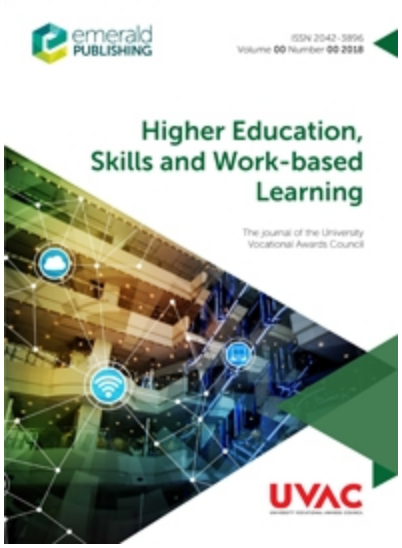

A transnational comparative study of preservice teachers' critical thinking skills and metaliteracy self-efficacy

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Nb. Version edited by the author due to errors in the automatic cross-reference fields to the tables and a mistake in the Table A6 note.

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Abstract

Purpose. While training students to new literacy and critical thinking has been recognized for several decades, it seems even more crucial today as education is presented as a lever to fight against fake news. Preservice teachers, both so-called digital natives at the cutting edge of the social web and tomorrow's educators, represent a useful object of study.

Methodology. Using a quantitative methodology, this article is part of sequential mixed design research aiming to describe the level of preservice teachers' (n = 245) critical thinking in three French-speaking nations: Wallonia, France, and Quebec. We aimed to see to what extent critical thinking skills (measured with a translated version of the Halpern Critical Thinking Assessment; Halpern, 2016) can notably be influenced by metaliteracy self-efficacy. Metaliteracy is a concept that aims to join information, digital, and media literacy providing a comprehensive framework "for engaging with individuals and ideas in digital environments" (Mackey and Jacobson, 2011, p. 70).

Findings. We establish the influence of individual determinants such as the feelings of self-efficacy in metaliteracy as well as the belief in the likelihood of becoming a teacher. We propose a model predicting the critical thinking skills based on self-efficacy in critical thinking and metaliteracy, the type of training, and the interaction between employment and the country of study.

Originality. Considering contemporary information issues and infodemic phenomena, critical thinking skills should be developed among preservice teachers. There is a significant positive correlation between metaliteracy self-efficacy and critical thinking skills. Pre-service teachers' country of study, as well as their training trajectory, seems to influence their critical thinking skills. Involvement in professional life also appears to promote critical thinking skills.

Keywords

critical thinking skills; information literacy; digital literacy; teacher training

Introduction

We live in a time of ever-accelerating social mediation of information where traditional intermediaries are gradually replaced by apomediaries, which are resources or individuals guiding consumers to trustworthy information or contributing to enhancing the credibility of information (Eysenbach, 2007) With the contemporary overabundance of information, we might assume that better-informed students would be better trained. This is why critical thinking and literacies (information literacy, digital literacy, etc.) are widely considered as 21st-century skills (van Laar *et al.*, 2017), valued in and out of the educational context. However, students can be impaired in their ability to distinguish fake news or to identify underlying intentions (Flood, 2015). Of course, teachers' relation to information is impacted by the digital revolution. For example, teachers are on the front lines to deconstruct conspiracy theories in their classrooms. In the pandemic context of "infodemia" and disinformation, the issue of information literacy and critical thinking skills becomes all the more relevant for education professionals (Puig *et al.*, 2021). If the level of study or profession doesn't

entirely prevent beliefs, education is probably one of the keys to address the issue. For example, it seems that people with higher education levels are less likely to believe in conspiracy theories (van Prooijen, 2017) and critical thinking is a way to help students to avoid non-empirical messages (Blair, 2012).

Many subskills are interrelated between information literacy and critical thinking (Desfriches Doria, 2018). This is particularly true with metaliteracy, an emerging conceptualization of literacies. It inspired the recent Quebec *Digital Competency Framework* (Ministère de l'Éducation et de l'Enseignement supérieur, 2019) and has been partially remobilized in recent ACRL (2016) framework. The latter strengthens the central idea of metaliteracy which encompasses critical self-reflection (Mohamed, 2019). Critical thinking can be defined, among various definitions, as "the propensity and skill to engage in an activity with reflective scepticism" (McPeck, 1981, p. 8).

During the last two decades, learners' information literacy has been studied in Wallonia (Belgium) and Quebec, as well as in France with similar methodology. Results obtained seem to attest that many undergraduate students have weak knowledge of the basic elements of the information search process in traditional environments (Pochet, 2016). Also, a meta-analysis seems to confirm that following vocational training (VT) has a positive impact on critical thinking skills and dispositions (Fong *et al.*, 2017). Considering the previous research between these three nations and the fact that the latter have specific teacher training programs (disciplinary or vocational training), it seems useful to extend the comparative study by adopting a renewed conceptual basement.

Literature Review

About Critical Thinking

Critical thinking is the subject of a great variety of definitions, but we can consider that it "is good thinking that is well reasoned and well supported with evidence" (Butler and Halpern, 2020, p. 152): to that, it is purposeful, reasoned, and goal-directed (Halpern, 1998). There is an agreement around conceptual key elements, like judgment, reasoning, reflective thinking, and metacognition (Fischer, 2001), which are mobilized to achieve the desired result by thinking rationally and in a goal-oriented fashion (Butler, 2012).

Critical thinking can be characterized by a set of skills that are: i) verbal reasoning (e.g., recognizing rhetorical fallacies); ii) argument analysis (e.g., distinguishing between facts and opinions, identifying argumentation); iii) hypothesis testing (e.g., discussing on causality and explanations based on empirical information); iv) likelihood and uncertainty (e.g., evaluating odds and chances); v) decision-making and problem-solving (e.g., selecting decisions or behavior from among plausible choices) (Butler and Halpern, 2020).

Since having critical thinking skills does not necessarily lead to a critical thinking process, critical thinking is not only a list of skills: that is also dispositions to use those skills and strategies because it is important to be disposed to put them into practice when necessary (Butler and Halpern, 2020; Hitchcock, 2018). Dispositions are

inclinations "to do something, given certain conditions" (Ennis, 1996). Therefore, contemporary theorization suggests understanding critical thinking as a set of skills and attitudes (Butler and Halpern, 2020). The *Delphi Report* model (Facione, 1990), identifies seven dispositions which are truth-seeking, open-mindedness, analyticity, systematicity, inquisitiveness, maturity of judgment, and critical thinking self-confidence.

Ennis and Scott (2018) identified 38 tools to measure critical thinking. Moreover, only three of these tools quantifying critical thinking skills or dispositions are available in French. Two of them focus on skills (the *Watson-Glaser Critical Thinking Appraisal*; WGCT and the *Cornell Critical Thinking Test*; CCTT) and one on the dispositions (the *California Critical Thinking Disposition Inventory*; CCTDI). The French versions of these tools (the WGCTA and the CCTT) appear to be unstudied and are based on different models. The third tool identified in French, the CCTDI, is based on *Delphi Report* model dispositions. Despite the usefulness of this tool, its restricted access encourages the use of another measuring tool and the choice of a more parsimonious approach that will allow us to discuss the effect of self-efficacy.

Metaliteracy and Critical Thinking

Critical thinking and information literacy (particularly content evaluation literacy) have overlapping conceptions (Hollis, 2019), suggesting some integration between literacy and critical thinking. Since the 2000s we see a conceptual reconstruction of literacies that echoes the lowering media boundaries enabled by ICT. For example, the latest ACRL (2016) framework suggests that maintaining an open mind and a critical stance is an ability to address research as an inquiry. Thus, the concept of Metaliteracy "is envisioned as [. . .] model for information literacy to advance critical thinking and reflection in social media" (Jacobson and Mackey, 2013, p. 84) and fits our new information and media environments (Špiranec, 2014). This conceptual junction between critical thinking and reframed literacies are for the future on the educational level: first, it results in bringing closer new media contexts and critical thinking; secondly, it makes it possible to operationalize critical thinking through information, digital, or media literacies skills frameworks. The portrayal of the critical thinker as an "amiable skeptics that investigate claims, but also evaluate their own claims and attempt to overcome their own biases" (Butler and Halpern, 2020, p. 156) is consistent with the portrayal of the metaliterate learner "always challenging his or her own biases through metacognitive thinking" (Mackey, 2019, p. 1) and the information literate learner with a "skeptical stance and with a self-awareness of their own biases and worldview" (ACRL, 2016, p. 4).

Yet, there is an anticipated articulation between information literacy and critical thinking (Desfriches Doria, 2018; Hollis, 2019). In short, we support the idea that critical thinking "for evaluating information should now be considered a basic literacy" (Georgiadou *et al.*, 2018, para. 1) and that's why metaliteracy offers a promising avenue to apprehend needed skills in the social-networks age. The concept is consistent with recent rapprochements between information, digital, media, or visual literacies. Four goals are suggested for learners: i) actively evaluate content while also evaluating one's own biases; ii) engage with all intellectual property, ethically and responsibly; iii) produce and share information on collaborative and participatory environments; iv) develop learning strategies to meet lifelong personal and professional goals (Mackey

and Jacobson, 2018). Learning objectives are linked to behavioral (what someone should be able to do), affective (learners' emotions or attitudes), cognitive (what students should know), and metacognitive (what learners think about their thinking) engagement with information and information ecosystem. Alongside learning objectives that echo the current evolving information ecosystem, "traditional" information literate skills can be linked to the so-called conceptual core of information literacy defined by Špiranec (2014), *i.e.,* finding, evaluating, using, or communicating information. Metaliteracy gives an important role to metacognitive and self-reflective skills in an increasingly complex information environment (Marzal and Martínez-Cardama, 2020)

Although little has been said on the subject, self-efficacy has a direct influence on information literacy in the same way that self-confidence is a part of critical thinking dispositions and influences critical thinking skills. Furthermore, if all new literacies (especially metaliteracy) are considered as interlinked with critical thinking, then one can assume that the self-efficacy for evaluating elements will influence critical thinking. A strong self-efficacy perception is essential for self-regulation, but also information literacy development throughout life (Kurbanoglu, 2003): ICT regular use and information literacy are positively correlated to ICT self-efficacy perception. For example, students with high levels of self-efficacy have a higher propensity to use library databases than students with low levels of information literacy (Tang and Tseng, 2013). Kurbanoglu *et al.* (2006) developed a scale to measure self-efficacy relating to traditional information literacy. The validity and fidelity indices established during the exploratory factor analysis of this "ILSE" scale are conclusive. More recently, Sommer & al (2021) displayed an adequate fit with the observed data by confirmatory factor analysis. Nevertheless, there is no self-efficacy scale considering conceptual evolution related to literacies and we believe that the development of instruments that respond to conceptual and societal changes is essential. That's why we developed and validated a self-efficacy scale based on partial metaliteracy goals and objectives (Author 1, 2020; *cf.* 4.3).

Research Questions

The research aimed to describe preservice teachers' critical thinking skills scores notably regarding environmental factors (training type, country of study, employment) and personal determinants (metaliteracy self-efficacy, belief in the likelihood to become a teacher) in three French-speaking nations (Wallonia, France, and Quebec).

The two research questions (RQ) were: RQ_i) what is the critical thinking skill level of 1st-year preservice teachers and how do they perceive and evaluate their metaliteracy skills?; RQ_{ii}) is Metaliteracy self-efficacy a good predictor of critical thinking skills or is the potential gap among preservice teachers the fruit of other characteristics?

Methodology

Background

This article is part of broader research conducted in Wallonia (French-speaking region of Belgium), France, and Quebec (principal French-speaking part of Canada). We focused on preservice secondary school history teachers to ensure a certain homogeneity of the sample.

It is meaningful to examine future teachers' skills because they will be at the core of educational projects against fake news. Quebec and the French Community of Belgium have chosen vocational training from the beginning of university education for their preservice teachers. French Community of Belgium also offers teaching training at the second cycle of university: this approach, which is also favored in France, involves completing a baccalaureate program in a disciplinary specialization first. These three countries provide a useful field to compare the effect of vocational training (VT) versus disciplinary training (DT).

Sample & Participants

Data collection took place in five establishments: one in France (Université Bordeaux-Montaigne), two in Quebec (Université de Montréal), and two in Wallonia (Université de Namur, and Henallux). This is a non-probabilistic convenience sample. The research sample is composed of preservice teachers entering higher education (1st year) and believing in the likelihood to become a teacher history in secondary/high school. We selected 245 responses ($n = 245$) that met these criteria. We focused our study on 2 types of training: the 1st one consists of preservice teachers in a post-secondary VT ($n = 63$); the 2nd consists of preservice teachers in a post-secondary disciplinary training DT ($n = 182$). Quebec preservice teachers in VT must complete a bachelor's degree (BA) in Secondary Social Sciences Education. French preservice teachers are in DT: preservice teachers should first complete a BA in History, Art History or Archaeology before attending a graduate program in Education. Finally, in Wallonia, the 2 options are available: the 1st alternative is to complete a "*régendat*" in Human Sciences Education like in Quebec (VT); the 2nd alternative is to complete a disciplinary program (e.g., a BA in History, Art History or Archaeology) before entering a graduate program in Education like in France (DT). Figure 1 summarizes the structure of the sample by country of study and the type of training.

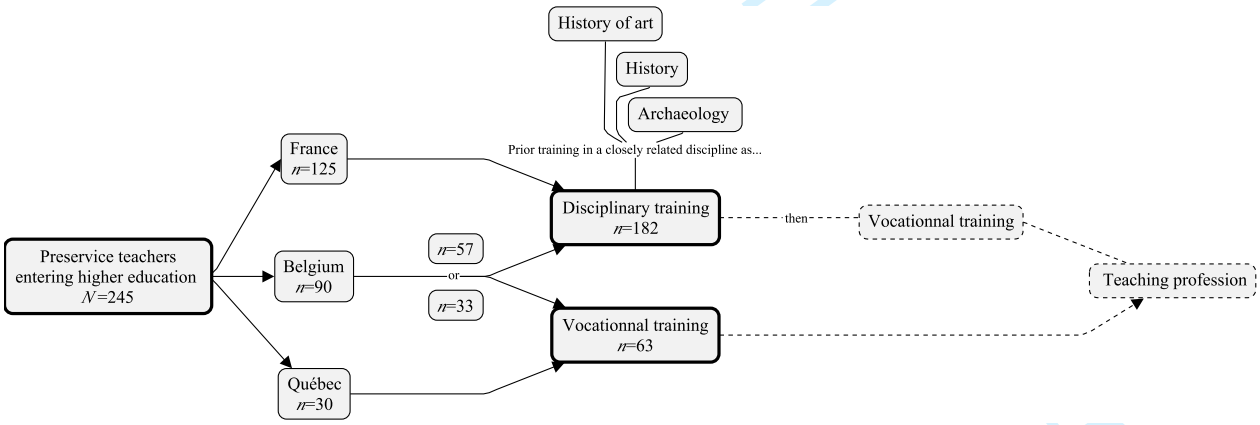

Figure 1. Structure of the sample by country of study and type of training.

Design and Instruments

The Halpern Critical Thinking Assessment (HCTA) is one of the most recent critical thinking skills tests. It assesses a five-factor model that is taken from the above-mentioned Halpern (1998) model. This test has two main versions: each of them is available in short (multiple-choice questions, MCQ) or long versions (open questions and MCQ). Compared to CCTT, HCTA is preferred by students and results show a good content validity (Verburgh *et al.*, 2013). For the HCTA translation into French, we adopted the short version (with MCQ) and followed the cross-cultural validation method (Vallerand, 1989). The confirmatory factor analysis (CFA) suggests that once reduced to 10 items (instead of 20), the 5-factor model specified by the author who developed the scale display adequate fit with the observed data collected; reliability is acceptable to good, $\omega_t = .78$ et $\alpha = .66$ (Author 1 *et al.*, 2021). This reduced version of the HCTA is called HBCTSS (HCTA Based Critical Thinking Skills Score).

Finally, metaliteracy self-efficacy (MASE) is a 16-item scale based on the thirty-two metaliteracy learning objectives (Mackey and Jacobson, 2018). Score reliability is excellent ($\alpha = .92$, $\omega = .92$) and EFA supports the one-factor model proposal (Author 1, 2020). Respondents must rate on a scale of 1 to 10 (1 = "Strongly disagree"; 10 = "Strongly agree") what they feel they can do.

Data Collection

Data were collected between December 2018 and March 2019. Essentially, surveys were completed face-to-face, during a course, for students at the University of Bordeaux-Montaigne, the University of Montreal, the University of Namur, and Henallux at the Malonne site ($n = 233$). Marginally, surveys were completed remotely for students at UQAM and at Henallux in Bastogne ($n = 12$). In all cases, these were digital forms administered on the Internet within a 40-minute time frame.

Analysis

Data preparation

We used the *k*-nearest neighbors (*k*NN) method which can be used regardless of the type of missing data (random or not). Data have been standardized (*z*-score).

Tests

RQ_i. As a first step, we sought to identify the extent to which scores on the HBCTSS and MASE scales might vary across the sample. We studied these interactions using Two-ways ANOVA. Finally, we also tested the score on these scales according to other independent variables such as gender and year of birth with One-Way ANOVA.

RQ_{ii}. We proceeded to a regression based on the general linear model. A stepwise model selection by Akaike Information Criterion (*AIC*) was performed, starting with a complete model, and testing the deletion of factors whose loss gives the most statistically insignificant deterioration of the model fit.

Data were analyzed with *RStudio Desktop* 1.4.1717 (*R* 4.1.1).

Results

Sample Characteristics

There are many demographic disparities among cases and countries as we can see in Table 1 about gender: unlike other cases where the male-female ratio is rather balanced, Wallonia vocational training is predominantly male (2/3 of respondents). In addition, we note that Quebec preservice teachers work far more than their Wallonian and French counterparts: only 10% of Quebec preservice teachers don't work in addition to their studies, while the proportion of unemployed preservice teachers is 85.6% in Wallonia and 74.4% in France (Table 1

Distribution of Preservice teachers' Gender within Types of Training and Countries

Type of Training	Gender	Country			Total
		Wallonia	France	Quebec	
Disciplinary Training	Men	49.1%	54.4%	-	52.7%
	Women	50.9%	44.0%	-	46.2%
	Other		1.6%	-	1.1%
	Total	100.0%	100.0%	-	100.0%
Vocational Training	Men	66.7%	-	50.0%	58.7%
	Women	30.3%	-	50.0%	39.7%
	Other	3.0%	-		1.6%
	Total	100.0%	-	100.0%	100.0%
Total Sample	Men	55.6%	54.4%	50.0%	54.3%
	Women	43.3%	44.0%	50.0%	44.5%
	Other	1.1%	1.6%	-	1.2%
	Total	100.0%	100.0%	100.0%	100.0%

).

Finally, preservice teachers in vocational training are slightly older: 68.3% of preservice teachers in VT are born before 1999 *vs.* 71.4% of preservice teachers in DT were born in 1999 or later (Table A1).

Table 1

Distribution of Preservice teachers' Gender within Types of Training and Countries

Type of Training	Gender	Country			Total
		Wallonia[1]	France[2]	Quebec[3]	
Disciplinary Training	Men	49.1%	54.4%	-	52.7%
	Women	50.9%	44.0%	-	46.2%
	Other		1.6%	-	1.1%
	Total	100.0%	100.0%	-	100.0%
Vocational Training	Men	66.7%	-	50.0%	58.7%
	Women	30.3%	-	50.0%	39.7%
	Other	3.0%	-		1.6%
	Total	100.0%	-	100.0%	100.0%
Total Sample	Men	55.6%	54.4%	50.0%	54.3%
	Women	43.3%	44.0%	50.0%	44.5%
	Other	1.1%	1.6%	-	1.2%
	Total	100.0%	100.0%	100.0%	100.0%

Table 2

Distribution of Preservice teachers' Employment within Types of Training and Countries

Type of Training	Employment	Country			Total
		Wallonia	France	Quebec	
Disciplinary Training	<20h/week	7.0 %	19.2 %	-	15.4 %
	≥20h/week	1.8 %	6.4 %	-	4.9 %
	Unemployed	91.2 %	74.4 %	-	79.7 %
	Total	100.0 %	100.0 %	-	100.0 %
Vocational Training	<20h/week	24.2 %	-	70.0 %	46.0 %
	≥ 20/week	.0%	-	20.0 %	9.5 %
	Unemployed	75.8 %	-	10.0 %	44.4 %
	Total	100.0 %	-	100.0 %	100.0 %
Total Sample	<20h/week	13.3 %	19.2 %	70.0 %	23.3 %
	≥20/week	1.1 %	6.4 %	20.0 %	6.1 %
	Unemployed	85.6 %	74.4 %	10.0 %	70.6 %
	Total	100.0 %	100.0 %	100.0 %	100.0 %

RQ_i. What is the critical thinking skill level of 1st-year preservice teachers and how do they perceive and evaluate their metaliteracy skills?

An overview of the institution's country. Visually, we can observe that French students have lower scores on critical thinking and metaliteracy self-efficacy scales than their Walloon and, especially, Quebec counterparts (Figure 2). An ANOVA reveals a significant difference in critical thinking skills (HBCTSS) by country, $F(2) = 7.47$, $p =$

[1] Actual distribution between women and men at the Université de Namur (DT) was 54.86% of women and 45,14% of men ($n = 144$) and distribution at Henallux (VT) was 30.99% of women and 69.01% of men (the last reported figures are for the 3 years of the programme).

[2] We didn't get any figures from Université Bordeaux-Montaigne.

[3] Actual distribution between women and men at the Université de Montréal was 36,67% of women and 63,33% of men ($n = 30$). We didn't get any figures from UQAM.

.001, the effect size is medium, $\eta^2_p = .06$, CI95% (.01, .12). The difference is significant between France and Quebec (mean difference: -.76; t[242] = -3.81, p_{holm} <.001, the effect size is large, Cohens'd = -.78, CI95% [-1.18, .37]) and between Wallonia and Quebec (mean difference: -.53; t[242] = -2.57, p_{holm} <.022, the effect size is medium, Cohens'd = -.54, CI95% [-.96, .12]).

In terms of metaliteracy self-efficacy, the difference is above the significance level, $F(2) = 2.81$, $p = .062$, the effect size is small, $\eta^2 = .02$, CI95% (.00, .07). The difference between France and Quebec is slightly above the significance level (mean difference: -.48; t[242] = -2.37, $p_{holm} = .056$, the effect size is medium, Cohens'd = -.48, CI95% [-.88, -.08]).

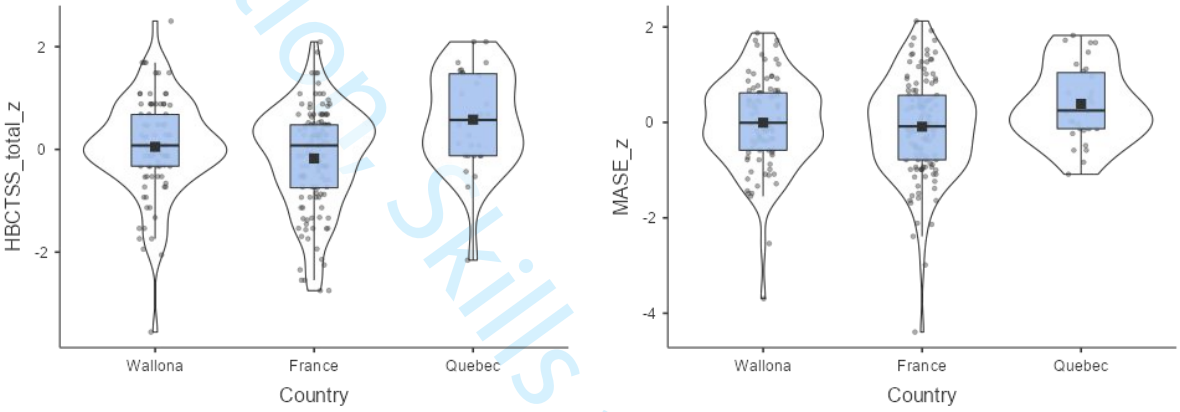

Figure 2. Box plots and violins of standardized HBCTSS (left) and MASE (right) by the institution's country.

An overview of scores by training type. It can also be observed that students in vocational training have very slightly higher scores on critical thinking and metaliteracy self-efficacy scales than their counterparts in disciplinary training (Figure 3). A t-test reveals a non-significant difference in critical thinking skills (HBCTSS) by country, $t(243) = -1.35$, $p = .179$, the size effect is small, Cohens'd = -.20, CI95% (-.48, .09). In terms of metaliteracy self-efficacy, the difference is significant, $t(243) = -2.68$, $p = .008$, the effect size is medium, Cohens'd = -.39, CI95% (-.68, .10).

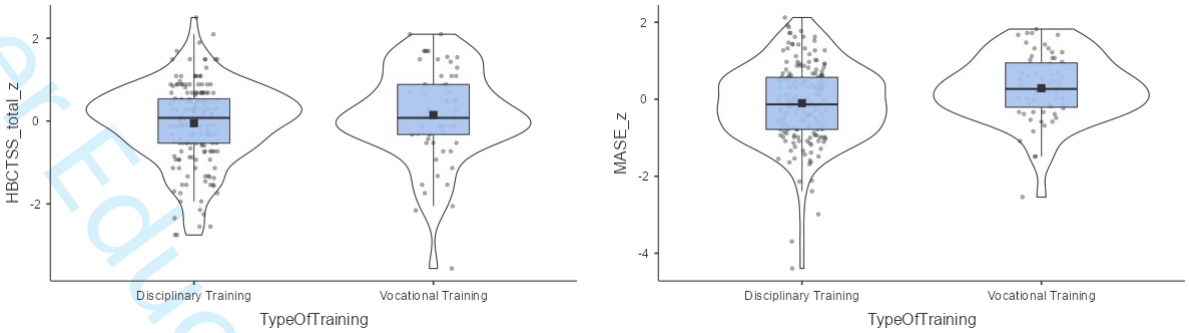

Figure 3. Box plots and violins of standardized HBCTSS (left) and MASE (right) score by type of training.

Interaction between the type of training and likelihood of becoming a teacher. Considering that students in VT believe more that they will become teachers after their studies than their colleagues in disciplinary education (χ^2 [3] = 44.07, p <.001; Cramer's V = .42), we question their combined effect on critical thinking and metaliteracy self-efficacy.

A two-way analysis of variance was conducted on the influence of the two independent variables (type of training and likelihood of becoming a teacher) on HBCTSS. There is no interaction effect, and the main effects are not statistically significant too (Table A2).

Finally, there is no statistically significant interaction effect and main effect on MASE (Table A3). However, there is a significant difference between students considering that it is very likely (7/7) that they will become teachers and students considering that become a teacher is neither likely nor unlikely (4/7) (+.45, *CI*95% [.03, .88], p = .033). There is a significant difference between VT students considering that it is very likely (7/7) that they will become teachers and DT students considering that become a teacher is neither likely nor unlikely (4/7) (+.61, *CI*95%[.00, 1.22], p = .048).

Interaction between the country of study establishment and employment. There are significant differences in employment between countries (χ^2 [4] = 64.72, p <.001; Cramer's V = .36), for example, students in Quebec work more than in France or Wallonia. Thus, we also question their combined effect on critical thinking and metaliteracy self-efficacy.

A two-way analysis of variance was conducted on the influence of the two independent variables (country of study and employment) on HBCTSS (Table A4). The interaction effect is just above the threshold of significance, $F(4,236) = 2.23$, p = .066, with large effect η^2_g = .04, CI95% (.00, .08). The difference between students working less than 20h/week students in Quebec and unemployed students in France is significant (+.86, *CI*95%[.13, 1.59], p = .009). There is also a significant difference between Quebec and French students working less than 20h/week (+1.06, *CI*95%[.15, 1.96], p = .009).

The main effects are significant. The main effect of the country of study yields an F ratio of $F(2,236) = 4.20$, p = .016, η^2_g = .03, CI95% (.00, .08), and the main effect

for employment yields an F ratio of $F(2,236) = 3.57$, $p = .030$, $\eta^2_g = .03$, CI95% (.00, .08).

Finally, there is no statistically significant difference in the two-way analysis of variance done on MASE (Table A5). There is no interaction effect, and the main effect of the country is not statistically significant. The main effect for employment is at the significant threshold, $F(2, 236) = 2.71$, $p = .068$, with a small effect $\eta^2_g = .02$, $CI95\%(.00, .07)$.

About gender and age. Even if the main effects are above the standard significance threshold, with negligible effects (HBCTSS: $F[2, 242] = .70$, $p = .498$, $\eta^2_p = .01$, $CI95\%[.00, .03]$; MASE: $F[2, 242] = 1.22$, $p = .297$, $\eta^2_p = .01$, $CI95\%[.00, .04]$), we identified gender differences in average. Men have higher metaliteracy self-efficacy levels than women (MASE: +.19, $p_{tukey} = .289$) and slightly higher critical thinking scores (HBCTSS: +.15, $p_{tukey} = .475$). Main effects of the year of birth are above the standard significance threshold too, with very small effects (HBCTSS: $F[7, 237] = 1.97$, $p = .059$, $\eta^2_p = .06$, $CI95\%[.00, .09]$; MASE: $F[7, 237] = 1.73$, $p = .103$, $\eta^2_p = .05$, $CI95\%[.00, .08]$): pairwise comparisons reveal small differences that are not significant.

RQ_{ii}. Is Metaliteracy self-efficacy a good predictor of critical thinking skills or is the potential gap among preservice teachers the fruit of other characteristics?

The correlation between the HBCTSS and the MASE was examined. A weak positive but significant correlation between critical thinking skills and metaliteracy self-efficacy can be observed, $r(243) = .23$, $p < .001$, CI95% (.10, .34). If we examine the correlation with the factors composing the HBCTSS (Figure 3), a weak positive correlation is identified for only two of them, the factor "Thinking as hypothesis testing" (above the significance level, $\rho = .11$, $p = .079$) and the "Decision-making and problem-solving" factor (significant, $\rho = .28$, $p < .001$). For the three other factors of the HBCTSS, the correlation with the MASE is almost zero ($\rho \simeq 0$).

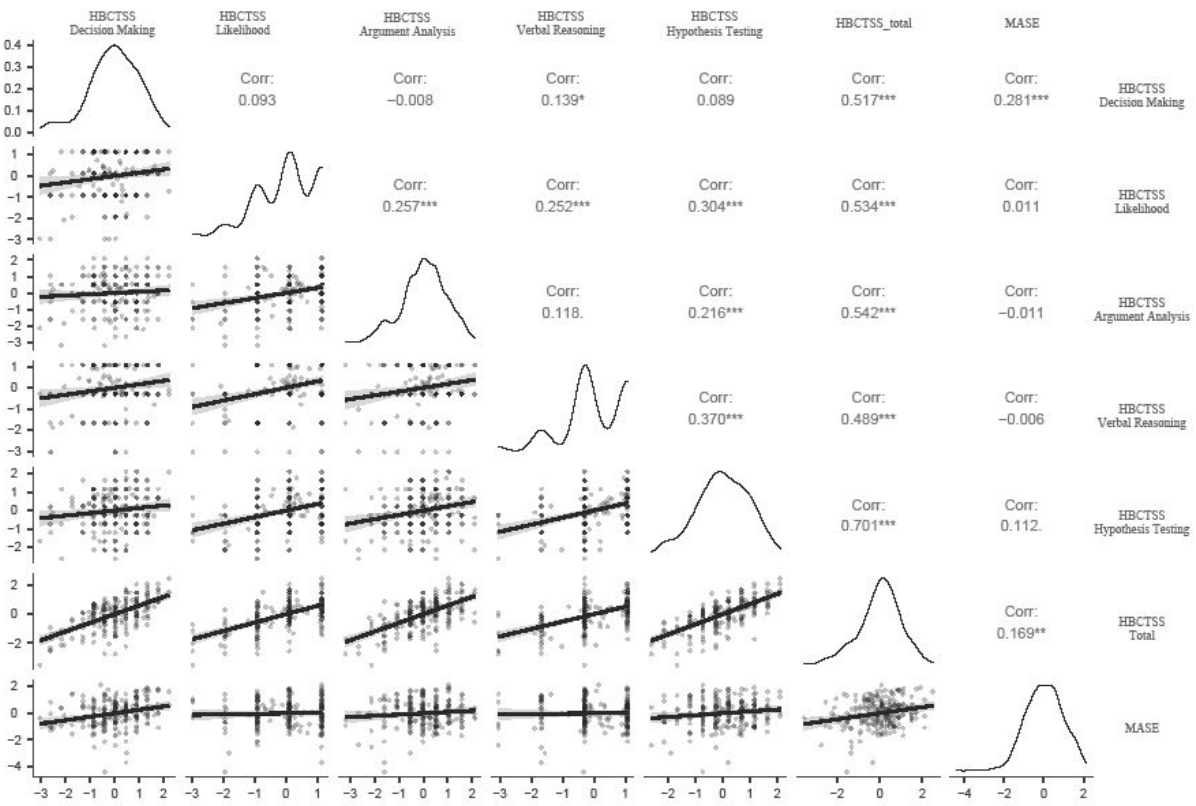

Figure 2. Spearman correlation matrix between MASE, and HBCTS, and its different factors

We tried to develop a model to investigate the factors influencing critical thinking skills, based on metaliteracy self-efficacy and the qualitative variables already mentioned. We did a backward elimination stepwise regression based on *AIC*. The best model to predict HBCTSS should be the one including metaliteracy self-efficacy, type of training, and country of study, with $AIC = -22.41$. The results of the regression indicate that the model is a significant predictor of critical thinking skills score (HBCTSS), $F(4, 240) = 8.21$, $p < .001$. This model explains 12% ($R^2 = .120$) of the variance (Table A6).

MASE, type of training, and country of study have significant effects (respectively $F[1, 240] = 11.74$, $p < .001$; $F[1, 240] = 6.73$, $p = .010$; $F[2, 240] = 9.06$, $p < .001$). The score for disciplinary training students is greater than the score for vocational training students by about ½ standard deviation (+.54, CI95% [.13, .95]). The score of Wallonia students is lower than that of their Quebec counterpart by almost one standard deviation (-.79, CI95% [-1,26, -.32]). Between students in France and Quebec, this difference exceeds the one standard deviation (-1.19, CI95%[-1.26, .32]).

Discussion

The main objective of this research was to describe the level of preservice teachers in critical thinking skills (HBCTSS), and metaliteracy self-efficacy (MASE) in three French-speaking nations.

Is training or employment the most important factor? In terms of critical thinking differences by the type of training, significant differences could be identified between preservice teachers in disciplinary training and vocational training. Students in the latter are getting higher average scores. Though, our results are ambiguous since it is Quebec training that has a positive influence. The relationship with employment, however, complex it may be to grasp, could explain part of our modeling: working while studying and the anticipation of becoming a teacher have positive impacts and metaliteracy self-efficacy.

The idea that vocational training would be positive for critical thinking skills and dispositions is also supported by the already mentioned Fong and Kim meta-analysis (2017). The authors assume that critical thinking is more relevant to the success of students in vocational training, especially in nursing where clinical reasoning is central. However, beyond the comparison of averages, our modeling rather tends to show that the role of vocational training on critical thinking skills is negative and that it is more the fact of studying in Quebec that would positively influence critical thinking skills. Yet, we hypothesize that it may not be so much the place of education that comes into play as the fact that preservice teachers in Quebec have a more active working life, and potentially in a para-educational context. The ANOVA factorial design showed that significant differences were identified according to the country and the time students worked. It has already been suggested that students working longer hours off-campus and juggling professional responsibilities had to maintain skills in time management, self-discipline, etc., leading to attitudes and skills conducive to high levels of critical thinking (Terenzini *et al.*, 1996). As reported in our data, Quebec students are more likely to work more than their Walloon or French counterparts: in 2011, 42.3% of full-time Quebec students worked during study sessions and at least 15 hours per week (Gauthier and Labrie, 2013). Among the compared OECD countries, Canada is the country with the highest proportion of students aged 15 to 24 receiving incomes from work (76.66%) and Belgium the second lowest (4.27%), while France (35.41%) is slightly below the OECD average (37.62%) (OCDE, 2017).

As for the likelihood of getting a job, it was already known that the type of job anticipated was a partial predictor of critical thinking dispositions (Rudd & Moore, 2003). However, it is probably not so much the anticipation of the type of job that is important as the motivation that results from the involvement in vocational training. To explain this, we can refer to motivation and social cognitive theory (Bandura, 1986). The learner's goals and motivation influence his or her efforts, both qualitatively and quantitatively, and his or her level of commitment. For example, a learner with high expectations, particularly because of his or her sense of self-efficacy and expectations (in this case, regarding his or her career goal), would be better able to set high goals, engage in an activity, or even persevere and deploy appropriate cognitive and metacognitive strategies, which are required for critical thinking.

For further research, we first recommend that further methodological work should be done to study the validity and reliability of the French language instruments used in this research. Then, it would be useful to look at the role of the professional context (vocational or non-vocational training, employment outside of school, internships, etc.) to identify more precisely its role in self-efficacy and critical thinking, by asking the following questions: Do students' professional activities and internships

contribute to critical thinking and, if so, in what way? If involvement in training with a strong professionalizing dimension helps to strengthen critical thinking dispositions and skills, how does this translate during training (courses, internships, etc.)? Mediation and moderation studies would help to answer this question. Finally, we suggest continuing this work in order to identify exogenous and endogenous variables that would strengthen the suggested model, particularly outside of teacher education programs.

Metaliteracy self-efficacy is an important variable on critical thinking skills but rather limited. The data collected highlighted the importance of the type of training and the country of study on the critical thinking skills score. Also, the correlation study and modeling suggest that metaliteracy self-efficacy influences critical thinking skills. While self-efficacy beliefs are generally considered to be predictive of outcomes, here this role appears to be angled and rather marginal.

These results, though showing a weak positive relationship, argue, on the conceptual level, for a better combination between information, digital or media literacy, and critical thinking. Links between critical thinking disposition and information literacy were already known (Çiçek Sağlam *et al.*, 2017), as well as media literacy being an important predictor of critical thinking disposition (Karaman, 2016). Conceptually, the results call for bringing metaliteracy (and all literacies) even closer to critical thinking. The conceptualization of critical thinking developed before the digital age and the ensuing informational revolution could be reworked to include literacy dispositions and skills.

Then, at the educational level, the link between critical thinking skills and literacies (whether metaliteracy or not) should be reinforced, as students need to mobilize strategies for filtering information from the Internet. Because of the removal of traditional intermediaries (teachers, scholars, etc.), young people now have the responsibility to detect reliable information. This would strengthen the operationalization of critical thinking and promote a better contextualization of scenarios used to quantify critical thinking. Initiatives such as the Quebec government's *Digital Competency Framework* (Ministère de l'Éducation et de l'Enseignement supérieur, 2019) are already contributing to bridging the gap between digital and informational skills and critical thinking, regardless of grade levels and whether one is a teacher or a learner. To take advantage of this, a teacher's training in technologies that is not only procedural is essential: not only should they know how to handle this or that technology, but they also need to understand the dynamics of the digital ecosystem in its many dimensions. Mirroring this, awareness-raising among learners is essential, in an interdisciplinary approach. Thus, one might imagine a disciplinary reflexive activity, requiring the use of information literacy strategies (what resources did I use, what did I do, etc.) and during which the student will have to describe (e.g., in a research diary) the procedures used, and the analysis strategies mobilized (How did I analyze and confront arguments? Why did I make one decision over another? What assumptions did I consider? etc.), to develop their final argumentation.

We suggest conducting studies on the place of metaliteracy and literacy on critical thinking scales. Given this conceptual shift, these studies would help answer the following questions: do metaliteracy dispositions, including self-efficacy, contribute to a better understanding of critical thinking dispositions? Does the assessment of

metaliteracy skills more accurately quantify critical thinking skills? Are critical thinking dispositions and skills mobilized differently in traditional and information-intensive contexts, especially on the Internet?

To go further, the current health context highlighted the importance of the subject and the need to link literacy and critical thinking. Brungard and Klucevsek (2019) suggested that metaliteracy and its four domains of intervention can be used to develop learners' scientific literacy. To us, this objective becomes critical in the context of the COVID-19 pandemic and because of the "infodemic" phenomena (Cinelli *et al.*, 2020; Monnier, 2020; Orso *et al.*, 2020): e.g., according to Dib *et al.* (2021), a sort of metaliteracy (called "eHealth literacy") is necessary to navigate on "the web in search for health information and processing the one encountered through social media" (Dib *et al.*, 2021, p. 2). However, the subject must not lead us to fall into Manichaeism: Cooke (2021) suggests a right to be misinformed, while emphasizing the necessity of further literacy training.

Limitations

The fact that samples in vocational training are much smaller than samples in disciplinary training may introduce a quantification bias. Since vocational training favors smaller class groups, further research will have to expand the samples. Besides, our research was conducted on a non-probabilistic convenience sample which introduces another sampling bias.

Regarding external validation, as a case study objective was not to generalize the results (Yin, 2006), we have to keep in mind that this research was conducted in a limited number of cases.

Finally, the research was conducted among the specific population of pre-service teachers in history, which may induce a bias and limits the generalizability of the results.

Conclusion

We were able to expose several differences related to metaliteracy self-efficacy and critical thinking skills for preservice teachers. Although gender is sometimes considered as an explanatory factor, such differences were not identified. However, important differences were identified according to the country of study and the type of training.

We proposed a model that contributes to partially explain the level of critical thinking skills. It includes four factors: country of study, type of training, and metaliteracy self-efficacy. Metaliteracy self-efficacy plays a more important role, which should bring up questions about the role of metaliteracy (and other literacies) for further research. More importantly, this opens the door to conceptual thinking aimed at bringing closer literacies and critical thinking. However, the effectiveness of this model is limited, explaining only about 12% of the total variance in critical thinking skills.

Thus, although differences can be analyzed in terms of national or educational specificities, we rather question the weight of the professional context of these results. Even if factors related to professional expectations and extracurricular employment

were excluded from the modeling for parsimony reasons, we note that, in Quebec, the proportion of preservice teachers who work is high and that working seems to have a positive effect on metaliteracy self-efficacy. Logically enough, we also note a greater propensity to project oneself into a specific professional goal among students in vocational training; the likelihood of becoming a teacher at the end of the training is positively correlated to critical thinking skills, self-efficacy in critical thinking, and self-efficacy in metaliteracy assessment. Further research could favorably question the role of professional and educational context as environmental factors capable of influencing informational literacies and critical thinking in terms of dispositions and skills.

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Appendices

Table A1

Distribution of Preservice teachers by type of training and year of birth

Year of birth		Disciplinary Training	Vocational Training	Total
1975 to 1979	Observed	2	3	5
	Expected	3.71	1.29	5.00
	% within column	1%	5%	2%
1980 to 1984	Observed	0	1	1
	Expected	0.74	0.26	1.00
	% within column	0%	2%	0%
1985 to 1989	Observed	3	1	4
	Expected	2.97	1.03	4.00
	% within column	2%	2%	2%
1990 to 1994	Observed	2	7	9
	Expected	6.69	2.31	9.00
	% within column	1%	11%	4%
1995 to 1997	Observed	19	13	32
	Expected	23.77	8.23	32.00
	% within column	10%	21%	13%
1998	Observed	26	18	44
	Expected	32.69	11.31	44.00
	% within column	14%	29%	18%
1999	Observed	45	14	59
	Expected	43.83	15.17	59.00
	% within column	25%	22%	24%
2000	Observed	85	6	91
	Expected	67.60	23.40	91.00
	% within column	47%	10%	37%
Total	Observed	182	63	245
	Expected	182.00	63.00	245.00
	% within column	100%	100%	100%

Table A2

Two-way ANOVA result using HBCTSS as the criterion and type of training and likelihood of becoming a teacher as predictors

Predictor	df_{num}	df_{den}	SS_{num}	SS_{den}	F	p	η^2
(Intercept)	1	237	.05	241.51	.05	.820	.00 [.00, .02]
Type of training	1	237	.45	241.51	.44	.506	.00 [.00, .03]
Teaching likelihood	3	237	.39	241.51	.13	.944	.00 [.00, .00]
Type of training × Teaching likelihood	3	237	.40	241.51	.13	.941	.00 [.00, .00]

Note. df_{num} indicates degrees of freedom numerator. df_{den} indicates degrees of freedom denominator. SS_{num} indicates sum of squares numerator. SS_{den} indicates sum of squares denominator. η^2 indicates generalized eta-squared. Values in square brackets indicate the 95% confidence interval[4].

Table A3

Two-way ANOVA result using MASE as the criterion and type of training and likelihood of becoming a teacher as predictors

Predictor	df_{num}	df_{den}	SS_{num}	SS_{den}	F	p	η^2
(Intercept)	1	237	.00	232.63	.00	.987	.00 [.00, 1.00]
Type of training	1	237	.63	232.63	.64	.423	.00 [.00, .03]
ProbTeaching	3	237	3.34	232.63	1.13	.336	.01 [.00, .05]
Type of training × Teaching likelihood	3	237	1.01	232.63	.34	.795	.00 [.00, .02]

Note. df_{num} indicates degrees of freedom numerator. df_{den} indicates degrees of freedom denominator. SS_{num} indicates sum of squares numerator. SS_{den} indicates sum of squares denominator. η^2 indicates generalized eta-squared. Values in square brackets indicate the 95% confidence interval.

[4] For partial eta-squared a confidence level of .90 is generally used rather than .95

Table A4

Two-way ANOVA result using HBCTSS as the criterion and country of study and employment (weekly working time) as predictors

Predictor	df_{num}	df_{den}	SS_{num}	SS_{den}	F	p	η^2
(Intercept)	1	236	5.15	220.02	5.52	.020	.02 [.00, .07]
Country	2	236	7.82	220.02	4.20	.016	.03 [.00, .08]
Employment	2	236	6.65	220.02	3.57	.030	.03 [.00, .08]
Country × Employment	4	236	8.33	220.02	2.23	.066	.04 [.00, .08]

Note. df_{num} indicates degrees of freedom numerator. df_{den} indicates degrees of freedom denominator. SS_{num} indicates sum of squares numerator. SS_{den} indicates sum of squares denominator. η^2 indicates generalized eta-squared. Values in square brackets indicate the 90% confidence interval.

Table A5

Two-way ANOVA result using MASE as the criterion and country of study and employment (weekly working time) as predictors

Predictor	df_{num}	df_{den}	SS_{num}	SS_{den}	F	p	η^2
(Intercept)	1	236	7.72	228.74	7.97	.005	.03 [.00, .09]
Country	2	236	3.70	228.74	1.91	.150	.02 [.00, .06]
Employment	2	236	5.26	228.74	2.71	.068	.02 [.00, .07]
Country × Employment	4	236	3.01	228.74	.78	.541	.01 [.00, .04]

Note. df_{num} indicates degrees of freedom numerator. df_{den} indicates degrees of freedom denominator. SS_{num} indicates sum of squares numerator. SS_{den} indicates sum of squares denominator. η^2 indicates generalized eta-squared. Values in square brackets indicate the 90% confidence interval.

Table A6

Regression results using HBCTSS as the criterion

	Est.	95% *CI*		*t* val.	*p*	*VIF*	Partial *r*
		Lower	Upper				
(Intercept)[a]	.50	.15	.84	2.86	.005		
MASE	.21	.09	.33	3.43	.001	1.03	.22
TypeOfTraining							
DT	.54	.13	.95	2.60	.010	2.26	.17
Country:							
Wallonia	-.79	-1.26	-.32	-3.29	.001	2.25	-.21
France	-1.19	-1.75	-.64	-4.23	.000	2.25	-.26

Note. [a]Represents reference level (levels Quebec, and Vocational training).