A Critical Analysis of Students' Cheating in Online Assessment in Higher Education: Post-COVID-19 Issues and Challenges Related to Conversational Artificial Intelligence

G. Bubaš, A. Čižmešija
University of Zagreb, Faculty of Organization and Informatics, Varaždin, Croatia
{gbubas, acizmesi}@foi.unizg.hr

***Abstract* – The latest advances in conversational artificial intelligence (CAI) systems that are available to the general public have intensified the debate on cheating in online assessment in higher education. The issue of cheating in online assessment in the educational context had already been given significant attention owing to school closures (lockdown periods) during the COVID-19 pandemic and the consequent transition from on-site to online teaching and assessment. In our paper we present statistical data on cheating in online courses and academic dishonesty in general, as well as an overview of motives for and methods of cheating reported in the literature, with a focus on the period of the COVID-19 pandemic. Recommendations are also provided regarding the use of specific techniques and tools to prevent cheating in online exams. Since plagiarism is an important problem in academic assessment the potential misuses of CAI in higher education are also briefly analyzed. This paper comprises a synthesis of related review papers and meta studies with reports of empirical research findings, as well as the experiences of the authors of the paper.**

Keywords – e-learning, online assessment, cheating, COVID-19 pandemic, conversational artificial intelligence, review, critical analysis

I. INTRODUCTION

Quality in educational and psychological assessment has been in the focus of professionals for decades [1]. The Standard 6.6. of the *Standards for Educational and Psychological Testing* published in 2014 [2, 116-117] has been labeled "Reasonable efforts should be made to ensure the integrity of test scores by eliminating opportunities for test takers to attain scores by fraudulent or deceptive means." In particular, the following recommendations can be found within this standard: "Test developers should design test materials and procedures to minimize the possibility of cheating."; "Test administrators should follow established policies for dealing with any instances of testing irregularity."; "In any evaluation of work products (e.g. portfolios) steps should be taken to ensure that the product represents the test taker's own work, and that the amount and kind of assistance provided is consistent with the intent of the assessment." In addition, the *International Test Commission*, together with the *Association of Test Publishers*, in 2022 issued their *Guidelines for Technology-Based Assessment* [3]. Two of the guidelines in that document should be especially mentioned, i.e., guideline 8.2. declaring that "A testing organization should continuously analyze the risk of cheating and theft threats and adopt, implement, and maintain appropriate solutions for those threats that carry the highest risk", as well as guideline 8.7. which states that "A testing organization should put in place measures to detect and report cheating or content theft and respond to them as quickly as possible. These measures may include data forensics, monitoring Internet sources for disclosed content, monitoring the test taker during the test, and methods to report test fraud when observed."

In her comments of the *Standards for Educational and Psychological Testing*, Camara [4] emphasizes that the term 'secondary users' of testing can include not only teachers and students, but also policymakers and educational reformers who have influence in shaping or implementing educational policy and programs. Such *secondary users*, who have less expertise in measurement, are more likely to misuse assessment in new and challenging ways in comparison to *primary test users* (e.g. psychologists and educational researchers). It is important that all users, including secondary users, make reasonable efforts to follow the *Standards* [2] where applicable.

A paper by Jenkins et al. published in 2022 [5] reported an *increase of concerns* about cheating in online classes during the COVID-19 pandemic that was especially present in the time of *shutdown* of colleges and their shift to predominantly *online* education and assessment. This study performed on 214 students of psychology at one university in the USA has uncovered that, due to the COVID-19 pandemic, *first time cheating* was on the rise and that cheating in *online classes* was more frequently reported in comparison to cheating in *in-person classes*. The overall reporting of cheating in this study was very high – 74.8% of the surveyed students reported that they had cheated at least with one type of graded material (exams, quizzes, homework, and project/paper). Also, cheating in *online classes* was more present in case of exams, quizzes and homework assignments when compared to *traditionally delivered on-site classes*. Interestingly, only one of the students who participated in this survey reported that he/she had been caught cheating.

In a national survey in Germany [6] performed from November to December 2020 the students (N=1,608) were questioned about their academic dishonesty during the summer semester of the 2019/2020 academic year (this was the first COVID-19 semester with lockdowns at most

academic institutions in Europe). The results of this survey also indicated a much higher self-reported frequency of cheating in *online* versus *on-site* exams. A brief review paper performed by Maryon et al. [7] (published in December 2022) analyzed 16 studies that addressed the issue of *online cheating* during the COVID-19 pandemic and found that, due to the sudden change to online delivery of courses, both educators and researchers recognized *negative effects* on students' academic integrity during the peak of this transition.

In two surveys performed in May 2020 [8] (N=789 instructors) and September 2021 [9] (N=2,868 instructors), a team of experts engaged by the academic publisher and service provider Wiley investigated the instructors' concern about students' cheating in *online* course delivery. In the 2020 survey a total of 93% of the surveyed instructors felt that students were "more likely" (31%) or "significantly more likely" (62%) to cheat *online* than *in-person*. A decrease by 16% in this negative perception was found in the later (i.e. 2021) survey, in which the percentage of instructors who reported that the students were more likely to cheat *online* than *in-person* had declined to 77%. It must be noted that the September 2021 Wiley survey also collected data from students (N=682), most of whom (59%) stated it was "easier" or "significantly easier" to cheat *online*, therefore confirming the previously mentioned instructors' concern about online assessment. For comparison purpose, regarding the period *before* the COVID-19 pandemic, it must be mentioned that in an earlier study [10] (N=659 for students and N=303 for faculty), that was published in 2019, the majority of students (63%) and faculty (56%) at one university in the USA perceived cheating and plagiarism as a greater problem in *online classes*, while only a small percentage of students (5%) and faculty (7%) found cheating and plagiarism to be a greater issue in *traditional courses*.

Assessment is an important component of the education process in higher education institutions (HEI). Accordingly, the recommendations from the *Standards for Educational and Psychological Testing* [2] and *Guidelines for Technology-Based Assessment* [3] should be considered when planning and performing various types and modalities of *online* student evaluation. The previously reported empirical findings regarding the *prevalence of students' cheating in online assessment* before, during and at the time of the easing of the COVID-19 pandemic, emphasize the importance of *quality in online assessment* at higher education institutions.

II. STUDENTS' MOTIVES FOR CHEATING IN ONLINE ASSESSMENT

According to a review paper that investigated *motives for cheating in online assessment* published by Noorbehbahani et al. [11] in 2022, the 38 specific means of cheating derived from the analyzed literature can be grouped into the following *four categories of reasons for cheating* (original formulations are slightly adapted): *teacher related* (e.g. poorly designed exams; restraint in punishing cheaters), *institutional* (e.g. lack of strict rules and policies on cheating), *students' learning characteristics* (e.g. inadequate academic skills and performance; low interest in the course and knowledge acquisition), and *students' personality characteristics* (e.g. laziness; risk proneness).

In a survey [12] performed in the winter semester of 2020/2021 academic year among the students of a technical university in Germany (N=416), 58.4% of the respondents stated that they had the opportunity to cheat during the *written online exams*. Also, 73.2% of the surveyed students affirmed that, in their opinion, the *online* assessment formats provide more opportunities for cheating than *on-site* exams. *Opportunity* can be considered an important factor for developing *intent* to cheat. It is noteworthy that a substantial share of 27.6% of the respondents in this German study confirmed they had engaged in at least partial cheating during the semester in which the survey was performed. One of the conclusions of the author of the study was that the group of students that would be *most likely to cheat* in online assessment consists of (a) those who are *morally willing* to do so and (b) those who find an *opportunity* to cheat.

The first *Wiley survey* performed in September 2021 [9] uncovered various facilitating factors for intent of students (N=682) to cheat in academic assessment: *pressure* (to get good grades; cost of education), *workload* (too much work to meet requirements; hard to balance study with other responsibilities) and *relevancy* (course content for examination is not relevant to the student or his/her major). It can also be concluded from the results of this Wiley survey that the students who are *more likely to cheat* have enrolled in college for *instrumental purpose* (because their parents or family wanted that; to make more money; to find a job they are passionate about). On the other hand, according to the second *Wiley survey*, the students are be *less likely to cheat* if they are *more aware of the negative consequences* (if the consequences are mentioned in the syllabus; if getting caught in cheating lowers grade or implies some other penalty; if proctoring devices are used), as well as if the *honor code had to be signed*. Interestingly, in another study [13] (N=60), when consecutive online exams were performed during summer 2020 (all taken by the students from home), it was found that a lesser level of cheating reduction was associated with the *appeal* not to cheat, students' *approval with non-cheating statement* and *time restriction*, in comparison to a greater level of cheating reduction in case in which a *warning statement of surveillance and administrative action* due to suspicious behavior during online testing was present.

In one of the *highly cited review studies* conducted by Whitley [14] and published in 1998, much before the COVID-19 pandemic (for a bibliometric analysis of most cited related studies see: [15]), the following most influential correlates of students' cheating in academic environment were uncovered: *demographic variables* (cheating was most notably associated with a younger age and being in a marital relationship), *ability* (greater association of cheating was found with a lower ability of performing specific tasks), *dishonesty at earlier levels of education* (e.g. in high school), *attitudes and norms related to cheating*, *personality variables* (morality; procrastination), and *situational variables* (honor codes; perceived workload; competition). In an earlier, also highly cited *empirical study* published in 1993, McCabe and Trevino [16] revealed that the students (N=6,096) were most likely to cheat if (1) they perceive that their peers cheat, (2) their perception of probability of being caught is lower, (3) there is less understanding/acceptance of integrity policy, and (4) there is possibility of a severe penalty. A newer study by Arnett Jensen et al. [17], published in 2002, presented the following *categories of*

academic cheating motives (here they are slightly rephrased and reorganized): *personal academic gain* (necessity to pass the exam; need for a good grade; maintaining class ranking), *conformity* (everyone else is cheating), *unfair treatment by instructor* (perceived unfairness of instructor; exam observed as deliberately too hard to pass), *no harm to others* (it isn't a big deal to cheat; no one suffers from my cheating), *low risk of detection or consequence* (students' assumption that they wouldn't get caught; have cheated before without getting caught; not expect much punishment by instructor if caught), *challenge* (maybe I can get away with it; the class is very competitive), *instrumental* (need to pass to get a job), *relationship or image management* (don't want to disappoint parents), and *situational* (didn't have enough time to study; "froze" during exam; currently depresses or do not have enough energy to prepare for exam). Finally, Jurdi et al. [18], in their paper published in 2011, categorized various predictors of cheating behaviors associated with motivation into *demographic*, *psychosocial*, *academic* and *situational* factors. In their study, performed on Canadian students (N=321), they found that *peers' cheating* had, respectively, a greatest *positive* correlation and *deep learning strategies* a greatest *negative* correlation with their composite measure of engagement in dishonest behavior.

This brief overview of selected studies of *cheating motives* before and during the COVID-19 pandemic, even though some of them are not directly related to *online cheating*, lists many incentives and variables associated with student's misconduct in online exams that need to be taken in account when planning remote assessment at HEIs.

III. VARIETY OF ONLINE CHEATING IN ONLINE COURSES

Janke et al. [6] have listed a considerable number of predominantly *offline* forms or techniques for cheating in academic assessment, while Noorbehbahani et al. [11] created a complementary and more comprehensive list of *online* forms of cheating. When these two lists are combined, the following categories and more specific instances of academic dishonesty during online exams can be proposed:

- *Self-reliance in testing* (examinee is using forbidden material – textbook, notes or cheat sheet; examinee performs internet search or uses offline digital resources on one's computer/smartphone).
- *Other-reliance in testing* (copying other persons' answers; getting help from a consultant or group of peers for performing individual assignment; handing in other persons' work; engaging in forbidden collaboration during testing or oral examination; engaging someone else to falsely impersonate the examinee during online testing or oral examination).
- *Plagiarism, self-plagiarism or falsification in written assignments, essays and seminar papers* (copying content from the internet, a book, or an article without naming the source; submitting the same work as a learning assignment for different courses; referencing sources that one has not read or consulted for writing the submitted text; modifying or making up information from scientific and other sources so that they better fit into the text that is being written).

According to the experiences of the authors of this paper, who have conducted numerous online tests and oral examinations during the COVID-19 pandemic, in combination with the observations of Noorbehbahani et al. [11] and other authors, the following modalities of online assessment and related cheating techniques can be defined (in form of three types of online examination):

(a) *Time limited online tests <u>without</u> surveillance* (cheating can include use of textbooks, cheating sheets, post-it notes, digital documents that can be searched with keywords, use of the internet, help from a consultant/collaborator in the same room or accessed remotely, screen sharing, use of imposters).

(b) *Time limited online tests <u>with</u> video surveillance and browser lock* (cheating can include all of the previous forms, with taking care of the angle of the camera view and more careful whispering by the consultant below the level detectable by microphone, redirecting the webcam, use of multiple devices like a second computer or a smartphone, use of headphones/earphones or a hidden earbud or use of external electronic devices like a miniature camera and spy earpiece).

(c) *Oral examinations using videconferencing tools like Zoom* (cheating by examinees can include all of the previous but with much greater care and control of the angle of the camera view, appropriateness of the movement of hands and direction of gaze, as well as promptness in oral responses to the questions that are being asked).

Having in mind the time given to the students to develop techniques for cheating in online exams (two years of lockdowns at HEIs during the COVID-19 pandemic), alongside with greater *circumstantial incentives* (less time for preparation; test that is difficult to pass; importance of passing the test; inadequate control of the examinees' testing environment; poor instructor skills for use of prevention technology; inadequate organizational culture at a higher education institution; peers that are cheating and pressure on others to also cheat), the sophistication and skill in use of *online cheating techniques* by interested students could gradually evolve to a substantial level, far beyond the ability of an average instructor to adequately confront them.

IV. PREVENTION OF CHEATING IN ONLINE EXAMS

The authors of this paper have performed numerous online assessments in form of *online tests with multiple choice questions*, as well as oral exams using videoconferencing tools like *BigBlueButton*. In case of *online tests* our most commonly used and, according to our experience with more than 20 online testing procedures performed, preferred combination of simultaneous application of various prevention methods was: (a) creation of a new set of questions for every online testing; (b) all students enlisted in a specific course in one generation are accessing the online exam for this course at the same time; (c) at least 35-40 questions in each test; (d) time restriction of test duration to 25-30 minutes for 35-40 multiple choice questions; (e) random order of multiple choice questions in the test for each examinee; (f) presentation in random order of at least 4-6 predefined responses for each multiple choice question; (g) statements of students before taking the test that they will not use unethical means during testing to achieve better results; (h) use of *Safe Exam Browser* which imposes a 'full-screen lock' to the computer of the examinee during the test; (i) video surveillance of the examinees via *BigBlueButton* videoconferencing tool and their use of a webcam or smartphone camera to enable monitoring of their behavior during the whole testing period.

The text of the statement that students agreed with before taking the online tests that were performed by the authors of this paper was: "By taking this online test, I declare and confirm that I will not use illegal and unethical means such as consulting printed or electronic content outside the test,

giving or receiving any help in answering the questions in the test, as well as any other forms of cheating in order to achieve a better result than the one I can achieve only based on my knowledge at the time of gaining access to this test." Video surveillance was organized in groups of up to 25 students per one *BigBlueButton* virtual classroom (it was integrated within the Moodle LMS, where the online exams were placed). The optimal solution for simultaneous online testing of large groups of students was for one instructor to perform video monitoring for a maximum of 2-3 groups with 20-25 students in each group.

The *Safe Exam Browser* (SEB) is an effective solution for preventing cheating on multiple-choice tests since it displays only the necessary navigation in the learning management system and prevents access to internet search engines and other local documents [19] by restricting the number of active applications during the exam period [20]. Because of potential technical problems, ensuring the opportunity for students to take the same online test without SEB is recommended (to discourage false statements about their inability to use SEB, those students who encounter technical problems could be obliged to take a subsequent oral exam). Documentation and instructions for the students on how to download, install and use SEB should also be provided, and a restriction should be made to use only a desktop/notebook computer to access the online test.

In order to mitigate potential negative impacts of online assessment, soon after the beginning of the COVID-19 pandemic the *University Computing Centre* of the University of Zagreb, Croatia, issued recommendations [21] for university instructors on how to hold and deliver distance learning exams. The first recommended step was to prepare the exam carefully and provide students with clear instructions on how to take the exam, including technical requirements, but also to state that any kind of cheating is not allowed. A prior *practice test* that simulates the conditions of the real exam was also advised. Another important guideline, intended to reduce the distribution of questions and answers among students, was to omit feedback for each question after submitting the test so that the correct answers are not revealed. It was also recommended to limit the number of questions per page and disable the return to previously viewed questions. Finally, a large base of well-formulated questions would make it more difficult to share test questions and correct answers.

In case of online exams performed by videoconferencing tools the only suitable (acceptable and inobtrusive) means of preventing cheating that was used by the authors of this paper was to careful monitor students' behavior and proceed to the next question in case the student hesitated with his/her answer to a question for more than a few seconds.

When using video conferencing tools for surveillance a reliable internet connection on the students' side is required, as well as the teachers' ability to monitor all students that are taking the online test (see: Haus et al. [22]). In case large groups of students are taking the online test, it is advised to provide a sufficient number of instructors to monitor online testing and also to complete checking student's cameras at least 5-10 minutes before they are scheduled to start an online test. Haus et al. emphasize the following potential advantages of using smartphone cameras as a surveillance method instead of webcams: (a) easier control of students accessing physical materials (books, devices) or speaking with others in the room during the exam; (b) even when the locked browser apps are used during the exam, the teacher can see students' behavior in real time by zooming in on each student window in the web conference; (c) the teacher can check students randomly or focus on a student who shows suspicious behavior during the exam.

Before using technology for conducting online exams the teachers should develop appropriate competences or be sufficiently instructed on how to perform testing with technology. Also, the students should be provided with adequate guidance and pre-trained, for instance with exercise/trial online testing, and should also be informed in advance about possible technical problems, especially if special software like SEB is used during online testing [23].

More advanced technical methods to prevent students' cheating in online exams include the use of remote *proctoring software*. Automatic online proctoring replaces instructors in monitoring the students while they are taking an online exam and can deter academic misconduct. One of the methods for automatic proctoring implies using software that accesses a student's webcam and monitors the video to identify behavior patterns that could indicate cheating. Besides having proctoring software to automatically control students' behavior during testing, the instructor can also choose to view the video in real time during the exam or review the video recording after the exam. A study conducted before the COVID-19 pandemic by Dendir and Maxwell [24] indicated that online proctoring with webcam recording software can reduce cheating in online courses. The same finding was reported in a study by Arnold [25] in relation to proctored online exams before and during the COVID-19 pandemic (it was conducted each year from 2015 to 2020). This latter study indicated that in each year of the study cheating in *proctored online exams* was not greater than in *proctored face to face on-site settings*. There are various countermeasures in virtual proctored examinations, including the use of 360-degree security cameras [26]. Despite important privacy concerns, the use of a 360-degree camera provides the proctor with similar ability as in the traditional on-site proctoring situation where he/she can oversee the testing place and occasionally walk to the students who are taking the exam [27].

V. PLAGIARISM ISSUES IN RELATION TO CONVERSATIONAL AI

Plagiarism is a form of academic dishonesty that is associated with taking someone else's work and presenting it as one's own. In educational settings it is most frequent in student work in form of homework assignments and essays. The predominant types of plagiarism are related to (a) students' copying or paraphrasing a source without citation, as well as with (b) having someone else do instead of them what is demanded in an assignment and presenting it as their own work. Plagiarism is an important issue in research on higher education from a theoretical [28] and practical perspective, for instance regarding plagiarism detection [29]. Dixon et al. [30] have emphasized that, when text-matching or "similarity detection" software is used for checking student coursework, the occurrence of problematically similar text without proper attribution appears in 25% to above 70% of samples, depending on published study. They also revealed a high percentage of students that were willing to exchange coursework with their peers, which is also considered a form of plagiarism.

Concerns about plagiarism have recently grown with the advance of conversational AI like chatbots or virtual agents. According to data collected in 2019 and presented on the *Statista* portal [31], very high percentages of users' questions

were correctly understood (above 99.8%) and answered (80%-93%) by popular virtual assistants like *Alexa*, *Siri* and *Google Assistant*. Introduction of *ChatGPT* for free public use in November 2022 was a turning point for the academia with numerous observations by educators that it may endanger the academic integrity of students. Since the introduction of *ChatGPT* to the general public, popular news portals like *Insider* [32] have been reporting on the academic exams that *ChatGPT* was able to pass and specialized portals like *TimesHigherEducation* have published commentaries on topics related to *ChatGPT* (for search results see: https://www.timeshighereducation.com/search?search=chatgpt). However, papers in *peer reviewed scholarly literature* that address this issue and discuss, for instance, the opportunities and challenges associated with the use of *ChatGPT*, as well as means for prevention of plagiarism [33] can only recently be found. Some authors have even used *ChatGPT* as a "co-author" to produce articles for scholarly journals about its use in plagiarism (e.g. [34], [35]). The use of *ChatGPT* in education is elaborated in pre-print papers without peer review available on public archive websites like *arXiv* (https://arxiv.org/) or EdArXiv (https://edarxiv.org/discover?q=chatgpt). In peer-reviewed journals there is lack of comprehensive analyses of issues associated with academic integrity and use of Large Language Models (LLMs) tools like *ChatGPT* (see: [36]).

Since the academic community is still adapting to the emergence of conversational AI and tools using LLMs it is too early to derive and present accountable statements about its future impact on higher education. Still, educators should pay much more attention to home assignments and exams/tests performed remotely/online if they are not adequately proctored. The authors of this paper recommend testing not only *ChatGPT*, but also other conversational AI tools like *Bing* chat and *ChatSonic* (https://writesonic.com/chat), as well as similar tools that will soon be available for public use (e.g. Google *Bard*), in relation to how the instructors at HEIs design and deliver online exams and homework assignments. For instance, the authors of this paper have found that *ChatSonic* can produce correct answers to multiple-choice questions in Croatian language that were used in their online exams during the COVID-19 pandemic.

VI. Conclusion

A brief review in the first ("Introduction") part of this paper indicated the fairly high percentage of students who were inclined to cheat in online exams *during* the COVID-19 pandemic, as well as of instructors who were concerned about such academic dishonesty of their students (see: [5], [6], [7], [8]). On the other hand, studies conducted *before* the COVID-19 pandemic also confirm that a greater percentage of students were likely to cheat in *online* assessment in comparison to traditional *on-site* assessment (for instance, see: [10]). In the second chapter of our paper entitled "Motives of students for cheating in online assessment" diverse reasons for academic dishonesty were extracted from the papers published *during* the COVID-19 pandemic (see: [9], [11], [12], [13]), as well as *before* the pandemic (e.g.: [14], [16], [17], [18]). Since our review of the analyzed literature established that the inclination to cheating in online exams was high and the students' motives to do so diverse and numerous, in the third section of our paper ("Variety of online cheating in online courses") we addressed this issue by creating categorizations of means for such academic dishonesty. In the first categorization, the findings of an *empirical study* related to predominantly *offline* cheating [6] were combined with a *review study* associated with *online* cheating [11] by the students in academic assessment. The second categorization in this section of our paper also included the experiences of the authors and addressed means for cheating in (a) *unsupervised* and (b) *supervised online tests*, as well as (c) *oral examinations* with the use of videoconferencing tools like *BigBlueButtom* or *Zoom*. The fourth section ("Prevention of cheating in online exams") presented a practical solution used by the authors of this paper for confronting cheating in online exams by combining several techniques, including students' agreement with an honor statement, video surveillance and use of *Safe Exam Browser*. The use of proctoring applications is also briefly addressed in this section, having in mind both their positive and negative aspects. Finally, in the fifth section or our paper "Plagiarism issues in relation to conversational AI" such tools and services are briefly considered in relation to cheating in assignments which student perform outside monitored *on-site* environments.

The study that is presented here presents a more contemporary analysis of research and addresses in more detail the period of the COVID-19 pandemic when compared to similar reviews of research papers published before the COVID-19 pandemic (i.e.: [37]). However, remote proctoring with the use of video surveillance and the challenges that were recently brought before the academic community with the increasing popularity of the *ChatGPT* conversational AI tool were not extensively analyzed in this paper. The authors of this paper agree that there are numerus controversies associated with remote proctoring in line with the statement of the *ACM US Technology Policy Committee* dated December 16, 2022 [38]. Also, because of the lack of peer reviewed research, it is still too early to make *reliable and accountable statements* about the use of conversational AI or LLM based tools for cheating in academic assessment.

The COVID-19 pandemic has brought academic integrity/dishonesty in online learning into the focus of researchers, policy makers and practitioners (e.g. [39], [40]). The appearance of conversational AI services like *ChatGPT* and *ChatSonic*, as well as their expected improvements and novel services being announced, make it an imperative to confront possible threats to academic integrity of students and critically review the methods of academic assessment that are performed outside proctored environments.

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