruments ensures that the data collected is both accurate and meaningful. Secondly, the inclusion of mixed methods can lead to a more nuanced understanding of EFL phenomena. Tashakkori and Teddlie (2010) argue for combining quantitative and qualitative approaches to capture the complexity of language learning. For example, interviews along with observations can complement the survey data and provide a deeper insight into learners' experiences and attitudes.

Thirdly, longitudinal studies are essential for understanding the development of latent variables over time. Dörnyei and Ushioda (2021) and Gardner (1985) point out that motivation and anxiety can fluctuate, affecting language learning outcomes. Longitudinal research can track these changes and provide valuable information on how to maintain learners' motivation and reduce their anxiety. Fourth, exploring the interplay between different latent variables can lead to more comprehensive models of language learning. Kline (2023) recommends the use of structural equation modeling (SEM) to investigate how factors such as cognitive ability (Baddeley, 1992) and sociocultural influences (Byram, 2021; Norton, 2000) interact to affect language acquisition. Fifth, ethical considerations must be included in research design. Creswell (2014) emphasizes the importance of maintaining participant confidentiality and obtaining informed consent form. Ethical research practices protect the rights of participants.

Therefore, future EFL research should focus on developing validated measurement instruments, using mixed methods, conducting longitudinal studies, examining interactions between latent variables, and adhering to ethical standards. If these recommendations are followed, researchers can contribute to a more accurate understanding of language learning and ultimately improve educational practices and outcomes.

Proposing Promising Methodologies

In the evolving field of EFL research, it is crucial to innovate and improve existing methods to better understand latent variables. This section proposes new potential methods that build on current practices to provide deeper and more accurate insights.

Integrated Mixed-methods Approach

In traditional mixed-methods research, data collection and analysis of quantitative and qualitative research are often separated. However, Creswell (2014) and Tashakkori and Teddlie (2010) point to

the potential for a more seamless integration of these methods. This approach suggests coding qualitative data from interviews and focus groups to quantify themes that can then complement quantitative analysis. For example, qualitative findings about learner motivation can be coded and statistically analyzed to gain more understanding of the underlying factors that influence motivation.

Adaptive Exploratory and Confirmatory Factor Analysis

Exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) are usually used at different stages of research. Brown (2015) and Hair et al. (2018) argue for their sequential application, but do not fully integrate them. In this methodology, an adaptive approach is proposed in which the results of EFA are iteratively refined and validated through multiple rounds of CFA. This cyclical process can improve the reliability of the identified factor structures. By continuously refining the model, researchers may better understand complex constructs.

Dynamic Structural Equation Modeling (DSEM)

Understanding changes in latent variables over time requires more dynamic models. Kline (2023) and Byrne (2016) discuss the advantages of SEM, but incorporating temporal dynamics can provide even deeper insights. Dynamic Structural Equation Modeling (DSEM) models interactions between variables at different points in time, providing a comprehensive view of changes over time. For example, tracking how student anxiety changes over the course of a semester can reveal important patterns that static models may miss.

The proposed methods offer several benefits. The integration of mixed methods can lead to richer data and more nuanced findings, as supported by Creswell (2014). Adaptive EFA and CFA processes can improve the reliability of factor structures and lead to deeper insights. DSEM provides a deeper understanding of changes in latent variables over time, which can lead to more effective instructional strategies. In practice, these methods can be used in various EFL research and teaching contexts. For example, by using an integrated mixed methods approach, educators can apply customized interventions based on a comprehensive understanding of students' needs. Adaptive EFA and CFA can improve the design of assessment tools, making them more accurate and reliable. DSEM can help track and respond to changes in student performance and well-being over time, leading to more effective support strategies.

In summary, these new proposed methods can build on the work of previous studies. By integrating, adapting and innovating existing methods, EFL research may produce more accurate, reliable and insightful results, ultimately improving educational practice and learners' experiences.

Conclusion

Understanding latent variables in the context of EFL is crucial to improving both research and educational practice. Latent variables such as linguistic competence, affective factors, cognitive abilities and socio-cultural influences play an important role in language learning and teaching. By using analytical methods such as exploratory factor analysis (EFA), confirmatory factor analysis (CFA) and structural equation modeling (SEM), researchers can uncover the underlying structures of these variables and validate their interrelationships. This article has emphasized the need for effective measurement instruments to enhance both the reliability and validity of research findings. By systematically reviewing key studies and identifying gaps in the literature, new research directions were proposed to advance the field of EFL research. Overall, this examination of latent variables underscores the importance of a systematic approach to EFL research. By combining theoretical insights with advanced statistical techniques, researchers can contribute to a deeper understanding of language learning processes. This knowledge could support the development of more effective educational approaches and improve the learning experiences and outcomes of EFL learners. Through continued research and empirical validation, the field can evolve to better meet the needs of learners in different contexts.

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