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**Research Article**

# Exploring HyFlex learning modality through adaption-innovation theory for student learning equity

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**ABSTRACT**

Equity is an important issue in student learning. HyFlex as a learning modality provides students an equitable opportunity to access learning through several modalities, which correlate with students' cognitive styles. The study investigates the relationship between student learning and cognitive styles, student-preferred modalities, and their equity in learning. The digital survey was sent to students and 451 students filled out the survey voluntarily. A structural equation model was developed to investigate the relationship between variables. The results indicate that students with innovation styles had a higher impact than students with an adaption style on the choice of three HyFlex learning modalities. The findings also show that student-preferred modalities encourage them to have equity in their learning. The current research provides novel knowledge on fostering learning equity by developing and adjusting students' cognitive styles to choose HyFlex learning modalities.

**Keywords:** HyFlex learning, cognitive styles, adaption-innovation, learning equity

## INTRODUCTION

Educational research has long focused on equity issues in student learning (Bianchini, 1997; Bowen & Cooper, 2021; Burgess & Williams, 2022; Hodge, 2006; Lambert, 2020; Super et al., 2020) Equality in education consists of two dimensions: equity and inclusion (Simon et al., 2007) Equality in learning can be promoted through the education system (Ainscow, 2016; Gorard & Smith, 2004). However, equality can also be seen from students' perspective because they are at the core of the equality (Sellar & Gale, 2011; Andrewartha & Harvey, 2017; Mahande & Abdal, 2022; Mahande et al., 2023; Howell, 2022). HyFlex courses allow students to choose between face-to-face and online teaching modes, accommodating their individual preferences and circumstances (Shek et al., 2022). Student preferences must be investigated through students' cognitive style, especially in determining optimal cognitive learning strategies and styles for face-to-face and online learning (Mahande & Abdal, 2022; Mahande et al., 2023).

HyFlex has been used for almost two decades. Nonetheless, the COVID-19 pandemic has pushed this mode of learning to be widely accepted and used (Mentzer et al., 2023) HyFlex learning provides flexibility for students that can affect their sense of equality (Howell, 2022; Lakhal et al., 2017). If given the option to

determine the most suitable combination, students will choose activities that align with their flexibility, comfort, and individual learning style (Kyei-Blankson et al., 2014; Nweke et al., 2022) This flexibility can contribute to a sense of equity because students can engage in learning in ways that suit their needs and preferences. The literature study results confirm that HyFlex learning environment allows students to choose a cognitive learning style that suits their needs (Esteron, 2021). However, the main challenge is identifying students' cognitive styles when learning is done online (Lo et al., 2012; Mahande & Abdal, 2023). This confirms the need for further investigation into what cognitive styles are appropriate for all three HyFlex learning modalities, which will provide learning equity for higher-education students.

Research conducted by Mahande and Abdal (2022) employed HyFlex learning conceptual model to realize equitable learning. The results of the study by Mahande and Abdal (2023) also emphasized the importance of measurement model analysis to investigate cognitive styles against the preferences of three HyFlex learning modalities that have the potential to offer equitable learning. The same research also focused on students' perceptions and preferences toward learning equity in HyFlex learning environment (Mahande et al., 2023). This study only presents a conceptual model consisting of the relationship between Kirton's (2004) adaption-innovation theory variables to the three modalities of HyFlex learning and equity learning, as well as analyzes indicators or items of each variable to produce valid and reliable measurement instruments. In addition, previous research has only investigated perceptions and preferences through descriptive studies. The research has not analyzed the relationship between variables directly or indirectly. Therefore, it is essential to investigate further the relationship between variables to provide a new understanding of what factors drive students to choose one of the learning modes among face-to-face, synchronous, and asynchronous learning modes in HyFlex learning modalities based cognitive styles and their effect on student equity in learning. Based on the previous statement, the current research addresses the following research questions:

**RQ1.** Based on adaption-innovation theory, how does a student's cognitive style directly affect Hyflex learning modalities and indirectly affect their feeling on equity?

**RQ2.** Do students' preferences and modalities of HyFlex Learning affect or mediate the relationship between cognitive styles and their feelings on equity?

## LITERATURE REVIEW

### HyFlex Learning Modality

HyFlex learning modality is developed based on flexible learning theory. In HyFlex learning system, students can choose learning materials and activities using three existing learning modalities: Face-to-face in class, synchronous online, and asynchronous online (Mahande & Abdal, 2023). Flexible learning is a modern method that utilizes the Internet and digital technologies to provide well-crafted, learner-focused, and interactive learning environments to individuals wherever and whenever they need it (Khan, 2007). Triyason et al. (2020) discussed the potential design options and difficulties associated with HyFlex, whereas Wright (2015) contended that for HyFlex to be effectively implemented, four primary factors must be considered: equivalence in experiences, reusability, accessibility, and the learner's ability to choose their mode of participation.

With effective management of these three HyFlex learning modes, students who participate remotely can participate in learning and obtain benefits equivalent to face-to-face students in class accessing learning materials and activities (Raman et al., 2021). A significant advantage of HyFlex approach is its flexibility, which can be tailored to student needs. However, students must have equal opportunities in choosing learning modes without discrimination between one method and another. Students should have equal access to learning resources that match their learning needs and cognitive styles. Student active learning strategies like feedback, class participation, or collaboration may require adjustment when implemented in different face-to-face and online learning environments (Mahande & Abdal, 2023; Mahande et al., 2023). This challenge requires investigating students' preferences and needs through a cognitive approach in the context of HyFlex learning and understanding students' views on choosing and implementing these modes to achieve equitable learning.

## Adaption-Innovation Theory

The cognitive style of Kirton's (2004) adaption-innovation theory suggests that each individual has the creativity and the ability to drive change, making them potential participants in complex problem-solving processes, each with their distinctive approach. While a person's approach and perspective are shaped by their life experiences, environment, and cognitive capacities, they are also shaped by their inherent cognitive or problem-solving style (Kirton, 2004). An individual's problem-solving style refers to how they prefer to cope with problems, regardless of their innate abilities or cognitive talents (Kirton, 2004).

In Kirton's (2004) view, cognitive abilities can be categorized into two main groups: adapters and innovators. Adapters refer to individuals who tend to adapt well to existing systems. Meanwhile, innovators tend to do things differently or more innovatively in using the system. Therefore, these differences in cognitive styles lead to differences in how each student utilizes HyFlex learning modality.

Based on the premise that cognitive styles influence creativity, problem-solving, decision-making, and aspects of a person's personality, Kirton (1984) argues that these styles form early in life and remain consistent over time and in various situations. Kirton (1984) introduced a dimension called adaption-innovation to assess cognitive styles, where adapters tend to be able to adapt well to existing methods or systems. In contrast, innovators tend to prefer to find new or different ways of using methods or techniques. Therefore, these differences in cognitive styles result in variations in how each student utilizes HyFlex learning modality. In other words, the better one's adaption and innovation, the greater his or her propensity and use of HyFlex learning modes (Mahande & Abdal, 2023). Therefore, this theory of service is considered a relevant framework for analyzing the cognitive style traits of students in choosing HyFlex learning mode.

Individuals who adopt adaptive problem-solving approaches tend to favor more structure in their problem-solving efforts. Adapters focus on addressing problems within clear boundaries (Lamm et al., 2011). Those who tend to adapt benefit from having clear boundaries to operate. They enjoy problem-solving but usually aim to make simple and immediate adjustments within existing systems, with the potential for these small changes to accumulate and result in more significant transformations over time (Lamm & Telg, 2015). If adapters are presented with activities that do not have a clear definition, they may experience difficulties and become frustrated.

Meanwhile, innovators tend to think outside the box and are often more open to change. Innovators tend to adopt innovative approaches to information processing and learning. When designing educational opportunities for adapters, including explicit expectations and guidelines is essential. Similarly, innovators need to create more innovative HyFlex modality activities. The unique characteristics of these two cognitive styles are interesting to explore, especially in relation to students' choice of HyFlex learning modalities in higher education.

## Students' Learning Equity

Learning equity ensures all students have equal access to high-quality education and learning opportunities, regardless of their background or circumstances. It involves addressing and eliminating disparities in educational outcomes and options based on race, socioeconomic status, gender, and ability. Learning equity aims to provide every student with resources, support, and opportunities to succeed academically and reach their full potential.

Research has shown that teaching and learning practices are crucial in achieving equity in education (Boaler, 2002). It is not just about the curriculum but also about teachers and their teaching methods (Boaler, 2002). Teachers need to employ culturally responsive and equity-focused practices, considering the diverse needs and backgrounds of their students (Athanases & Martin, 2006). This includes preparing teachers to teach English language learners, developing cultural knowledge and sensitivity, and promoting advocacy for equity beyond the classroom (Athanases & Martin, 2006).

A reform-oriented curriculum has been identified as a potential tool for promoting equity in the education (Boaler, 2002). However, it is essential to pay attention to the specific teaching and learning practices enacted in the classroom (Boaler, 2002). Teachers using a reform-oriented curriculum must create a supportive classroom environment, provide autonomy for all students, and actively engage students in learning to foster equity (Brandisauskiene et al., 2023).

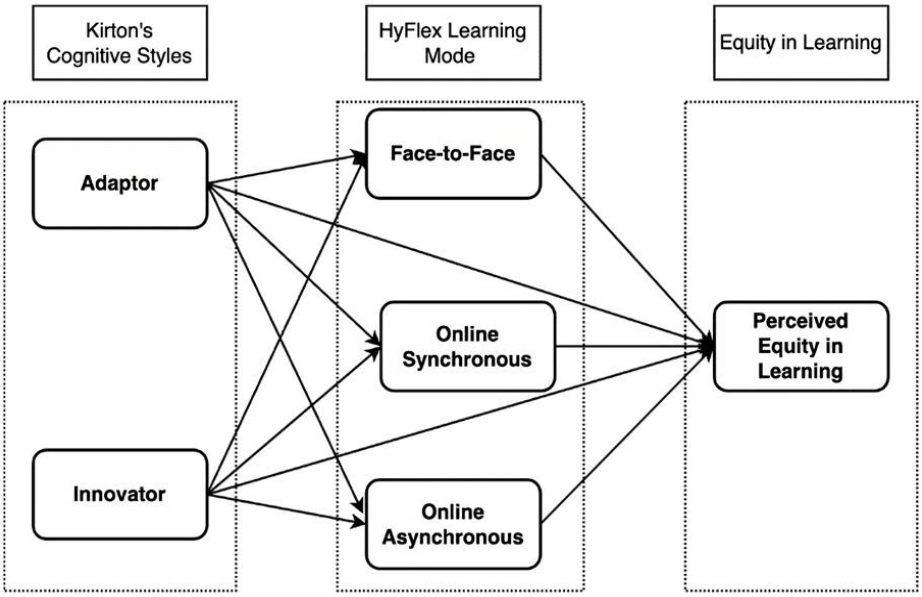


**Figure 1.** Framework of the study (Mahande & Abdal, 2023)

Equity in education is significant for students from low-income families (Brandisauskiene et al., 2023). Teachers can foster equity by providing more opportunities for autonomy, creating a supportive classroom environment, and involving students as active participants in the learning process (Brandisauskiene et al., 2023). It is also essential to consider the role of teacher support and perceived equity in promoting students' learning strategies (Brandisauskiene et al., 2023). In the context of HyFlex learning, equity issues have become more prominent, especially during the COVID-19 pandemic (Stone, 2022). Ensuring equity in HyFlex learning means addressing the digital divide and providing equal access to technology and internet connectivity for all students (Kono & Taylor, 2021). It also involves designing online learning experiences that are culturally sustainable and inclusive (Kono & Taylor, 2021).

To promote educational equity, educational leaders and policymakers must prioritize diversity, inclusion, and social justice (Haynes-Mendez & Nolan, 2021). This includes diversifying membership and leadership in educational organizations (Haynes-Mendez & Nolan, 2021), addressing systemic issues such as grading on a curve (Bowen & Cooper, 2021), and adopting an equity framework in palliative and end-of-life care research (Richards, 2022).

In conclusion, learning equity ensures that all students have equal access and opportunities to high-quality HyFlex learning in education. This requires addressing educational outcomes and opportunity gaps based on learning strategy/cognitive style, race, socioeconomic status, and ability (Mahande et al., 2023). Achieving learning equity involves using HyFlex learning-based teaching practices that are culturally responsive and focused on equity, promote advocacy for equity, and address systemic educational issues.

The framework of the study is presented in **Figure 1**.

The research conceptual framework illustrating the research hypothesis, as shown in **Figure 1**, was developed based on the literature we discussed earlier. This reflects the theoretical foundations identified and used to formulate hypotheses in this study.

## METHODOLOGY

### Research Design & Participants

This study was non-experimental quantitative research conducted using a cross-sectional survey. The cross-sectional survey collects information from a sample described from a predetermined population and data collected at just at one point in time (Fraenkel et al., 2023). In this study, information was collected only once over approximately four weeks.

**Table 1.** Demographic variables of respondents

| Variable | Number of respondents | Proportion (%) | *p*-value |
|---|---|---|---|
| Gender | | | <.001 |
| Male | 136 | 30.2 | |
| Female | 315 | 69.8 | |
| University types | | | .073* |
| Private university | 245 | 54.3 | |
| State university | 206 | 45.7 | |

Note. *Number of respondents in each group of variables does not significantly differ

Participants in this study are undergraduate students who have attended online lectures or hybrid learning at various universities in Indonesia, including state and private universities. Two approaches are used in sampling: taking universities conveniently and selecting students from these universities with simple random sampling methods. In addition, sample selection also considers partial least square structural equation modeling (PLS-SEM) analysis, where the number of samples chosen is five-10 times the number of observation parameters (items or indicators) present (Hair et al., 2012). The survey was conducted by sending digital forms to lecturers in various universities in Makassar, Indonesia. Each lecturer shared the survey URL link to the Google Form to be filled out by their students. As a result, 451 students voluntarily participated in the survey and completed the form. The demographic variable of the participants is shown in **Table 1**.

## Data Analysis

The survey consisted of 25 items plus some questions related to demographic data. Answers from respondents were analyzed using SmartPLS 4.0 with a structural equation modeling model and partial least square parameter estimation (PLS-SEM). PLS-SEM was chosen because it is the best type of SEM used for complex models (Akter et al., 2017; Hair et al., 2021), can work well on small samples, and is not normally distributed (Hair et al., 2012).

## Instruments

The survey instrument on HyFlex learning based on equitable cognitive styles was adapted from the authors' previous research (Mahande & Abdal, 2022), which divides several variables: cognitive styles, HyFlex learning modalities, and learning equity. The development of this instrument is based on environmental conditions, objects, and research objectives.

### *Cognitive styles*

The students' cognitive styles were measured using a modified Kirton (1976) adaption-innovation inventory. The inventory was a valid and reliable scale to differentiate individuals with adaptive properties and those with innovative properties (Kirton, 2004). The modification of the inventory was done by letting the scale measure individual adaption and innovation levels. The instrument consists of eight items, with four aspects each to measure the innovativeness and adaptiveness of the participants.

### *Student HyFlex learning modality*

A modified scale study measured student HyFlex learning modality preference (Malczyk, 2019). The scale was developed using three modality preferences:

(1) face-to-face,

(2) online synchronous (video conference), and

(3) online asynchronous learning.

Each of these modality preferences was measured using four items. The reliability and validity of the instrument are discussed in the measurement model.

### *Learning equity*

The student learning equity was assessed using a scale developed based on learning equity (Beatty, 2007). The scale consists of five items. The measurement model also discusses the scale's reliability and validity.

**Table 2.** Reliability & validity of items & constructs

| Variable | Items | Loadings | Rho A | AVE |
|---|---|---|---|---|
| Adaptor | Ad1 | 0.825 | 0.700 | 0.508 |
| | Ad2 | 0.642 | | |
| | Ad3 | 0.704 | | |
| | Ad4 | 0.668 | | |
| Innovator | In1 | 0.826 | 0.748 | 0.665 |
| | In2 | Out | | |
| | In3 | 0.818 | | |
| | In4 | 0.801 | | |
| Face-to-face | FF1 | 0.748 | 0.846 | 0.591 |
| | FF2 | 0.847 | | |
| | FF3 | 0.636 | | |
| | FF4 | 0.801 | | |
| | FF5 | 0.795 | | |
| Online asynchronous | OA1 | 0.855 | 0.854 | 0.695 |
| | OA2 | 0.871 | | |
| | OA3 | 0.861 | | |
| | OA4 | 0.742 | | |
| Online synchronous | OS1 | 0.847 | 0.844 | 0.682 |
| | OS2 | 0.842 | | |
| | OS3 | 0.821 | | |
| | OS4 | 0.791 | | |
| Equity | Eq1 | 0.794 | 0.862 | 0.632 |
| | Eq2 | 0.852 | | |
| | Eq3 | 0.811 | | |
| | Eq4 | 0.841 | | |
| | Eq5 | 0.662 | | |

## RESULTS

PLS-SEM consists of two stages, namely

(1) measurement model and

(2) structural model (Hair et al., 2021; Hair Jr et al., 2022).

The measurement model investigates the relationship between latent variables and their indicators, while the structural model tests the relationship between latent variables (Hair et al., 2021).

### Measurement Model Analysis

Measurement models produce metrics such as factor loadings that express the extent to which items contribute to the latent variable or item reliability. The value of factor loadings must be greater than or equal to 0.708, ensuring the latent variable's average variance extracted (AVE) is at least 50% (Ringle & Sarstedt, 2016). However, loading values between 0.4 and 0.708 can still be included in the model (not excluded) (Hair Jr et al., 2022). **Table 2** shows that all items have met the loadings criteria, meaning that the items in the questionnaire can reflect the variables well.

AVE value is a form of composite validity or validity of the collection of items that comprise the latent variable. An AVE value of at least 0.5 means that the items that contain the latent variable together can two reflect at least 50% of the latent variable (Valle & Assaker, 2016). Another measure used in the measurement model is rho A. This measure expresses the internal reliability of the latent variable. It performs better than composite reliability, which provides an upper limit, and Cronbach's alpha, which provides a lower limit of the internal reliability (Dijkstra & Henseler, 2015). In addition, the results of rho A are more consistent than the other two measures (Henseler, 2021). Results in **Table 3** show that all six variables tested in this measurement model have good composite validity and internal reliability. The last property that needs to be analyzed in the measurement model is discriminant validity, which indicates whether the variables in the model are unique (not similar) to each other (Franke & Sarstedt, 2019). The measure used is heterotrait-monotrait ratio (HTMT), which measures average correlation between items that differ in the construct (Henseler et al., 2015). One rule of thumb for HTMT is that the maximum value is 0.85 (Franke & Sarstedt, 2019).

**Table 3.** HTMT between constructs

| | Adaptor | Asynchronous | Equity | Face-to-face | Innovator |
|---|---|---|---|---|---|
| Adaptor | | | | | |
| Asynchronous | 0.766 | | | | |
| Equity | 0.688 | 0.789 | | | |
| Face-to-face | 0.777 | 0.653 | 0.670 | | |
| Innovator | 0.839 | 0.783 | 0.695 | 0.847 | |
| Synchronous | 0.601 | 0.805 | 0.660 | 0.579 | 0.700 |

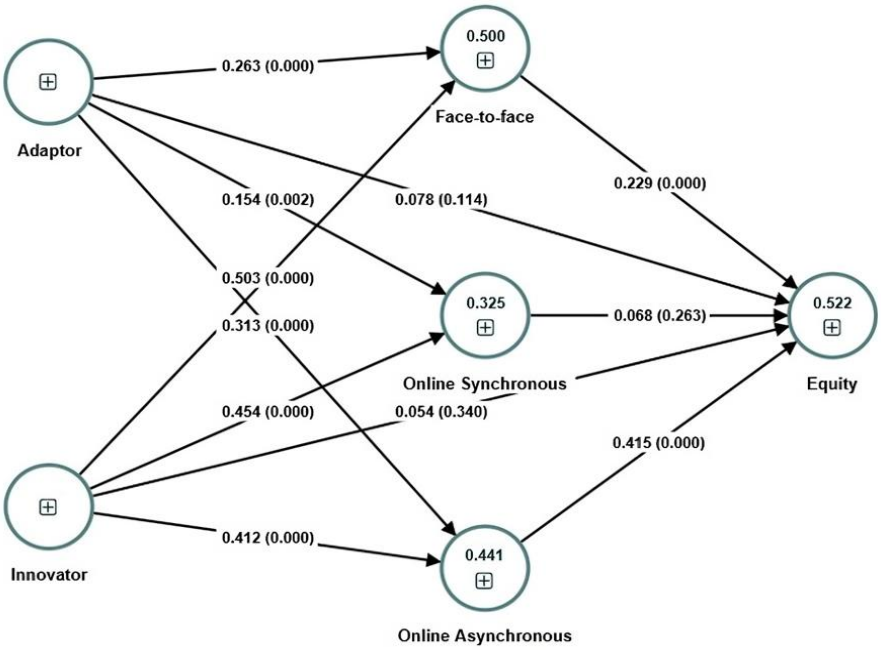


**Figure 2.** Structural model with hypothesis testing results (Source: Authors)

**Table 4.** Total effect of constructs in model

| Path | Path coefficient | t-statistics | *p*-value |
|---|---|---|---|
| Adaptor->asynchronous | 0.313 | 7.277 | *** |
| Adaptor->equity | 0.278 | 5.312 | *** |
| Adaptor->face-to-face | 0.263 | 5.344 | *** |
| Adaptor->synchronous | 0.154 | 3.218 | *** |
| Innovator->asynchronous | 0.412 | 9.294 | *** |
| Innovator->equity | 0.371 | 7.515 | *** |
| Innovator->face-to-face | 0.503 | 10.914 | *** |
| Innovator->synchronous | 0.454 | 9.092 | *** |
| Asynchronous->equity | 0.415 | 7.334 | *** |
| Face-to-face->equity | 0.229 | 4.300 | *** |
| Synchronous->equity | 0.068 | 1.136 | 0.256 |

Note. t-statistics>1.96 & ***p<.001

**Table 3** shows that the HTMT ratio between the two variables in the model shows a value less than the 0.85 limit. In other words, each variable in this study is unique or does not measure the same thing.

## Structural Model Analysis

A good measurement model indicates that the data can be used to analyze the structural model. The results of PLS estimation for the structural equation model, the values of path coefficients, and the item loadings for the research framework are displayed in **Figure 2**.

The bootstrap method is required to obtain results on the structural model, a resample, or repeated sampling method to produce a t statistical value (Hair et al., 2021). The recommended number of repeated samples is 10,000 repetitions (Streukens & Leroi-Werelds, 2016). **Table 4** illustrates the hypotheses that have been formulated in this study along with the results of the SEM analysis that has been produced.

**Table 5.** Indirect effect of constructs in model

| Path | t-statistics | *p*-value |
|---|---|---|
| Adaptor->asynchronous->equity | 5.074 | 0.000 |
| Innovator->asynchronous->equity | 5.160 | 0.000 |
| Adaptor->face-to-face->equity | 2.850 | 0.004 |
| Innovator->face-to-face->equity | 3.204 | 0.001 |
| Adaptor->synchronous->equity | 2.847 | 0.004 |
| Innovator->synchronous->equity | 3.171 | 0.002 |

Note. p<.001

The results of the analysis show that the adaptor trait has a positive effect on the tendency to choose asynchronous lectures ($\beta$=0.313, $p$<.001), face-to-face ($\beta$=0.263, $p$<.001), synchronous ($\beta$=0.154, $p$<.001) and equity ($\beta$=0.278, $p$<.001). The same is shown by innovators who also show a positive influence on the tendency to choose asynchronous ($\beta$=0.412, $p$<.001), face-to-face ($\beta$=0.503, $p$<.001), synchronous ($\beta$=0.454, $p$<.001) and equity ($\beta$=0.415, $p$<.001). Adaptors preferred asynchronous lectures, while innovators more likely to choose face-to-face and synchronous courses. However, innovators significantly influenced the three learning modes more than adaptors. The same is true for the effect on equity. More robust path coefficients were shown by innovators when compared to adaptors. **Table 5** shows the indirect effects of innovator adapters on equity through the three HyFlex learning modalities.

The analysis results show that adaptors and innovators indirectly influence learning equity through three modalities of HyFlex learning: face-to-face, synchronous online, and asynchronous online. The Innovator style has the most significant influence on equity through online asynchronous modalities.

## DISCUSSION

The current research aims to investigate the effect of student adaption-innovation on HyFlex learning modality and students' learning equity. The results show that students with adaptor cognitive style choose asynchronous learning. Students with adaptive cognitive styles choose asynchronous learning mode for several reasons. Firstly, research has shown that learners with high working memory capacity, a cognitive trait, prefer a reflective, intuitive, and sequential learning style (Graf et al., 2008). Asynchronous learning allows students to engage in self-paced learning, reflecting on the material and processing information at their own speed (Zheng et al., 2009). This aligns with the preferences of students with adaptive cognitive styles who prefer a reflective learning style. Secondly, asynchronous learning allows students to engage in active, sensing, and visual learning styles selected by learners with low working memory capacity (Graf et al., 2008). Asynchronous learning allows students to access and review course materials multiple times, allowing them to engage in active learning by interacting with the content at their pace (Zheng et al., 2009). This flexibility will enable students to process information visually and engage in hands-on activities, enhancing their learning experience.

The findings also show that students with innovative cognitive styles prefer face-to-face or synchronous learning. Kirton (2004) cognitive style index measures an individual's preferred problem-solving mode and reflects their adaptability and preference for innovative thinking (Sadler-Smith et al., 2000). Innovators desire to do things differently (Cassidy, 2004). This property might affect their preferred mode.

However, innovator cognitive style has a stronger relationship with their preferred learning mode than adaptive cognitive style. Kirton (2004) adaption-innovation theory distinguishes between adaptor and innovator students based on their problem-solving preferences and cognitive styles (Sadler-Smith et al., 2000). Adaptors are individuals who prefer structure and tend to work within established guidelines and procedures to solve problems. They focus on improving existing processes and systems (Hutchinson & Skinner, 2007). On the other hand, innovators are individuals who prefer to challenge the status quo and think outside the box. They are more likely to deviate from established procedures and seek novel approaches to problem-solving (Hutchinson & Skinner, 2007).

Adaptor students tend to be more conformist and prefer to work within established frameworks and guidelines (Hutchinson & Skinner, 2007). They are comfortable with routine and choose incremental changes rather than radical innovations (Johnson et al., 2008). Adaptors are often detail-oriented and prefer to refine

existing ideas and processes (Passig & Cohen, 2014). They are likelier to follow established procedures and rely on tried-and-tested methods (Lapp et al., 2019). Adaptor students may excel in tasks that require attention to detail and adherence to established protocols (Lomberg et al., 2016).

In contrast, innovator students are more likely to challenge existing norms and seek unconventional solutions (Johnson et al., 2008). They are comfortable with ambiguity and uncertainty and are willing to take risks (Passig & Cohen, 2014). Innovators are often creative and enjoy exploring new possibilities and approaches (Puccio, 2001). They are more likely to generate original ideas and think outside the box (Foxall et al., 1992). Innovator students may excel in tasks that require creativity, problem-solving, and the ability to think critically (McLeod et al., 2008). This property may become the basis for why innovator students show a higher interest in learning mode, whether face-to-face, synchronous, or asynchronous learning.

The findings also suggest that HyFlex's three learning modalities, face-to-face, online synchronous, and online asynchronous, can correctly mediate the relationship between the adaptor-innovator's cognitive style and students' perceptions of learning equity. Recent results show that students' preference for HyFlex learning modalities positively influences students' perceptions of equity. Teaching modes can influence the impact of modality preferences on learning equity. For example, implementing HyFlex learning combines face-to-face, synchronous, and asynchronous learning modes to promote equitable learning (Mahande & Abdal, 2022). The study proposes a conceptual model that considers students' cognitive styles and different HyFlex learning modalities to create a fair learning environment (Mahande & Abdal, 2023). This suggests that the flexibility of instructional modes can help accommodate students' diverse modality preferences and promote learning equity. The descriptive research findings also provide information that the three modalities of HyFlex learning have the potential for equitable learning (Mahande et al., 2023).

However, the challenge is ensuring digital equity and addressing student engagement concerns (Kono & Taylor, 2021). Policies and processes designed for on-campus students should be tailored to meet the needs of online students to maintain equity in the learning experience (Stone et al., 2022). One of them is recognizing students' potential characteristics and needs by investigating their cognitive styles. By considering these challenges and designing learning experiences, which prioritize equity, HyFlex learning can promote equitable access and opportunities for all students. Thus, the results of this research can have theoretical and practical implications for the development of HyFlex learning design and learning content that is more adaptive and inclusive.

## CONCLUSIONS, LIMITATIONS, & FUTURE RESEARCH

The current study contributes to the growing topic of equity in learning by providing empirical evidence of how students' cognitive styles encourage them to choose the modality best suited for their learning in the context of HyFlex. Cognitive style is the relationship between personality and cognition and influences attitudes, values, and social interactions. Kirton adaption-innovation theory divides cognitive styles into adapters (who better or quickly adapt the system) and innovators (who like to do things differently or innovatively). The better the adapter and innovator, the higher the student prefers HyFlex learning modalities and equity learning. These cognitive styles also led to differences in how each student utilized HyFlex learning modality.

Students with innovative traits tend to have higher attitudes than adaption traits to HyFlex learning modality preferences. Innovators prefer to challenge the status quo and think outside the box. They are more likely to challenge existing norms and seek unconventional solutions, are comfortable with ambiguity and uncertainty, and are willing to take risks. These characteristics enhance their attitude towards new learning modalities such as HyFlex learning.

On the other hand, adaptors are better at adapting to various cognitive situations and learning effectively in different HyFlex learning environments. These characteristics are excellent at coping with complex and multifaceted tasks in HyFlex learning. The elements of cognitive styles and students' freedom in choosing their learning modalities in HyFlex also encourage their equality in education. Students will be aware of their learning equality by having the characteristics and space to select their preferred learning modality.

This research has limitations because it only involves students in South Sulawesi, Indonesia. The results will likely be different if this study involves students and lecturers from various universities in all provinces in Indonesia and even abroad by adding diverse moderation variables. In the future, more longitudinal research is needed to explore and develop diverse constructs that can enhance HyFlex learning and promote learning equity in a broader range of contexts.

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**Declaration of interest:** The authors declare no competing interest.

**Data availability:** Data generated or analyzed during this study are available from the authors on request.

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