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Analyzing the Impact of a Practical Student Checklist on Addressing Misinformation in Anatomy and Related Fields in Dentistry

Kátia Cristiane Hall
Federal University of Pelotas
Rafael M. dos Santos
Federal University of Pelotas
Larissa M. Wohlfeil
Pontifical Catholic University of Rio Grande do Sul
Carla L. David
Federal University of Pelotas
Carlos E. Cuevas-Suárez
Autonomous University of the State of Hidalgo
Andrea Kaplan
University of Buenos Aires
Marco A. D. Silva
Federal University of Campina Grande
Rafael G. Lund
rafael.lund@gmail.com

Federal University of Pelotas

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Abstract

Contexto

The shift to remote learning during the COVID-19 pandemic increased students' exposure to online content, raising their vulnerability to health misinformation. This study aimed to develop and evaluate a practical checklist to help preclinical dental students critically assess the credibility of digital health information.

Métodos

A 10-item checklist was designed to identify key elements indicating reliable content. Three adapted news items—classified as true, partially true, or false—were assessed using this checklist. A cross-sectional survey was conducted with 85 dental students from a Brazilian university. Participants received the instrument via institutional email and WhatsApp. Descriptive statistics, Cronbach's alpha, the Mann–Whitney U test, and the Chi-square test were used for data analysis.

Resultados

Most students correctly identified the false (75%) and partially true (67%) news. However, only 43% correctly classified the true news, suggesting challenges in recognizing trustworthy content. Editorial features like grammar and publication date were more frequently noted, while fewer students identified authorship and source origin. Gender differences were statistically significant in some checklist items; no significant differences were found between academic levels.

Conclusões

The checklist supported students' ability to detect misleading information but revealed difficulties in validating true content. These findings underscore the need for structured tools in health education to develop critical thinking and digital literacy among students.

INTRODUCTION

The COVID-19 pandemic accelerated the adoption of digital technologies in education, including anatomy teaching, due to the suspension of face-to-face university activities [1]. While synchronous and asynchronous learning formats offer flexibility and new opportunities for virtual engagement [2], hands-on modalities such as dissection classes and visual labs remain essential for achieving anatomy learning objectives, particularly in medical and dental education [3]. These methods allow students to develop spatial understanding and manual dexterity—skills that are especially critical in dental programs.

Anatomy education is grounded in a structure that combines theoretical instruction with practical application, aiming to prepare students for clinical decision-making. This framework relies not only on

institutional resources and curricular design, but also on students' ability to critically engage with diverse information sources—including those found online [4].

Despite the benefits of remote learning, preclinical students have expressed concerns about diminished quality in small-group teaching, hands-on experiences, and academic progression, alongside challenges such as information overload, anxiety, and confusion about the reliability of online resources [5, 6].

The proliferation of online health information has further complicated the educational landscape. Misinformation spreads rapidly through social media platforms such as Facebook, Instagram, TikTok, and WhatsApp [7], often exploiting visually appealing formats and emotive language, which encourage impulsive sharing among young people. These platforms have also transformed interpersonal interactions in anatomy education, enabling global engagement and collaboration among professionals, but also providing a space for unverified content to circulate [8, 9].

In recent years, the spread of misinformation has emerged as a global concern, significantly impacting public perception and decision-making across health-related fields. This phenomenon is particularly relevant in higher education, where students increasingly rely on digital platforms and social media for academic and clinical learning [10]. A bibliometric analysis conducted by Yeung et al. (2022) revealed a steady growth in publications addressing health-related misinformation, underscoring its prevalence and significance [11]. However, in the context of undergraduate health education few studies have explored how misinformation affects students' academic development, decision-making, and trust in scientific evidence. Despite increasing digital literacy efforts, recent findings indicate that many students struggle to distinguish between credible sources and misleading content online [12].

Therefore, integrating strategies to detect and prevent misinformation within the educational environment is not only timely but essential. Critical thinking skills have been shown to improve individuals' ability to assess the accuracy of information, particularly in distinguishing credible content from misinformation [13]. Unlike general discussions of ethical reasoning, the skill of identifying and managing misinformation requires specific cognitive and evaluative strategies—such as recognizing biased or unverified claims and applying structured criteria to assess content validity [14].

Educators play a central role in fostering these skills, equipping students to navigate the digital environment critically and to combat misinformation effectively [15]. As subject-matter experts, they are also responsible for selecting high-quality online resources aligned with curricular goals and guiding students in their interpretation. However, it remains unclear what types of online information students actually use and how they evaluate its relevance and trustworthiness in the context of anatomy learning.

In light of these challenges, this study proposes the development and validation of an educational Checklist designed to help preclinical dental students critically assess the credibility of online content. This instrument is grounded in the critical thinking framework for higher education in health sciences [16] and addresses the need for structured assessment tools that foster analytical skills among undergraduate students. The hypothesis is that the Checklist will significantly enhance students' critical

thinking abilities, improving their capacity to differentiate accurate information from misinformation and complementing their academic development in anatomy.

MATERIALS AND METHODS

Type and design

This is an observational, exploratory, quali-quantitative, and cross-sectional study. To support the elaboration of the proposed Checklist, we were inspired by an American non-profit website called Politifact (https://www.politifact.com/), which was created in 2007 and is still active. An anonymous online questionnaire was also created following discussions between the authors about the use of this tool by the students. It was considered timely and appropriate to understand the students' perspectives and experiences using this student Checklist for detecting safe sources of learning. Such information could potentially enable the preclinical students to enjoy such a routine experience for their autonomous studies.

A copy of the practical Checklist and the questionnaire is provided as Supporting Information (Supplementary - S1). The questionnaire was tested and received ethical clearance (CAAE: 25002719.9.0000.5318). All participants provided a written consent.

This report was prepared based on the STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) Checklistlines for cross-sectional studies [17] and the CHERRIES (Checklist for Reporting of Internet Electronic Research Results) checklist [18]. Therefore, Pereira et al. (2023) developed the formulation, and the numbering of the checklist, which played a crucial role in shaping this study [19]. The questionnaire underwent validation by twenty health professionals from diverse fields. An initial exploratory study was undertaken to rationalize the application of the proposed checklist—this checklist was then adhered to and adjusted based on the study's specific nature.

In this study, we adapted the questions from the Practical Checklist, which includes various questions and answers, to evaluate how dental students from all semesters perceive and prioritize care regarding online information. For this purpose, we used evaluation scales. Since the goal was to assess students' opinions and perspectives, a Likert-scale questionnaire was considered the most appropriate format for these questions.

The study was conducted in two stages:

First stage

Collection of information and diagnosis based on the distribution of the questionnaire, aiming to validate the proposed Checklist.

Second stage

Application and distribution of the practical Checklist itself to assess its functionality.

Calculation of the sample and participants (Study size)

This study had an intentional convenience sample with an online application at the Faculty of Dentistry of UFPel. The sample size for both stages was calculated using the OpenEpi program (Version 2.3.1, www.OpenEpi.com, updated on 04/06/2013) was used, considering the following parameters: total number of students in the Dentistry academic area of 445, prevalence of students using online content to acquire knowledge of 50%, a contour effect (deff) of 1.2, 80% power and 5% significance level where a minimum of 85 students were found to be shown. Adding another 20 percent to control for confounding variables and some 20 percent for losses and/or negatives. The appropriate sample should include 119 responses.

Data Sources/Measurement

First stage: Dissemination of the Questionnaire

The questionnaire was distributed via institutional emails and WhatsApp groups with the support of student representatives during two months, from April 1 to June 1, 2023. Additionally, we shared a news article about anatomy with the aim of assessing the functionality and applicability of the Student Checklist. Students were tasked with analyzing the accuracy of the information presented in the article, using the Checklist as a reference to support their answers. This approach not only sought to evaluate the students' understanding of the topics covered but also aimed to foster critical thinking and research skills, reinforcing the Checklist's role as a reliable and practical reference tool. Students were informed that they would have one week to respond to the questionnaire. During this period, two reminders were sent to encourage their classmates' participation. After data collection, all responses were analyzed to verify participant eligibility. This process included verifying the identification data provided by respondents (such as name, semester, and class), ensuring that only students regularly enrolled in the Dentistry program at UFPel were included in the final sample. Responses that did not meet these criteria were excluded from the analysis.

Given that a 50% response rate was expected and that the overall number of preclinical students enrolled was small, it was considered inappropriate to conduct a pilot study as it would have reduced the actual power of the study. The questionnaire was converted to an online questionnaire using Google Forms® (Alphabet Inc., Mountain View, CA).

Questionnaire content and variables analyzed

Table 1 shows the questions and variables evaluated through the survey carried out on dental students.

Table 1
Questions that make up the survey conducted with dental students.

Question	Answers
1. When you come across information found on the Internet, do you consider it important to have previously heard of the website where the scientific information is available?	( ) Very important. ( ) Important. ( ) Moderate. ( ) Sometimes important. ( ) Not important.
2. When you come across information found on the Internet, do you usually check whether there is a page citing the source from which the information was extracted?	( ) Very frequently. ( ) Frequently. ( ) Occasionally. ( ) Rarely. ( ) Never.
3. When you come across information found on the Internet, do you usually check whether the scientific information has clearly attributed sources?	( ) Very frequently. ( ) Frequently. ( ) Occasionally. ( ) Rarely. ( ) Never.
4. When you come across information found on the Internet, do you check whether this content is being disseminated by other reputable media outlets?	( ) Very frequently. ( ) Frequently. ( ) Occasionally. ( ) Rarely. ( ) Never.
5. When you come across information found on the Internet, do you pay attention to whether the writing contains significant spelling and/or grammar mistakes?	( ) Very frequently. ( ) Frequently. ( ) Occasionally. ( ) Rarely. ( ) Never.
6. When you come across information found on the Internet, do you check whether the information has a publication date?	( ) Very frequently. ( ) Frequently.

Question	Answers
	( ) Occasionally. ( ) Rarely. ( ) Never.
7. When you come across information found on the Internet, do you pay attention to whether there is anything suspicious in the URL (Uniform Resource Locator)?	( ) Very frequently. ( ) Frequently. ( ) Occasionally. ( ) Rarely. ( ) Never.
8. When you come across information found on the Internet, do you pay attention to whether there is an image accompanying the article or scientific report, and whether this image is credited to someone?	( ) Very frequently. ( ) Frequently. ( ) Occasionally. ( ) Rarely. ( ) Never.
9. When you come across information found on the Internet, do you check whether the author responsible for the content is clearly identified and whether their contact information is provided?	( ) Very frequently. ( ) Frequently. ( ) Occasionally. ( ) Rarely. ( ) Never.
10. When you come across information found on the Internet, do you check whether the cited documents are official or citations from specific articles or reports related to the topic?	( ) Very frequently. ( ) Frequently. ( ) Occasionally. ( ) Rarely. ( ) Never.
11. When you come across information found on the Internet, which website do you use most frequently to search for information?	( ) Google Chrome. ( ) Microsoft Edge. ( ) Mozilla. ( ) Educational institutional pages. ( ) Professional website pages.

Question	Answers
	( ) Scientific information search engines. ( ) I don't know.

Second stage: Implementation and Evaluation of the Student Checklist for Online Content Assessment

This initial stage allowed us to collect relevant information about students' attitudes and behaviours concerning online information, serving as a basis for developing the proposed Checklist. In this sense, we developed the Student Checklist, which consists of a set of 11 questions with more restricted alternatives, predominantly dichotomic ("yes" or "no')'. These questions were designed to Checklist students in conducting a careful and well-founded scientific search. Also, academic level was self-reported by the students via the questionnaire and categorized into two main groups: basic cycle (1st to 5th semesters) and advanced cycle (6th to 10th semesters). Table 2 shows the questions in the Student Checklist developed.

Table 2
Questions that make up the developed Student Guide.

Question	Answers
1. Have you heard about the website where scientific information is available?	( ) Yes ( ) No
2. Is there a page with the source from which the information in the text being read was taken?	( ) Yes ( ) No ( ) The page informs that it may contain fake or unverified content.
3. Does the scientific information contain a clearly attributed source(s)?	( ) Yes ( ) No
4. Is the information being disseminated by other reputable media?	( ) Yes ( ) No ( ) I don't know
5. Does the writing have significant spelling and/or grammatical errors?	( ) Yes ( ) No
6. Does the information have a publication date?	( ) Yes ( ) No
7. Is there anything strange about the URL (Uniform Resource Locator)?	( ) Yes ( ) No
8. If there is an image accompanying the scientific article or report, is this image attributed to someone?	( ) Yes ( ) No ( ) No image
9. Is the author responsible for the content clearly identified and is there information on their means of contact?	( ) Yes ( ) No ( ) I don't know
10. Are the documents cited official or quotes from specific articles or reports on the subject to which they are attributed?	( ) Yes ( ) No

These questions were carefully selected to address essential aspects in the evaluation of online scientific content. The Student Checklist, therefore, represents a valuable tool for dental students, enabling them to perform an autonomous search for information based on scientific and reliable criteria.

Evaluation of the Student Checklist Effectiveness

Participants were randomly assigned to one of three news articles for the application of the Checklist, using a randomized numeric sequence generated in Microsoft Office Excel 2019 software (Microsoft Corporation, Redmond, Washington, DC, USA). Each participant received a unique random number, and the allocation to one of the three news scenarios (fake, partially true, or true news) was based on predefined numerical intervals. The news articles used in this experiment all addressed the same central theme (anatomy) but were intentionally formatted into three distinct versions for the purpose of evaluating different types of content:

1. **True news**: This version presented all necessary characteristics and scientifically substantiated information (Supplementary – S2).
2. **Partially true news**: This article contained elements of truth but included inconsistencies and questionable data (Supplementary – S2).
3. **False news**: This version was based on incorrect and scientifically unfounded information (Supplementary – S2).

The allocation of participants to each version of the article allowed for a comparative analysis of how students evaluated the accuracy and reliability of online anatomical information. The articles were disseminated via email to the same group of students who had responded to the initial questionnaire in 2023. However, due to a lower-than-expected response rate (30%), additional outreach was conducted, targeting students from the 2nd, 3rd, and 4th semesters, who had recently completed an anatomy course and could evaluate the content more effectively.

Quantitative analyses

After applying the Student Checklist with multiple choice questions, students were able to assess whether the page that published the content was reliable or whether it was necessary to look for another source of data.

From the selected answers, it was possible to assign a score and interpret the results as follows:

If all or most of the answers are positive (from 7 to 10)

The source appears to be reliable. This indicates that the content has consistent and scientifically based characteristics, suggesting that it can be considered reliable.

If only a few questions have positive answers (4 to 6)

This can be considered a warning sign, indicating that the information appears legitimate, but there is a lack of consistency in the details. In this case, it is recommended to seek the content from other sources to get a more comprehensive and consistent view.

If there are few or no positive responses (from 0 to 3)

This indicates that the source is not reliable. There are many problems with the publication that jeopardize its credibility. It is recommended to avoid this source and seek information from other more reliable sources. These scoring scores and the interpretation of the results provide learners with an objective criterion for assessing the reliability of online information sources. This approach helps develop students' critical thinking skills and encourages them to search for reliable and scientifically based sources.

Bias

Efforts to address potential sources of bias in our study included the random allocation of participants to the intervention (questionnaire and use of the educational Checklist) and control groups (no intervention) to minimize selection bias. Additionally, data analysis was conducted by researchers who were blinded to the group allocation of each participant to reduce observer bias. To control for response bias, the anonymity of participant responses was ensured, ensuring that their answers did not influence the decisions during data collection.

Statistical analysis

Descriptive statistical analyses were performed to examine the responses of the 85 dental students who participated in the study, enabling the identification of frequencies and distributions of variables in both stages. This approach facilitated a comprehensive characterization of the dataset and the identification of relevant patterns.

Data processing included frequency distribution analysis and statistical testing, conducted using SigmaPlot 12.0 (Systat Inc., San Jose, CA, USA) and Jamovi version 2.4 (Jamovi Project, Sydney, Australia), an open-source statistical software built on the R language. The internal consistency of the questionnaire items was assessed using Cronbach’s alpha, calculated in Microsoft Excel 2019 (Microsoft Corporation, Redmond, WA, USA), to evaluate the reliability and validity of the instrument.

In the first phase, to investigate the latent structure of the questionnaire, a Principal Component Analysis (PCA) with orthogonal varimax rotation was conducted using Jamovi. This multivariate technique enabled the empirical validation of the proposed theoretical constructs and reduced dimensionality by identifying clusters of interrelated variables. The suitability of the data for PCA was verified through the Kaiser-Meyer-Olkin (KMO) measure and Bartlett’s test of sphericity. Component retention was based on Kaiser’s criterion (eigenvalues > 1) and analysis of the scree plot. Interpretation of the extracted components was guided by rotated factor loadings, which informed the structural coherence of the instrument. The variables were measured using Likert-type scales, designed to capture respondents' perceptions. Given the ordinal nature of the data and the absence of assumptions regarding normality, the Mann–Whitney U test was employed to compare independent groups. Additionally, the Chi-square test was utilized to assess potential associations between categorical variables.

In the second phase, data regarding the dissemination and application of the Student Checklist were analyzed using descriptive and inferential statistical methods, aimed at evaluating implementation trends and student engagement with the instrument.

RESULTS

The study was conducted in two phases, with a six-month interval between them, involving different cohorts of the Dentistry program at the Federal University of Pelotas (UFPel). The first phase consisted of a questionnaire application, while the second, conducted in January and February 2024, focused on the analysis of news content using a checklist developed by the students themselves. The news articles were manipulated based on the checklist criteria: the article classified as true contained all reliability items; the partially true article had some information removed; and the false article was deliberately reduced, omitting several verification elements. This approach allowed the evaluation of students' ability to identify misinformation without requiring direct analysis of scientific articles.

Although the content of the news addressed brain development, the topic was deemed appropriate for Dentistry students, as general anatomy is covered in the early stages of the curriculum. Therefore, the theme was pedagogically relevant and aligned with the students' prior knowledge.

Demographics

The research findings were based on responses from 85 dental students who voluntarily participated in the questionnaire of the study titled 'Practical Checklist for Dental Students Dealing with Misinformation.' Additionally, responses from students who did not sign the authorization terms were excluded from the final analysis. Research items underwent evaluation using Cronbach's alpha to assess internal consistency, reliability, and validity. The obtained Cronbach's alpha value demonstrated acceptable questionnaire reliability (0.77).

The demographic data of the participants are presented in Table 3. Among the respondents, 69% identified as female and 31% as male. Sex was self-declared; the questionnaire offered the option "prefer not to disclose," but no participant selected this alternative. With regard to academic level, 56% of the participants were enrolled in the advanced cycle of the Dentistry program (the end of the undergraduate course), which includes students from the 6th to the 10th semester. This group represented the largest individual proportion of the analyzed sample.

Table 3
Demographic Profile of Study Participants.

Characteristics	Frequency n (%)
Total number of students	85 (100.0)
Sex	
Female	59 (69)
Male	26 (30)
Prefer not to say	0 (0)
Cycle	
Basic	37 (43)
Advanced	48 (56)

Exploratory Factor Analysis (Principal Component Analysis)

An exploratory factor analysis (EFA) was performed using PCA with varimax rotation to investigate the underlying factor structure of the questionnaire. The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy was 0.594, indicating borderline adequacy for factor analysis. Bartlett's test of sphericity was significant ($\chi^2(55) = 187$, $p < 0.001$), supporting the factorability of the correlation matrix.

Extraction criteria included eigenvalues greater than 1.0 and inspection of the scree plot (Table 4), which suggested a three-factor solution explaining 49.5% of the total variance. The factors were interpreted based on the rotated component matrix and corresponded with the theoretical domains: (1) Source Credibility Evaluation (including items regarding familiarity with the website, authorship identification, and media coverage, reflecting the perceived reliability and trustworthiness of sources). (2)Verification of Origin and Source (grouping items related to checking citations, official documents, and source references, indicative of critical information validation behaviors). (3) Technical and Visual Content Analysis (containing items on spelling quality, publication date, suspicious URLs, and image attribution, representing formal indicators of content credibility).

Table 4a) Component Statistics

Summary

Component	Eigenvalue	% Total Variance	% Cumulative
1	2.21	20.1	20.1
2	1.95	17.7	37.9
3	1.28	11.7	49.5

Table 4b) Assumption Check
Bartlett's Test of Sphericity

χ^2	gl	p
187	55	<.001

Inter-factor correlations were minimal, suggesting that these factors measure distinct constructs. These results support the structural validity of the instrument (Table 5).

Table 5. Principal Component Analysis

Component Weights

	Component			
	1	2	3	Singularity
A1			0.700	0.494
A2	0.314		0.718	0.328
A3	0.505			0.666
A4			0.304	0.807
B1	0.887			0.206
B2	0.907			0.157
B3		0.654		0.441
C1		0.475		0.758
C2		0.686		0.493
C3		0.426		0.761
C4		0.683	0.304	0.441

Note: 'varimax' rotation was used.

Inter-component Correlations

	1	2	3
1	—	0.00	0.00
2		—	0.00
3			—

Information Collection, Analysis, and Diagnosis for Checklist Validation via Questionnaire Distribution

Comparisons were made between the students' responses and their academic level. Regarding each question, approximately 56.48% of participants, who rated 4 and 5 on the Likert scale, showed no statistically significant differences between the groups of different academic levels. However, when comparing gender with the different responses, interesting findings emerged (Table 6).

Table 6
Gender-Based Comparison: Median and Interquartile Range of Responses (n = 85)

Question	Median (interquartile range)		P-value
	Female n = 59 (69%)	Male n = 26 (30%)	
1	5 (4–5)	4.5 (4–5)	> 0.05
2	4 (3–4)	4 (3-4.2)	> 0.05
3	4 (3–4)	4 (3-4.2)	> 0.05
4	4 (3–4)	4 (3–5)	> 0.05
5	5 (4–5)	5 (3.7-5)	> 0.05
6	5 (4–5)	4 (3–5)	0.04*
7	4 (2–5)	3 (2–4)	0.04*
8	3 (3–4)	3 (2–4)	> 0.05
9	3 (2–4)	3(2–4)	> 0.05
10	3(2–4)	4 (2–4)	> 0.05
11	2 (1–4)	2 (1–4)	> 0.05

For the sample studied, the importance of having prior knowledge about the website where scientific information is available was reported by 54.1% (46) of the participants as "very important," while 32.9% (28) considered it “important”. When comparing sex in this response, there was no significant difference ($\chi 2$ (2, N = 46) = 54.1%, p = 0.38). Similarly, attention to spelling or grammatical errors in writing and verifying the publication date of information was reported as "very often" by 63.5% (54) of the participants. Regardless of gender, both groups showed concern for this condition, with no significant difference found ($\chi 2$ (2, N = 85) = 100%, p = 0.04) (Fig. 1).

In the following questions, no statistically significant differences were found between the groups. When dental students were asked about checking the authorship of information, 38.8% (33) checked "often," 29.4% (25) answered "occasionally," 22.4% (19) checked "very often," and 9.4% (8) checked "rarely."

Regarding the frequency of verifying if the source is clearly attributed, 41.2% (35) checked "often," 25.9% (22) checked "occasionally," and 23.5% (20) checked "very often," while 8.2% (7) checked "rarely" and 1.2% (1) checked "never." Regarding the dissemination of information, only 31.8% (27) of the participants reported investigating "often" whether the content is being disseminated by other reputable media, while 14.1% (12) reported "rarely" investigating and 4.7% (4) marked "never" (Fig. 2).

Concerning the origin of the information, the majority of responses, 25.9% (22), indicated that they "rarely" pay attention to the URL. When comparing responses between female and male groups, the female group predominantly marked 5, establishing statistically significant differences ($\chi 2$ (5, N = 59), p = 0.04). The different uses of images and contact details of the authors of the information were also evaluated, with 34.1% (29) and 36.5% (31) responding "occasionally," respectively. Significant differences were also found in this question when comparing the female and male groups ($\chi 2$ (2, N = 59), p = 0.05).

When asked if the cited documents are official or are quotes from specific articles or reports on the assigned topic, 30.6% (26) responded "often," 27.1% (23) responded "occasionally," and 21.2% (18) responded "rarely" (Fig. 3a).

No differences were found when comparing the groups. Finally, for the browsers and sites most used by students, "Google Chrome" was the most chosen option, representing 64.7% (55) of the responses. "Scientific information seekers" were selected by 17.6% (15) of the participants. The "Microsoft Edge" browser received 7.1% (6) of the responses, while professional website pages were mentioned by 3.5% (3) of the participants. Other options obtained 2.4% (2) of the responses (Fig. 3b).

Analysis of News Evaluation Using the Student Checklist:

The evaluation of news items as classified by the Student Checklist revealed varying levels of performance. For false news, 75% (21) of students scored within the expected range (0–3 positive responses), suggesting that most participants correctly identified the lack of reliability in the news. However, 25% (7 students) scored higher than expected, indicating challenges in detecting inconsistencies in unreliable content.

For partially true news, 67% (20 students) scored within the expected range (4–7 positive responses), demonstrating reasonable competence in identifying inconsistencies. Nonetheless, 33% (10 students) scored outside the expected range, revealing difficulties in identifying subtle inconsistencies in content with partial truth.

Regarding true news, 43% (14 students) achieved the expected range (7–10 positive responses). However, 57% (18 students) scored below the expected range, suggesting difficulty in recognizing reliable content, indicating that the Checklist was less effective in aiding students in validating legitimate sources (Fig. 3c).

Broader Analysis of Results

The broader analysis of the results reveals variability in the reliability of news items across multiple evaluation criteria. In Table 7 we can check the breakdown of the results for each news item.

Table 7
Analysis of News Items by Evaluated Criteria

Evaluated Criterio	News Item 1 (True)	News Item 2 (Partially True)	News Item 3 (False)
Affirmative Responses ("Yes")			
Correct spelling and grammar	93,8% (30 responses)	93,3% (28 responses)	53,6% (15 responses)
Indication of publication date	93,8% (30 responses)	75,9% (22 responses)	10,7% (3 responses)
Clearly attributed sources	81,3% (26 responses)	76,7% (23 responses)	64,3% (18 responses)
Adequate URL	78,1% (25 responses)	86,7% (26 responses)	57,1% (16 responses)
Publication in reputable media outlets	62,5% (20 responses)	75,9% (22 responses)	63,0% (17 responses)
Attribution of images to the author	62,5% (20 responses)	23,3% (7 responses)	17,9% (5 responses)
Clear identification of author/editorial team	62,5% (20 responses)	53,3% (16 responses)	28,6% (8 responses)
Negative Responses ("No")			
Availability of author contact information	84,4% (27 responses)	93,3% (28 responses)	92,9% (26 responses)
Familiarity with the hosting website	71,9% (23 responses)	83,3% (25 responses)	78,6% (22 responses)
Indication of publication date	-	-	89,3% (25 responses)
Attribution of images to the author	-	76,7% (23 responses)	82,1% (23 responses)
Clear identification of author/editorial team	-	-	71,4% (20 responses)
Adequate URL	-	-	42,9% (12 responses)
Neutral Responses ("I don't know")			
Official status of cited documents	65,6% (21 responses)	53,3% (16 responses)	67,9% (19 responses)

General Observations

Regarding reliability indicators, the most frequent affirmative responses were related to basic editorial criteria (such as spelling, grammar, and source attribution) and publication indicators (such as date and reputable media outlets). On the other hand, in terms of reliability gaps, issues like the availability of author contact information, familiarity with the hosting website, and the official status of documents were areas with frequent negative responses or uncertainty. Therefore, this analysis shows that while factual attributes such as spelling and grammar were well-rated, the authenticity of sources and the reliability of hosting platforms were less clear, especially in partially or falsely classified news items.

The p-value was used to assess statistical significance in the comparisons between different groups, such as academic level and gender of the participants, regarding their responses to the questionnaire. When the p-value was greater than 0.05, as in the comparisons between groups of different academic levels, no statistically significant differences were observed, indicating that the responses from students in the basic and advanced cycles were similar. However, for questions related to gender, p-values smaller than 0.05 were observed, as in questions 6 and 7, suggesting significant differences in responses between female and male students. These results indicate that while academic level did not significantly impact participants' responses, gender was a relevant factor in some questions, reflecting differences in how information was evaluated and interpreted by the participants.

DISCUSSION

Social media and online platforms have emerged as influential tools in health education, particularly in the fields of dentistry and medicine, which share foundational disciplines such as anatomy. These resources have demonstrated potential to enhance professional networking, education, and the understanding of complex topics like anatomy, thereby contributing to advancements in health training [20]. This study evaluated whether the development and implementation of an educational Checklist could improve students' critical thinking skills in assessing online scientific content, especially in areas like anatomy. The results partially confirmed the hypothesis: while a significant proportion of dentistry students successfully identified key indicators of false information, a subset struggled to apply fundamental strategies for verifying content reliability. These findings underscore the Checklist's effectiveness in promoting critical evaluation skills while highlighting the need for further refinement to address persistent gaps in its application.

The Principal Component Analysis (PCA) of the questionnaire items elucidated the multidimensional framework underlying students' strategies for evaluating online information. The three extracted components represent discrete domains of verification: (1) source credibility, encompassing familiarity with the website, authorship, and media endorsement; (2) verification of content origin, including citation scrutiny, official documentation, and source attribution; and (3) technical and visual content assessment, involving orthographic accuracy, publication timeliness, suspicious URLs, and image provenance. These

distinct but relatively orthogonal factors indicate that students employ heterogeneous and independent cognitive mechanisms when appraising the reliability of digital information. The results further substantiate the construct validity of the instrument, affirming its suitability for both research and pedagogical applications.

Given the observed multidimensionality, educational interventions aiming to enhance critical evaluation skills should consider tailoring instruction to these specific domains independently [21]. This approach acknowledges that competence in evaluating one aspect (e.g., source credibility) does not inherently translate to proficiency in others (e.g., technical content analysis), thereby necessitating a comprehensive, domain-specific pedagogical framework [22].

In today's educational landscape, autonomous learning in complex areas like anatomy relies heavily on accurate information [23]. To prevent the spread of fake news and misinformation, it is crucial to implement effective strategies and conditions. Encouraging students to cross-check information from reliable platforms and providing Checklistlines for evaluating online sources are essential steps. Additionally, integrating critical thinking exercises into the anatomy curriculum and teaching students to question and analyze information before accepting it are also important [24].

In the present study, a formal control group was not established based on predefined patterns of social media interaction. However, participants' basic interactions with social media platforms were indirectly assessed through questionnaire items that investigated their habits and preferences for seeking academic information online (e.g., preferred browsers, platforms used for scientific searches, and frequency of verification practices). These variables allowed us to infer general usage patterns and attitudes toward digital information sources, which served as a practical baseline to compare with the effects of the educational Checklist.

Based on this study's results, the need to implement the proposed student Checklist is evident. While many students in this research demonstrated attention to relevant details when identifying false content, a significant portion still lacks knowledge of fundamental aspects required to verify the authenticity of online information. Furthermore, the investigation by Ruffo and Semeraro (2022) highlighted that, despite this gap, students tend to more easily explore biases that hinder the distinction between true and false news [25]. This finding reinforces the importance of providing students with clear guidance to help them conduct a critical and well-grounded search for reliable sources that complement their university studies, contributing to their ability to discern information found online.

As stated by Topal and Shargh (2023), the student Checklist offers relevant guidelines and questions that assist students in evaluating the reliability of information sources, which supports its potential to address this gap [26]. The validation of the Student Checklist reveals both its strengths and limitations in promoting critical thinking among dentistry students in dealing with online misinformation. Overall, the Checklist proved effective in identifying inconsistencies in false and partially true news but showed limitations in validating true content.

In this context, one factor that may have contributed to the lower-than-expected percentage of correct responses regarding true news relates to the study's title, "A Practical Checklist for Students Facing Online Misinformation." By emphasizing combating misinformation, this title may have influenced participants to adopt a more critical and skeptical stance toward all presented content, including true information. Studies indicate that confirmation bias, intensified by implicit suggestions in the study's context, can significantly shape how information is evaluated [27].

Although social media applications operate independently from web browsers, browsers play a fundamental role in accessing online information. Students frequently rely on browsers to access scientific databases, perform academic searches, and verify the accuracy of content encountered on social platforms. The choice of browser can influence how information is presented, due to personalization algorithms and browsing history. Studies have shown that such personalization can limit the diversity of accessible sources, reinforce cognitive biases, and potentially increase susceptibility to misinformation. The way students interact with browsers and conduct online searches is directly related to their ability to critically evaluate information. Therefore, understanding browser preferences and usage behaviors is essential for developing effective digital literacy strategies and combating misinformation in educational settings [28].

Thus, when interpreting the true news, students may have assumed it also contained inconsistencies due to the predisposition generated by the study's title. This difficulty in validating reliable sources highlights a relevant issue in education: balancing critical thinking with trust in legitimately scientific information. Lagarde and Hudgins (2018) suggest that while critical skills are essential for identifying flaws and inconsistencies, informed trust in legitimate sources is equally crucial for academic and professional practice [29]. Therefore, training students to develop this duality is fundamental.

As education increasingly emphasizes autonomous learning, it becomes essential to establish robust measures to prevent the spread of misinformation, particularly in anatomy education **(30).** Preclinical medical and dental students often manage a significant volume of information during their initial years, making it critical to provide tools such as well-designed questionnaires to enhance their ability to identify reliable sources. The Covid-19 pandemic further underscored these challenges, with students losing access to cadaver-based learning and the associated contextual and sensory experiences, demonstrating the need for innovative approaches to support independent, reliable learning in anatomy education.

The relevance of comparison lies in the assumption that students in more advanced semesters may have developed more refined critical thinking skills and broader exposure to scientific content, potentially reducing their susceptibility to misinformation. However, our results revealed no statistically significant differences between the groups, suggesting that academic progression alone does not necessarily lead to improved digital literacy or greater resistance to misinformation. Redaelli et al. (2025) stated that their findings are consistent with this conclusion [13].

Another question to discuss is about the gender of the sample. So, the influence of gender on the interpretation of information, particularly in digital contexts, has been discussed in recent literature. Studies such as Lan & Tung (2024) and Hadlington et al. (2023) suggest that gender may influence the way individuals engage with, interpret, and trust online content [12, 31]. In our study, some statistically significant differences were observed in specific questionnaire responses related to attention to content origin and author credibility, with female students generally demonstrating greater sensitivity to these factors. While these findings should be interpreted with caution due to sample size limitations, they align with emerging research that highlights gender as a possible variable in digital media literacy and misinformation susceptibility.

Limitations of the study

The study on pre-clinical dental students in southern Brazil has limitations, including a convenience sample and lower response rate. However, it emphasizes the need for refining the Student Checklist and implementing strategies to help students navigate online information. Future research should involve diverse student populations to extend results to other areas and equip future professionals with critical evaluation skills. Future studies are needed to determine whether these supplementary learning formats for preclinical students are equally effective and adaptable for anatomy education across broader contexts.

CONCLUSION

Within the limitations of this study, it can be concluded that a Checklist to discerning between reliable information and false content on the Internet is extremely relevant so that future professionals can base their training on scientific evidence. In an increasingly informative and globalized world, students must develop skills to identify the veracity of information found online. In an increasingly informative and globalized world, students must develop skills to identify the veracity of information found online. Based on this study, it was possible to develop a simple and direct questionnaire, aimed at dental students from different countries, which is currently being validated.

Finally, the implementation of this proposed student Checklist has the potential to contribute to the training of more critical professionals, able to access and utilize reliable information, thus strengthening the quality of scientific production and the advancement of the field of Dentistry.
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Declarations

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

This study was approved by the Research Ethics Committee of the Federal University of Pelotas (Universidade Federal de Pelotas, UFPel), Brazil (CAAE: 25002719.9.0000.5318). All participants

provided written informed consent prior to participation. The study was conducted in accordance with the principles of the Declaration of Helsinki.

Carlos E. Cuevas-Suárez

CARLOS E. CUEVAS-SUÁREZ, D.D.S., M.Sc., Ph.D., is a professor and researcher at the Universidad Autónoma del Estado de Hidalgo, Mexico. He holds a Master's degree in Biomedical and Health Sciences and a Ph.D. in Dentistry from the Federal University of Pelotas, Brazil. His research focuses on dental materials, adhesion, universal adhesives, systematic reviews, and biocompatibility. Dr. Cuevas-Suárez's work bridges the gap between anatomical science and restorative dentistry, exploring how the structural properties of teeth influence the performance and longevity of dental materials. His contributions enhance the practical application of anatomical knowledge in clinical practice, particularly in adhesive dentistry.

Rafael G. Lund

RAFAEL G. LUND, PhD, is an associate professor in the Department of Restorative Dentistry at Pelotas Dental School, Federal University of Pelotas, Brazil. He teaches dental carving and restorative dentistry to undergraduate and graduate students. His research interests include dental education, educational development, and curricular assessment of student learning.

Eigenvalues

Scree plot

FUNDING

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ETHICS APPROVAL AND CONSENT TO PARTICIPATE

A copy of the practical checklist and the questionnaire is provided as Supporting Information (Supplementary – S1). The study protocol and questionnaire were reviewed and approved by the Research Ethics Committee (CAAE: 25002719.9.0000.5318). All participants provided written informed consent prior to their inclusion in the study.

CONSENT FOR PUBLICATION

Not applicable.

CLINICAL TRIAL NUMBER: not applicable.

STATEMENT OF ORIGINALITY

The authors confirm that the work has not been previously published, is not under consideration for publication elsewhere, and will not be submitted simultaneously to another publication.

NOTES ON CONTRIBUTORS BIOGRAPHIES

KÁTIA C. HALL, D.D.S., is a Master's student in Dental Clinic, with an emphasis on Restorative Dentistry and Cariology, in the Post-Graduate Program in Dentistry at Pelotas Dental School, Federal University of Pelotas, Rio Grande do Sul, Brazil. Her research interests include dental anatomy, tooth carving, and oral health education.

RAFAEL M. DOS SANTOS is an undergraduate dentistry student at Pelotas Dental School, Federal University of Pelotas, Rio Grande do Sul, Brazil. His research interests focus on oral epidemiology, dental education, educational development, graduate student professional development, and curricular assessment of student learning.

LARISSA M. WOHLFEIL, D.D.S., M.Sc., is a phd student in Dental Clinic at the Pontifical Catholic University of Rio Grande do Sul, Porto Alegre, Rio Grande do Sul, Brazil. Her research interests include developing, implementing, and assessing new educational tools to create an engaged learning environment for dental students.

MARCO A. DIAS DA SILVA, M.Sc., Ph.D., is a distinguished professor and researcher in oral biology and public health at the Faculty of Dentistry, University of São Paulo, Brazil. His research focuses on oral health epidemiology, evidence-based dentistry, and the integration of technology in dental education. Dr. Dias da Silva is also a key collaborator on FAPESP-supported projects, exploring innovative approaches to dental education and community-based health strategies.

Author Contribution

KCH conceived the study, coordinated project development, and contributed to manuscript writing. RMS assisted in data collection, survey distribution, and contributed to drafting the methods section. LMSW and CLDP prepared Figures 1–3 and Tables 1–3, and contributed to the writing of the results section. CEC-S and AEK performed data analysis, including statistical tests, and contributed to the interpretation of findings. MADS provided expertise in study design, methodology, and critical revision of the manuscript. RGS supervised the entire project, contributed to the conception of the checklist, and critically revised the manuscript for important intellectual content.All authors contributed to the discussion, reviewed the manuscript, and approved the final submitted version.

Data Availability

The datasets generated and analyzed during the current study are not publicly available due to ethical and confidentiality restrictions related to participant privacy. However, the data may be made available from the corresponding author upon reasonable request.

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Figures

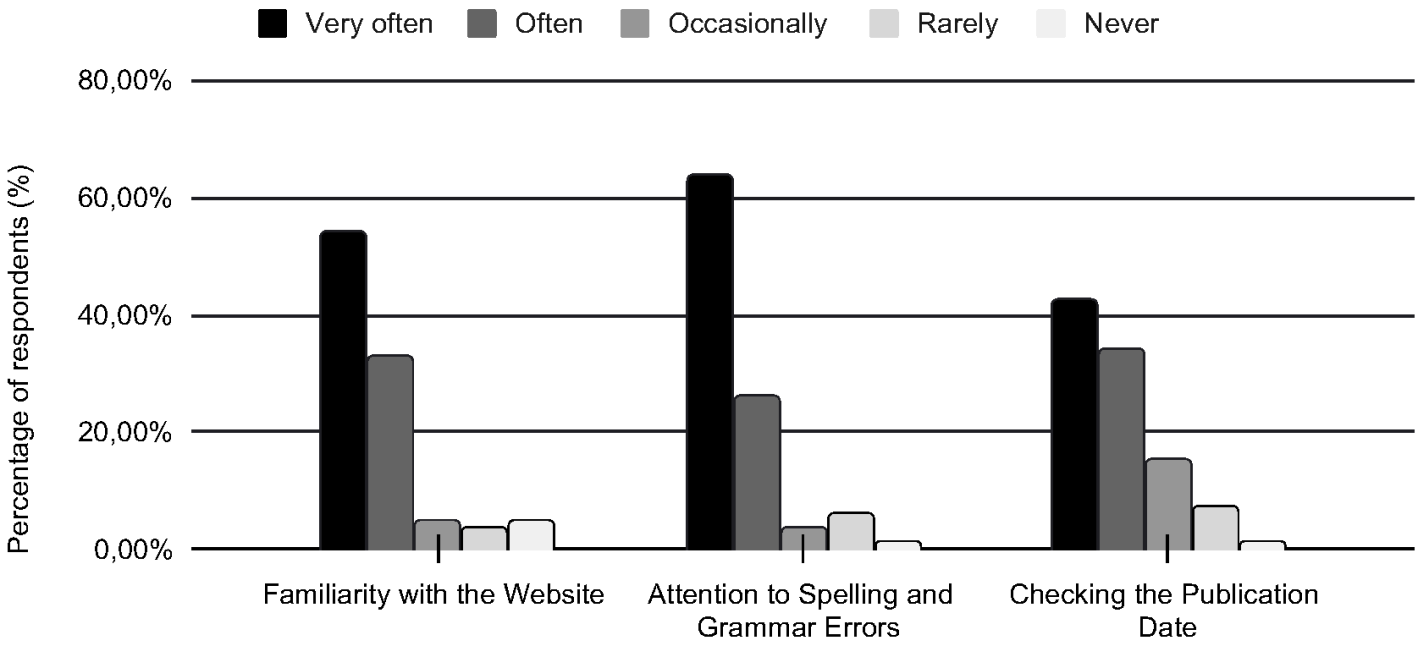


Figure 1

Perception of the importance of source credibility and content verification among participants.

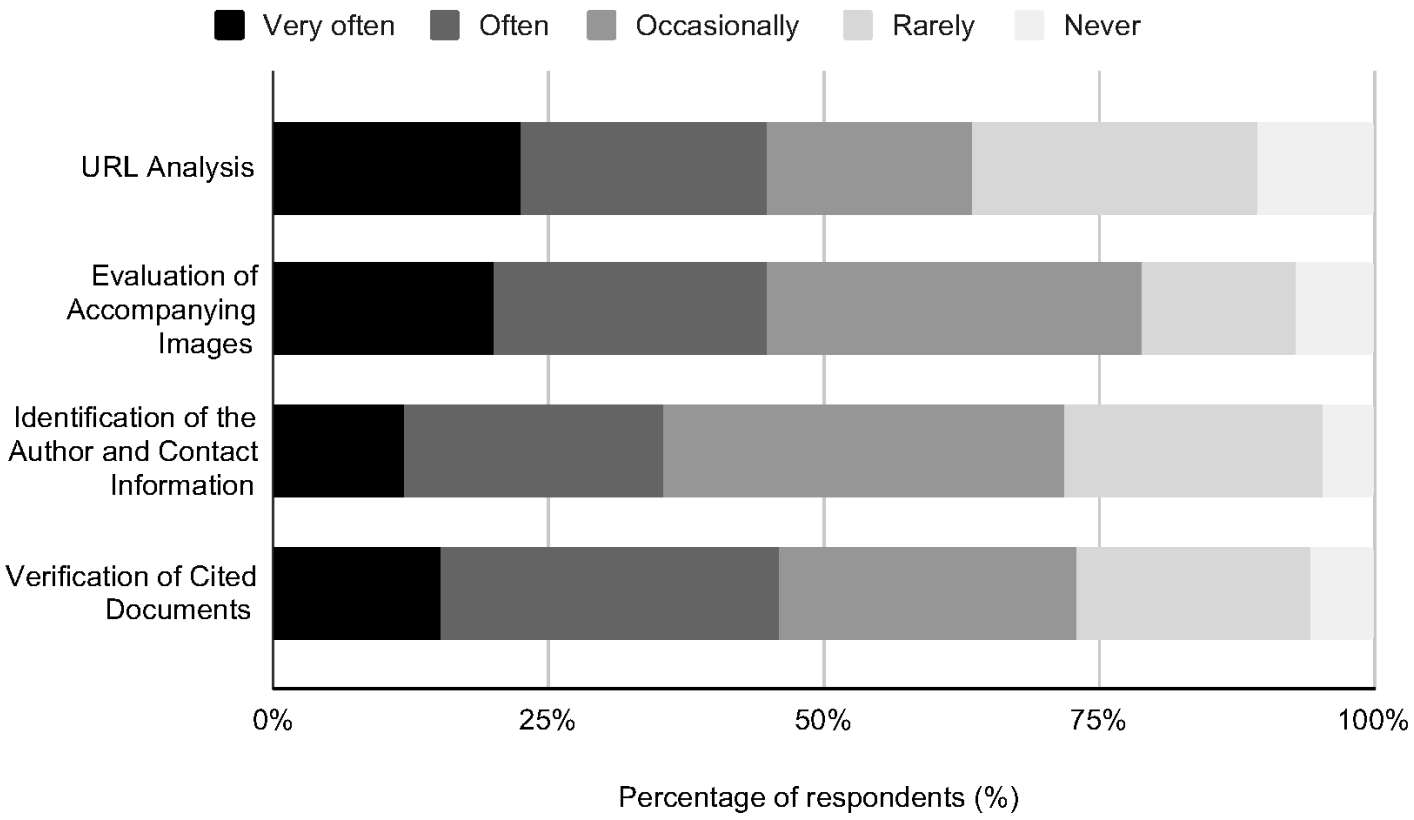


Figure 2

Frequency of information verification practices among dental students.

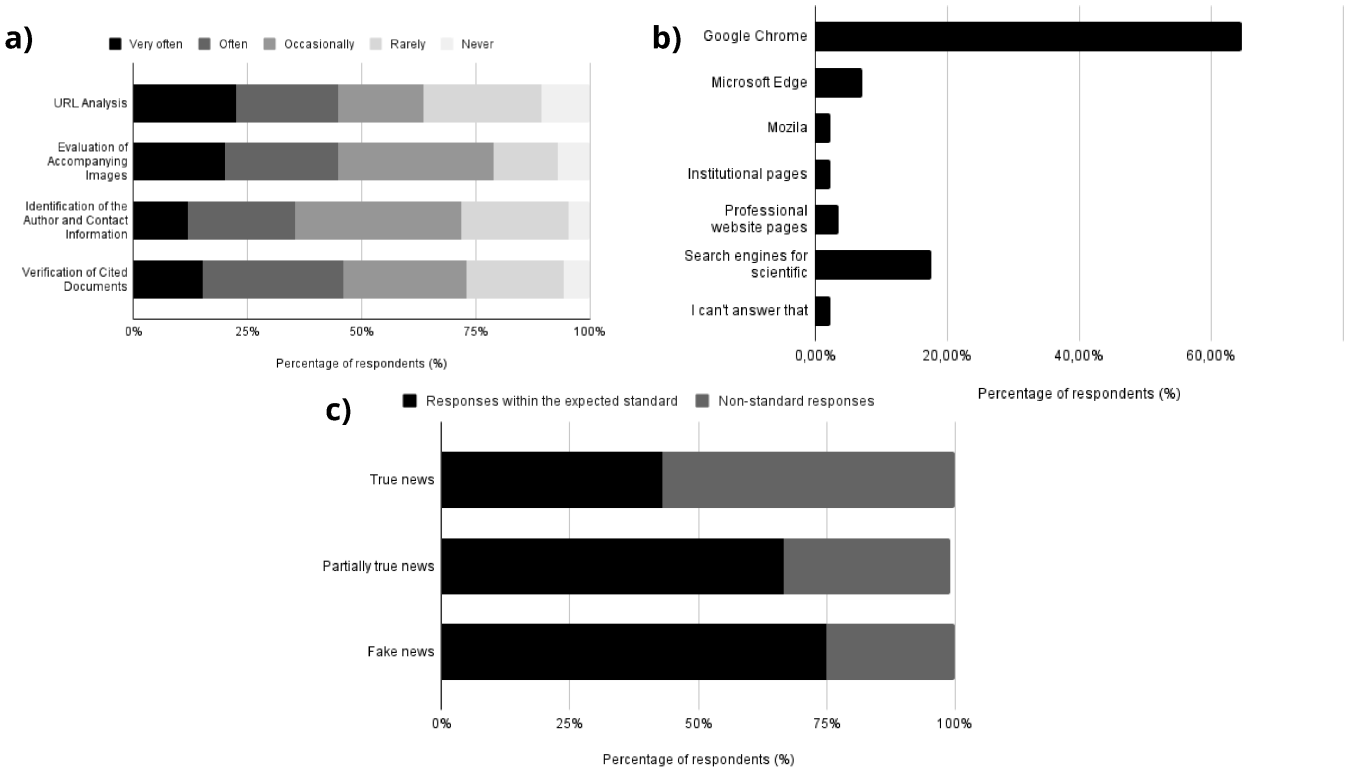


Figure 3

a). Attention to source origin and citation verification among participants; 3 b). Browser most frequently used by students to search for information; 3 c). Evaluation of news reliability by students using the student checklist.

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- SupplementaryS1FN.docx
- SupplementaryS2FN.pdf