Validation of the Faculty Readiness to Teaching Online (FRTO) scale

Stella Y. Kim

Department of Educational Leadership, CATO College of Education,
The University of North Carolina at Charlotte, Charlotte, North Carolina, USA,
and

Florence Martin

Department of Teacher Education and Learning Sciences, College of Education,
North Carolina State University, Raleigh, North Carolina, USA

Abstract

Purpose – The current study examined several aspects of validity evidence for the Faculty Readiness to Teaching Online (FRTO) scale.

Design/methodology/approach – Data were collected from 307 faculty in higher education. Construct validity was evidenced through an exploratory factor analysis and a reliability coefficient. Differential validity was explored using the differential item functioning analysis to explore potential bias in items due to gender and age. In addition, convergent validity was tested by correlating FRTO with years of teaching online, the primary modality of instruction and whether there is required training in online teaching by the institution.

Findings – The findings from validation showed that new factors emerged and also demonstrated differences based on instructors gender and age, as well as based on teaching experience and primary modality of teaching.

Originality/value – The findings confirmed the previous study’s results (Martin et al., 2019) and provided some modifications to the instrument. The factor structure did not conform to the original four factors proposed in the instrument; instead, the newly loaded factors were course design and facilitation, course technologies, course expectations and resources and time management. The revised instrument can be presented and discussed at online teaching professional development programs to help faculty understand the core competencies they need to better instruct students.

Keywords Faculty online teaching, Online teaching readiness, Validation of an instrument

Paper type Research paper

Online teaching and learning have gained significant popularity in recent years, with the COVID-19 pandemic further accelerating its adoption. Beyond pandemic-induced shifts, various factors affect instructors’ readiness to teach online. Phan and Dang (2017) conducted a review of studies on teacher readiness for online teaching and identified six key factors, including training, time constraints, attitudes, pedagogy and methodology, and technology competence. In another review, Cutri and Mena (2020) discussed affective considerations, pedagogical considerations, and organizational considerations as crucial components of online teaching readiness. This integrated review aims to explore faculty readiness for online teaching, which is defined as “a pre-assessment of faculty’s preparedness (mental and physical) to develop and implement online teaching” (p. 362).

Online teaching demands distinct competencies compared to traditional face-to-face instruction (Ko and Rossen, 2017). Over the years, several researchers have examined these competencies. Studies by Aydin (2005), Bawane and Spector (2009), Goodyear et al. (2001), Guasch et al. (2010), and Varvel (2007) have delved into this area, although some of these investigations are dated. More recently, some researchers have developed instruments to measure faculty readiness for online teaching (Chi, 2015; Eslaminejad et al., 2010; Gay, 2016; Lim, 2023; Martin et al., 2019; So and Swatman, 2010). Other researchers have adapted online teaching readiness instruments or other measures to examine faculty readiness (Adi Badiozaman and Segar, 2022; Bolliger and Halupa, 2022; Paliwal and Singh, 2021; Scherer et al., 2021; Si et al., 2021; Soeselo et al., 2021). Moreover, several universities have used...
readiness instruments to evaluate if faculty are prepared to teach online (e.g. Penn State, 2022; University of Maryland, 2022). However, it is worth highlighting that some of these instruments lack comprehensive systematic study or empirical testing.

Instructor online teaching readiness
Teaching online requires a unique set of skills and characteristics compared to traditional face-to-face teaching (Ko and Rossen, 2017). However, due to the complexity of online teaching, researchers have conceptualized online teaching readiness differently. For example, Gay (2016) viewed online teaching readiness as a composite of three components, technical, lifestyle, and pedagogical readiness. In contrast, Lim (2023) conceptualized it as a composite of five elements: technology, pedagogy, online communication, time and environment management, and institutional support.

Another challenge in conceptualizing online teaching readiness is the inconsistency in terminology used by researchers. Lim (2023) highlighted that the same construct was referred to differently by different researchers. For instance, Martin et al. (2019) used the term “course design readiness” while Meloncon (2007) referred to the same construct as “pedagogical readiness.” The following section seeks to mitigate any confusion readers may encounter due to this inconsistency in terminology and to provide clarity regarding the terms used in the current study. Specifically, the current study adopts the terminologies and the conceptual framework established by Martin et al. (2019) since the primary purpose was to validate their measure.

Martin et al. (2019) defined faculty readiness as “a state of faculty preparation for online teaching,” aligning with Cutri and Mena’s (2020) definition, and developed the Faculty Readiness to Teach Online (FRTO) instrument. They adapted Rollnick et al.’s (2010) health behavior change readiness framework to establish the framework of the FRTO and identified four constructs of online teaching competencies: course design, course communication, time management, and technical skills (Figure 1). These constructs were identified through a review of literature and existing readiness instruments. In the following sections, we reviewed the literature associated with each of these constructs.

Course design
Course Design refers to the pedagogical competence (Varvel, 2007) that emphasizes the alignment of learning objectives, instructional materials, activities, and assessments with

Figure 1.
FRTO initial constructs for readiness

Source(s): Author’s own creation/work
course standards and academic goals. Underscoring the significance of the pedagogical role, Bawane and Spector (2009) noted that among the roles of online instructors, the pedagogical role takes the highest priority, followed by professional, evaluator, and social roles. Similarly, Mishra and Koehler (2006) emphasized the instructor’s ability to align technological knowledge with effective pedagogical strategies for effective teaching. Unfortunately, Gay (2016) found a deficiency in pedagogical readiness of online lecturers, even though many online lecturers possessed substantial technological expertise.

Recently, Bolliger and Martin (2021) expanded on this concept of pedagogical competence by developing the online course design elements framework, which includes five categories of design standards: (1) overview, (2) content presentation, (3) interaction and communication, (4) assessment and evaluation, and (5) learner support. The FRTO instrument encompasses various course design items, such as course orientation, learning objectives, learning activities, instructional videos, teaching methods, and assignments and assessments, all of which are essential design elements recommended in established instructional design processes (Dick et al., 2001; Gagné et al., 1992; Morrison et al., 2004).

Course communication

Course Communication is an essential competence for online teaching, as it fosters a supportive learning community and facilitates meaningful learner engagement (Tallent-Runnels et al., 2016). This facet is also known as course facilitation, which encompasses social, pedagogical, technical, and managerial aspects (Berge, 1995). Effective course facilitation helps students feel more connected to the course and their peers, which can enhance their overall learning experience (Martin et al., 2018). Lim (2023) emphasized the dominance of text-based asynchronous communication in online environments and pointed out the need for adept online communication skills for successful online teaching. In alignment with Lim (2023), Badiozaman (2021) reported that online instructors viewed online communication competence as a core skill to establish pedagogical relationships and maintain a presence in the virtual learning environment. Echoing this perspective, Chou and Chou (2021) advocated for the implementation of professional development initiatives aimed at equipping instructors with online communications skills to enhance their self-efficacy.

The FRTO instrument includes course communication items that focus on aspects of facilitation, including sending announcements and emails, moderating discussions, responding to student questions, providing feedback on assignments, communicating expectations, compliance, and policy, and using synchronous technologies (Badiee and Kaufman, 2015; Sheridan and Kelly, 2010). Both synchronous and asynchronous methods of communication are included in FRTO, allowing for a comprehensive assessment of instructors’ communication skills.

Time management

Time commitment has been identified as a crucial competency for online teaching, as the transition from face-to-face to online instruction requires different competencies and time commitment (Bolliger and Wasilik, 2009; Giles et al., 2014; Van de Vord and Pogue, 2012). Researchers have reported that online teaching preparation demands additional time (Bacow et al., 2012; Baran, 2011) due to the requirement for high interaction and presence (Bolliger and Halupa, 2022; Cavanaugh, 2005; Nambiar, 2020; Lim, 2023). This issue of additional time burden was even exacerbated during the global pandemic. A few studies documented escalated workloads during the pandemic, driven by factors such as unstable Internet connection, external distractions, diminished physical connectivity with learners (Gao and Zhang, 2020; Huang, 2020; Joshi et al., 2021). Boyer-Davis, who surveyed 307 full-time faculty members, reported an elevated stress level termed “technostress” during the pandemic compared to the pre-pandemic era.
Oyarzun et al. (2020) examined time management strategies and highlighted the importance of clear expectations and content organization into modules or units for the instructors to manage their time effectively. Correspondingly, Heath and Shine (2021) accentuated time management’s pertinence during the pandemic and suggested three time management skills including asynchronous teaching, chunking (breaking down tasks into manageable components), and micro-learning. These findings collectively suggest that instructors’ adeptness in effective time management is imperative for efficient online teaching. The FRTO instrument includes time management items focusing on the time required for course design preparation, weekly facilitation and grading hours, utilization of Learning Management Systems (LMS) features, and learning about new strategies or tools.

Technical
Technical competence focuses on the instructor’s knowledge and use of technology tools, which is crucial for successful online teaching. The transition from face-to-face to online teaching can be particularly challenging for instructors who were trained using traditional teaching methods. The FRTO instrument includes several items focusing on technical competence, such as basic computer operations, efficient navigation in the LMS, collaborative functionality in LMS and other tools, creating and editing videos, identifying and sharing open educational resources, and seeking help from the help desk when necessary.

Research has shown that instructors possessing advanced technical competency tend to report greater satisfaction with online teaching (Blundell et al., 2020; Masry-Herzalah and Dor-Haim, 2022; McLawhon, 2009). However, Lim (2023) highlighted that mixed findings exist in the literature concerning the significance of technological readiness for successful online teaching and noted the need for further investigation on this topic. For instance, Bolliger and Halupa (2022) observed no difference in technical competence between seasoned and novice online instructors.

Instructor online teaching readiness survey instruments
Several instruments exist for evaluating faculty readiness for online teaching. Some of these instruments have a broad focus e-learning readiness (Eslaminejad et al., 2010; So and Swatman, 2010), while others specifically target online learning readiness (Chi, 2015; Martin et al., 2019). Table 1 provides the details of these instruments and the constructs they examine.

Most of the instruments listed in Table 1 underwent content validation through consultation with a panel of content experts or assessments from such experts (Chi, 2015; Eslaminejad et al., 2010; Gay, 2016; Martin et al., 2019). Additionally, some of these instruments were validated in terms of factor structure using exploratory factor analysis (EFA) (So and Swatman, 2010; Eslaminejad et al., 2010; Martin et al., 2019). For instance, Martin et al. (2019) performed a confirmatory factor analysis (CFA) on a dataset of 205 faculty to evaluate the fit of the pre-set factor structure, which met the minimum required sample size for running CFA. However, it is advisable to conduct further testing of the data structure using a larger sample size to enhance the validity of the findings.

Unfortunately, beyond the original papers proposing and developing these instruments, no additional validation efforts have been made. It is essential to provide additional validity evidence to enhance confidence in drawing valid inferences from these measures. Moreover, many of the original studies relied on limited pieces of validity evidence, which calls for careful judgment when evaluating the validity of the measures. Therefore, additional research to validate and refine these instruments would be beneficial.

The FRTO instrument, since its publication, has garnered over 300 citations and has been widely used in various studies (e.g. Adi Badiozaman and Segar, 2022; Bolliger and
Given the widespread popularity of the FRTO instrument in the online learning community, it is important to subject it to a thorough evaluation to ensure its validity. The current study aims to assess the instrument’s validity from multiple angles, including (1) internal structure (construct) validity, (2) differential validity, and (3) convergent validity. In particular, the factor structure proposed by Martin et al. (2019) was found to be a poor fit for the data collected in the current study (see below for more detail). This finding highlights the need for reassessment of the factor structure, and warrants further investigation to develop a robust instrument.

### Validation of the FRTO scale

<table>
<thead>
<tr>
<th>Name of instrument</th>
<th>Authors/Year</th>
<th>Number of survey items</th>
<th>Constructs measured</th>
</tr>
</thead>
<tbody>
<tr>
<td>e-learning readiness of teachers and schools in Hong Kong</td>
<td>So and Swatman (2010)</td>
<td>42 items</td>
<td>(1) Government and Public Support; (2) ICT Infrastructure and Technical Support; (3) Individual Preparedness/ICT Competency; (4) e-Learning Materials; (5) Training Opportunity; (6) Students Preparedness; (7) Attitude towards e-Learning; (8) Leadership/e-Leadership; (9) Competency of Peers</td>
</tr>
<tr>
<td>Instructors’ readiness for implementing e-learning in continuing medical education in Iran</td>
<td>Eslaminejad et al. (2010)</td>
<td>37 items</td>
<td>(1) Familiarity with online education; familiarity with LMS; (2) Willingness to teach adopting new technology; (3) Willingness to have innovation in instruction; (4) Ability to deliver e-material; (5) Ability to provide e-content; (6) Being accustomed to the virtual environment</td>
</tr>
<tr>
<td>Readiness to teach online scale</td>
<td>Chi (2015)</td>
<td>33 items</td>
<td>(1) Teaching and Learning, Social and Student Engagement; (2) Faculty and Technology Support; (3) Course Development and Instructional Design; (4) Evaluation and assessment</td>
</tr>
<tr>
<td>Online instructor e-learning readiness</td>
<td>Gay (2016)</td>
<td>18 items</td>
<td>(1) Technical readiness; (2) Lifestyle readiness; (3) Pedagogical readiness</td>
</tr>
<tr>
<td>Faculty readiness for teaching online</td>
<td>Martin et al. (2019)</td>
<td>32 items</td>
<td>(1) Course design, (2) course communication, (3) time management, (4) technical</td>
</tr>
</tbody>
</table>

**Source(s):** Authors’ own creation/work

### Relationships of FRTO with other variables

This section reviews the literature exploring the relationships between FRTO and various demographic and experiential variables, including age, gender, primary teaching modality, online teaching experience, and required training as important variables for online teaching readiness.

While limited research has specifically examined the impact of faculty age on online teaching readiness, Sultan et al. (2021) found that age did not significantly affect faculty satisfaction with teaching online. Similarly, in a study focusing on teachers in primary, secondary, or vocational educational institutions in Latvia, Mirke and Tzivian (2021) found no difference in online teaching readiness between older and younger educators.
The literature on gender differences in online teaching has produced mixed findings. Studies by Shea (2007), Horvitz et al. (2015), and So and Swatman (2010) have reported differences based on gender. Specifically, Shea found that male faculty rated their ability to use instructional technology higher, consistent with the findings of So and Swatman (2010) indicating that male teachers exhibited greater individual preparedness for online teaching. In contrast, Horvitz et al. (2015) found that female faculty reported higher self-efficacy in employing online instruction strategies compared to their male counterparts. Additionally, Vang et al. (2020) found that female faculty had significantly higher perceptions of course design and communication in online teaching. On the other hand, Aydin (2005) found no difference in faculty perception of competencies.

Martin et al. (2019) found significant differences in self-efficacy between online instructors who teach synchronous, asynchronous, and hybrid courses compared to those who teach face-to-face, particularly in course design and technical competency. This finding was corroborated by Vang et al. (2020), who reported that faculty primarily engaged in synchronous or asynchronous online learning had higher self-efficacy in course design compared to those primarily teaching face-to-face.

Research has consistently shown that faculty with more years of experience exhibit higher self-efficacy in online teaching compared to those with less experience (Muñoz Carril et al., 2013; Shea, 2007). Moreover, Martin et al. (2019) found that teaching experience positively correlated with self-efficacy in course design, course communication, and technology by. Instructors who completed required training demonstrated higher perception of the importance and self-efficacy of online teaching competencies, with course communication being particularly valued (Martin et al., 2019; Vang et al., 2020).

**Purpose of the study and research questions**

While several universities use a readiness scale for instructors, these scales have not been empirically validated to the best of our knowledge. Martin et al. (2019) developed the FRTO instrument to measure faculty preparedness for online teaching in response to a high demand of online teaching. However, the FRTO measure has not yet undergone systematic validation efforts. Therefore, the purpose of this study is to investigate various aspects of validity evidence for the FRTO instrument. The following research questions guided this study:

**RQ1.** To what extent does FRTO prove construct validity based on exploratory factor analysis and a reliability coefficient?

**RQ2.** To what extent does FRTO exhibit fairness with respect to gender and age, supporting the differential validity of the instrument?

**RQ3.** To what extent does FRTO demonstrate convergent validity through its correlation with external variables that are known (or theoretically reasonable) to be related?

**Methods**

*Data collection and participants*

Data was collected twice in this study from three community colleges located in the Southeast region of the United States and from higher education institutions across the country. An electronic survey was also distributed to three distribution lists, namely the Association for Educational Technology (AECT) Communications, the American Educational Research Association (AERA) Online Teaching and Learning Special Interest Group, and a southeastern public university’s faculty in the United States. The researcher obtained approval from the Institutional Review Board (IRB) for conducting research at the
researcher’s institution. Informed consent was collected from all participants, who were faculty members in higher education, by requesting them to click on the “Yes, I consent” option of the first page of the online survey. The survey was aimed at faculty who teach in higher education, and collected demographic information such as gender, age, years of online teaching, and primary course delivery mode. A total of 307 faculty responded to the survey, and Table 2 shows the demographic information of the participants.

**Measurement instrument**

Martin et al. (2019) developed the FRTO instrument to measure faculty’s perceived importance of online teaching competencies and their efficacy in effective online teaching. The instrument was created through expert reviews, resulting in 32 items divided into two sections, each using a different Likert scale. In the first section, respondents rated the importance of each competency on a five-point Likert scale, ranging from 1 (not important at all) to 5 (very important). The second section asked respondents focused on respondents’ self-assessment of their ability to accomplish specific tasks using a five-point Likert scale ranging from 1 (I cannot do it at all) to 5 (I can do it well).

While the first section assesses faculty’s perceived importance of each teaching practice, which does not necessarily imply the existence of a latent trait, the main focus of the validation effort in this study was on the second section, which evaluates faculty’s online teaching efficacy (FRTO-efficacy). The first section (FRTO-perception) was occasionally used as a reference to better examine the latter.

**Data analysis**

To explore the factor structure and evaluate the construct validity of FRTO, an exploratory factor analysis (EFA) was conducted. Prior to performing the analysis, several assumptions were tested, including the presence of multivariate outliers, multivariate normality,
factorability, and linearity. One extreme case was removed from the analysis as a result. Since the normality assumption was not met (Shapiro–Wilk test with w = 0.568, <0.001), the principal axis method was used for factor extraction, and oblimin rotation was selected based on the assumption that correlated factors. The Bartlett’s test of sphericity was significant (χ²(496) = 4110.409, <0.001), indicating the suitability of the data for factor analysis. The Kaiser-Meyer-Olkin (KMO) value was 0.94, exceeding the recommended threshold value of 0.7 (Kaiser, 1974), which supports the adequacy of data for factor analysis. Additionally, the Omega reliability was investigated to ensure the reliability of the measure.

To evaluate fairness of FRTO across different demographic groups, differential item functioning (DIF) analysis was conducted using logistic ordinal regression DIF with item response theory (IRT) ability estimates as the conditioning variable. DIF has been used in the literature as a means to detect potential bias and to test the assumption of equivalence across different groups concerning the quality of instruments. It is important to note that the detection of DIF implies the presence of a secondary construct, which may not be the primary construct primarily being measured. However, the existence of a secondary construct does not necessarily indicate that validity of the instrument is compromised or that the item is assessing an unintended aspect. In certain cases, this secondary construct might indeed be an intended measurement aspect of the item. Thus, determining whether DIF arises from an intended or unintended secondary construct typically requires a thorough content review of the item in question (Penfield et al., 2007).

DIF was examined with respect to gender (male vs female) and age (younger than 50 vs older or equal to 50) using the R program “lordif” (Choi et al., 2011). The cut-off age of 50 was chosen arbitrarily, considering that the average age was 49 for the sample, resulting in 94 and 96 participants in each age group. The full original dataset could not be used for DIF analysis because some respondents did not provide their demographic information on the survey, leading to a subset of data for DIF analysis.

Finally, convergent validity was assessed by correlating FRTO with external variables believed to be positively related, including (1) years of online teaching, (2) the primary teaching modality, and (3) required training in online teaching by their institution. The Spearman correlation coefficient was used to examine the relationship between years of online teaching and FRTO. Since the years of online teaching were assessed using five categories (see Table 2), the Spearman correlation coefficient was considered more appropriate than the Pearson product-moment correlation. For the other two variables, a one-way ANOVA was performed to determine if there were significant differences in FRTO ratings across groups.

Findings

Research question 1 – construct validity

Initially, our plan was to use a larger sample to conduct a CFA to validate the suggested factor structure from the previous study by Martin et al. (2019). However, the fit indices indicated a poor fit (CFI of 0.748, TLI of 0.727, RMSEA of 0.109, and SRMR of 0.084), suggesting the need for further investigation of the factor structure. To obtain more stable results and identify a model with better fit, we adopted a theory-building approach (EFA) rather than a theory-testing approach (EFA), given the poor fit of the data to the factor structure proposed by Martin et al. (2019) and the lack of consensus in the literature regarding the appropriate factor structure for faculty readiness in online teaching. The results suggested some modifications to the proposed framework, with some items not aligning well with the pre-set factor structure (Table 3). Items with absolute factor loadings of less than 0.30 were deemed not relevant to their corresponding factor, and each of the four factors was redefined based on the factor loadings (Table 4). Although item 23 had a higher factor loading on the second factor, it
<table>
<thead>
<tr>
<th>Course design</th>
<th>F1</th>
<th>F2</th>
<th>F3</th>
<th>F4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Create an online course orientation (e.g. introduction, getting started)</td>
<td>0.395</td>
<td>0.251</td>
<td>0.155</td>
<td>0.142</td>
</tr>
<tr>
<td>Write measurable learning objectives</td>
<td>0.348</td>
<td>0.239</td>
<td>0.230</td>
<td>0.185</td>
</tr>
<tr>
<td>Design learning activities that provide students opportunities for interaction (e.g. discussion forums, wikis)</td>
<td>0.708</td>
<td>0.082</td>
<td>0.039</td>
<td>0.091</td>
</tr>
<tr>
<td>Organize instructional materials into modules or units</td>
<td>0.202</td>
<td>0.650</td>
<td>−0.051</td>
<td>−0.002</td>
</tr>
<tr>
<td>Create instructional videos (e.g. lecture video, demonstrations, video tutorials)</td>
<td>0.211</td>
<td>0.442</td>
<td>0.217</td>
<td>0.166</td>
</tr>
<tr>
<td>Use different teaching methods in the online environment (e.g. brainstorming, collaborative activities, discussions, presentations)</td>
<td>0.586</td>
<td>0.245</td>
<td>−0.006</td>
<td>−0.010</td>
</tr>
<tr>
<td>Create online quizzes and tests</td>
<td>0.669</td>
<td>0.193</td>
<td>0.039</td>
<td>0.066</td>
</tr>
<tr>
<td>Create online assignments</td>
<td>0.693</td>
<td>0.086</td>
<td>0.082</td>
<td>−0.002</td>
</tr>
<tr>
<td>Manage grades online</td>
<td>0.395</td>
<td>0.251</td>
<td>0.155</td>
<td>0.142</td>
</tr>
<tr>
<td><strong>Course communication</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Send announcements/email reminders to course participants</td>
<td>0.683</td>
<td>−0.168</td>
<td>0.230</td>
<td>0.057</td>
</tr>
<tr>
<td>Create and moderate discussion forums</td>
<td>0.319</td>
<td>0.237</td>
<td>0.251</td>
<td>0.183</td>
</tr>
<tr>
<td>Use email to communicate with the learners</td>
<td>0.681</td>
<td>−0.249</td>
<td>0.080</td>
<td>0.175</td>
</tr>
<tr>
<td>Respond to student questions promptly (e.g. 24–48 h)</td>
<td>0.307</td>
<td>−0.237</td>
<td>0.206</td>
<td>0.391</td>
</tr>
<tr>
<td>Provide feedback on assignments (e.g. 7 days from submission)</td>
<td>0.118</td>
<td>−0.230</td>
<td>0.192</td>
<td>0.497</td>
</tr>
<tr>
<td>Use synchronous web-conferencing tools (e.g. Adobe Connect, Webex, Blackboard Collaborate, Skype)</td>
<td>0.104</td>
<td>0.618</td>
<td>0.161</td>
<td>0.028</td>
</tr>
<tr>
<td>Communicate expectations about student behavior (e.g. netiquette)</td>
<td>0.095</td>
<td>0.070</td>
<td>0.723</td>
<td>0.002</td>
</tr>
<tr>
<td>Communicate compliance regarding academic integrity policies</td>
<td>0.108</td>
<td>−0.055</td>
<td>0.830</td>
<td>−0.048</td>
</tr>
<tr>
<td>Apply copyright law and fair use guidelines when using copyrighted materials</td>
<td>−0.057</td>
<td>0.028</td>
<td>0.805</td>
<td>−0.060</td>
</tr>
<tr>
<td>Apply accessibility policies to accommodate student needs</td>
<td>−0.100</td>
<td>0.071</td>
<td>0.574</td>
<td>0.133</td>
</tr>
<tr>
<td><strong>Time management</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Schedule time to design the course prior to delivery (e.g. a semester before delivery)</td>
<td>0.054</td>
<td>0.116</td>
<td>−0.010</td>
<td>0.620</td>
</tr>
<tr>
<td>Schedule weekly hours to facilitate the online course</td>
<td>0.072</td>
<td>0.055</td>
<td>−0.022</td>
<td>0.787</td>
</tr>
<tr>
<td>Use features in learning management system in order to manage time (e.g. online grading, rubrics, SpeedGrader, calendar)</td>
<td>0.146</td>
<td>0.302</td>
<td>0.160</td>
<td>0.331</td>
</tr>
<tr>
<td>Use facilitation strategies to manage time spent on course (e.g. discussion board moderators, collective feedback, grading scales)</td>
<td>−0.069</td>
<td>0.370</td>
<td>0.304</td>
<td>0.327</td>
</tr>
<tr>
<td>Spend weekly hours to grade assignments</td>
<td>0.193</td>
<td>−0.096</td>
<td>−0.079</td>
<td>0.769</td>
</tr>
<tr>
<td>Allocate time to learn about new strategies or tools</td>
<td>−0.327</td>
<td>0.261</td>
<td>0.161</td>
<td>0.628</td>
</tr>
<tr>
<td><strong>Technical competence</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Complete basic computer operations (e.g. creating and editing documents, managing files and folders)</td>
<td>0.714</td>
<td>0.088</td>
<td>0.020</td>
<td>−0.006</td>
</tr>
<tr>
<td>Navigate within the course in the learning management system (e.g. Moodle, Canvas, Blackboard, etc.)</td>
<td>0.717</td>
<td>0.233</td>
<td>−0.010</td>
<td>0.025</td>
</tr>
<tr>
<td>Use course roster in the learning management system to set up teams/groups</td>
<td>0.171</td>
<td>0.484</td>
<td>0.131</td>
<td>0.149</td>
</tr>
<tr>
<td>Use online collaborative tools (e.g. Google Drive, Dropbox)</td>
<td>0.142</td>
<td>0.692</td>
<td>0.070</td>
<td>−0.005</td>
</tr>
<tr>
<td>Create and edit videos (e.g. iMovie, Movie Maker, Kaltura)</td>
<td>0.006</td>
<td>0.721</td>
<td>0.046</td>
<td>0.007</td>
</tr>
<tr>
<td>Share open educational resources (e.g. learning websites, Web resources, games and simulations)</td>
<td>0.010</td>
<td>0.530</td>
<td>0.111</td>
<td>0.229</td>
</tr>
<tr>
<td>Access online help desk/resources for assistance</td>
<td>0.157</td>
<td>0.275</td>
<td>0.372</td>
<td>0.145</td>
</tr>
</tbody>
</table>

**Note(s):** The italicized values indicate the largest factor loading among the four factors

**Source(s):** Authors’ own creation/work

Table 3. Faculty readiness to teaching online factor loadings
was retained in the last factor due to its close content alignment with factor 4. The Alpha coefficients were found to be 0.96 and Omega H was 0.75, indicating satisfactory reliability of the instrument.

**Research question 2 – differential validity**

Regarding DIF analysis, three items were flagged by gender: item 9 (“Create and moderate discussion forums”), item 11 (“Complete basic computer operations”), and item 23 (“Use facilitation strategies to manage time spent on course”). Item 9 showed non-uniform DIF, with female faculty reporting higher confidence on this item than male faculty when their overall efficacy is low, but rating it lower than males when their overall efficacy is high. Item 11 exhibited differential power of discrimination depending on gender, being more effective in discriminating between low and high teaching efficacy for female faculty than for male
faculty. For item 23, male faculty were more lenient on this item than female faculty, particularly those with low overall efficacy. However, the magnitude of DIF was not substantial when considering the difference in item parameter estimates (see Table 5). The IRT item parameter estimates for male and female groups are presented in Table 5, with most items having only one or two difficulty parameters due to limited responses (some response categories were merged if the number of responses was smaller than 5).

When examining age as a potential source of item bias, four items were identified as potentially problematic (Table 6). Specifically, item 18 (“Respond to student questions promptly”) was found to be more effective in discriminating among older faculty compared to younger faculty, while items 19 (“Provide feedback on assignments”) and 24 (“Spend weekly hours grading assignments”) were rated higher by older faculty compared to younger faculty. In contrast, younger faculty tended to be more lenient on item 29 (“Use online collaborative tools”) compared to older faculty who held the same level of overall teaching efficacy.

Research question 3 – convergent validity

The correlation analysis revealed a significant positive association between years of online teaching experience and FRTO-efficacy (Spearman rho = 0.207; p < 0.001), indicating that faculty members who had been teaching online for longer felt more confident in their ability to do so effectively. However, there was no significant correlation between years of online teaching and FRTO-perception (Spearman rho = −0.058; p = 0.3124), suggesting that the perceived importance of online teaching practices did not vary with years of experience. This finding is not unexpected, as teaching efficacy tends to improve with more experience (Shea, 2007), but the perceived importance of specific teaching practices may be influenced by other factors.

The ANOVA test indicated no significant difference in FRTO-perception across the four categories of primary teaching modality (3, 297) = 0.933, = 0.425. In contrast, FRTO-efficacy showed significance (3, 297) = 16.13, <0.001, partial = 0.14. Post-hoc multiple comparisons with Tukey’s Honestly Significant Distance (HSD) identified a significant difference between asynchronous (M = 145.2, SD = 11.8) and face-to-face (M = 131.9, SD = 17.9),

<table>
<thead>
<tr>
<th>Item</th>
<th>Female</th>
<th>Male</th>
<th>Female</th>
<th>Male</th>
<th>Female</th>
<th>Male</th>
</tr>
</thead>
<tbody>
<tr>
<td>9: Create and moderate discussion forums</td>
<td>2.656</td>
<td>3.763</td>
<td>-1.954</td>
<td>-1.500</td>
<td>-0.271</td>
<td>-0.632</td>
</tr>
<tr>
<td>11: Complete basic computer operations</td>
<td>4.316</td>
<td>1.330</td>
<td>-0.901</td>
<td>-1.567</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>23: Use facilitation strategies to manage time spent on course</td>
<td>2.332</td>
<td>2.435</td>
<td>-0.908</td>
<td>-1.467</td>
<td>0.486</td>
<td>0.421</td>
</tr>
</tbody>
</table>

Source(s): Authors’ own creation/work

<table>
<thead>
<tr>
<th>Item</th>
<th>&lt;50 years</th>
<th>&lt;50 years</th>
<th>&lt;50 years</th>
</tr>
</thead>
<tbody>
<tr>
<td>18: Respond to student questions promptly</td>
<td>3.677</td>
<td>2.188</td>
<td>-1.077</td>
</tr>
<tr>
<td>19: Provide feedback on assignments</td>
<td>2.319</td>
<td>1.213</td>
<td>-1.006</td>
</tr>
<tr>
<td>24: Spend weekly hours to grade assignments</td>
<td>3.607</td>
<td>1.373</td>
<td>-0.363</td>
</tr>
<tr>
<td>29: Use online collaborative tools</td>
<td>1.643</td>
<td>2.090</td>
<td>-1.290</td>
</tr>
</tbody>
</table>

Source(s): Authors’ own creation/work

Validation of the FRTO scale

Table 5. Differential item functioning analysis results for gender

<table>
<thead>
<tr>
<th>Item</th>
<th>&lt;50 years</th>
<th>&lt;50 years</th>
<th>&lt;50 years</th>
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<td>2.090</td>
<td>-1.290</td>
</tr>
</tbody>
</table>

Source(s): Authors’ own creation/work

Table 6. Differential item functioning analysis results for age
<0.001. Additionally, face-to-face also differed significantly from synchronous ($M = 142.0, SD = 13.3, <0.01$) and hybrid ($M = 142.0, SD = 12.3, <0.001$) modalities.

Finally, the completion of required training in online teaching did not lead to significance for both FRTO-perception ($1, 303 = 0.092, = 0.762$, and FRTO-efficacy ($1, 303 = 0.592, = 0.592$).

Discussion and originality
The present study aimed to evaluate the validity of the FRTO instrument in terms of construct, differential, and convergent validity. The findings confirmed the previous study’s results (Martin et al., 2019) and provided some modifications to the instrument. The factor structure did not conform to the original four factors proposed in the instrument; instead, the newly loaded factors were course design and facilitation, course technologies, course expectations and resources, and time management (see Figure 2).

1. Course design and facilitation: Items on design and facilitation loaded together, indicating that facilitation items have to also be set up during design.
2. Course technologies: Online courses rely heavily on technologies, and several items loaded together for a factor on technologies.
3. Course expectations and resources: Policies and resources are critical for online teaching.
4. Time management: Time management is essential for online courses so that the online instructor does not get overwhelmed and this resulted in a factor structure.

Based on the differential validity analysis, three items exhibited significant differences between male and female faculty. To better understand the potential causes of these differences, relevant literature was consulted. Campbell and Varnhagen (2002) found that female faculty prefer using communication technologies such as email and discussion forums. Almuqayteeb (2009) reported that female faculty tend to have positive attitudes towards adopting technology tools. Schifter (2002), on the other hand, observed that female faculty faced more difficulties in integrating technology into their teaching. In contrast, male faculty were found to be more up-to-date with information on technology (Spotts et al., 1997). These findings imply the possibility of variations in online teaching practices attributed to

Figure 2. Modified factors of FRTO

Source(s): Author’s own creation/work
gender, and potentially indicate the presence of a secondary construct, such as technology adaptability. Considering the insights provided by the literature, it does not appear that the existence of this secondary construct points towards gender bias. Instead, the group-level disparities related to the secondary construct might have contributed to the identified DIF, which emphasizes the importance of encompassing this secondary construct within the instrument. Furthermore, after a thorough content review of the three items, no substantial issues were uncovered. Thus, we concluded that retaining these three items in the instrument is appropriate.

Four items were flagged for potential item bias due to faculty age. Older faculty tended to rate items higher that belong to “Time Management,” while younger faculty reported higher on an item that assesses faculty’s capability of using external tools. These differences may be due to actual differences in teaching practices among age groups. For example, research by Joshi et al. (2022) found a significant relationship between satisfaction with online teaching and age, attributing this relationship to the fact that older faculty develop coping mechanisms that result in less burnout (Saini et al., 2021). Additionally, Schifter (2002) found that junior faculty feel more comfortable with technology. Therefore, it is likely that the two age groups differ in two distinct areas of online teaching competence: time management and technology. Given this evidence, we suggest that these items can be used without further investigation.

The results of the convergent validity analysis support the validity of the FRTO instrument. Specifically, we found a significant positive relationship between years of online teaching and FRTO scores, which is consistent with previous research (Downing and Dyment, 2013; Lichoro, 2015). In addition, we identified significant differences in FRTO scores between instructors whose primary teaching modality was asynchronous versus face-to-face, as well as between face-to-face and synchronous, and face-to-face and hybrid modalities. These findings make sense since faculty who primarily teach online or in blended formats would likely have more confidence and experience in online teaching compared to those who mainly teach face-to-face.

Implications and future directions/limitations
A fine assessment of online teaching competencies can inform faculty to revise their online courses as needed, and higher education institutions can support their faculty through professional development initiatives. The revised instrument can be presented and discussed at online teaching professional development programs to help faculty understand the core competencies they need to better instruct students. The FRTO can be used as (1) a self-assessment tool for faculty who currently teach online or are trained to teach online, (2) an evaluation rubric for peer observation, and (3) a resource for instructional designers to help faculty better prepare for online teaching.

Additionally, by objectively and reliably measuring faculty readiness for online teaching, institutions can make informed-decisions by using this validated instrument. The ratings from the FRTO instrument can play a role in institutional decision-making processes related to faculty recruitment, promotion, and tenure. Eventually, this validated measure has the potential to enhance the quality of online education. By identifying the key competencies and factors that contribute to effective online teaching, institutions can strategically allocate resources to bolster faculty proficiency in these areas, which may ultimately lead to better learning outcomes and student satisfaction in online courses.

The theoretical contribution of this study lies in its refinement of the conceptualization of faculty readiness for online teaching. As pointed out by Lim (2023), the lack of consensus regarding the factor structure of online teaching readiness poses a challenge. A thorough scrutiny of FRTO, a most widely adopted scale for evaluating online teaching readiness, has
advanced our understanding of this construct. While several researchers advocated for the inclusion of institutional elements, such as professional development programs, technical support, and digital tools or systems, in the delineation of online teaching readiness (Howard et al., 2021; Scherer et al., 2021), FRTO did not incorporate this factor. Instead, the scale predominantly aims to assess individual faculty’s readiness and enhance their preparedness for effective online teaching. The outcome of this study, therefore, presents a comprehensive framework that captures the multifaceted essence of online teaching readiness. Also, even though there are subtle differences in terminology, the factor structure closely aligns with Gay (2016)’s three-factor model that includes technical, lifestyle, and pedagogical facets. When comparing these frameworks, FRTO further refines the “lifestyle” aspect by introducing two dimensions, namely “Course expectations and resources” and “Time management” to adequately address their distinct attributes.

The study further contributes to the existing literature by empirically validating the FRTO instrument. By examining construct validity, differential validity, and convergent validity, the study establishes the reliability and validity of the FRTO instrument. This rigorous validation process eventually enhances confidence in its use as a reliable measure of faculty readiness for online teaching. This heightened rigor lends weight to future research endeavors in this area. Particularly, the COVID-19 pandemic prompted a notable lack of adequate preparedness among many instructors in higher education (Brooks and Grajel, 2020). Consequently, there has been an amplified urgency to comprehensively assess faculty preparedness for transition to online courses. This validated measure can serve as a diagnostic tool to assist online instructors.

However, it is important to note some limitations of this study. Firstly, while the results support the validity of the instrument, there is no direct checkbox that confirms the validity of a measure. Validity is established through a combination of empirical evidence and theoretical rationale. Therefore, there may be additional validity evidence that needs to be examined in future research. Additionally, this study did not conduct confirmatory factor analysis (CFA), and it would be valuable to confirm the newly proposed factor structure using CFA in future research. Lastly, differential validity evidence suggests that some items may need further examination for potential gender bias. Future research should investigate whether this is due to inadvertent impact or actual differences in online teaching practices.

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**Corresponding author**
Stella Y. Kim can be contacted at: stella-kim@uncc.edu