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Academic Integrity in Online Testing: A Research Review

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Abstract

This paper provides a review of research on online education, with a focus on the methods used to promote academic integrity. Broader issues about how and why academic dishonesty occurs, and the mixed findings in relation to whether or not academic dishonesty may be more or less prevalent in online classes are discussed. Understanding the varied nature of academic dishonesty can improve the implementation of methods used to promote academic integrity, and more importantly, provide students, faculty, and staff with an ethical framework that can extend beyond academia.

1. Introduction

Academic integrity entails commitment to the fundamental values of honesty, trust, fairness, respect, responsibility, and courage (Fishman, 2014). From these values, ethical academic behavior is defined, creating a community dedicated to learning and exchange of information. For a post-secondary institution, ensuring that students and staff are acting in an academically integrous manner reinforces an institution's reputation such that an academic transcript, degree, or certificate has a commonly understood meaning, and certain knowledge and skills can be inferred of its holder. In turn, individual students benefit from this reputation and from the inferences made based on their academic accomplishments. At a broader level,

understanding the fundamental values of academic integrity that are held within a community -- and behaving in accordance with them -- instills a shared framework for professional work, making explicit the value of the mastery of knowledge, skills, and abilities.

Fair and effective methods for promoting academic integrity have long been considered within postsecondary education. Though the possibility of students engaging in academic misconduct has always existed, there is a widespread belief that departures from integrity are on the rise (e.g. Hard, Conway, & Moran, 2006). With the introduction of technology into the classroom and the popularity of online classes, new opportunities for “e-cheating” exist (e.g. Harmon & Lambrinos, 2008; King & Case, 2014). Distance learning courses have grown rapidly in the 21st century, growing from an estimated 9.6% enrollment in 2002 to a 63.11% enrollment in 2010 (Allen & Seaman, 2010). Online distance education is expected to continue to expand, and as universities move towards online delivery, faculty and administrators are faced with the challenge of developing methods to adequately assess student learning in an online environment while maintaining academic honesty¹.

The topic of academic misconduct is of particular concern to online instruction because of the absence of face-to-face interaction between instructors and students (Moten, Fitterer, Brazier, Leonard, & Brown, 2013) and the opportunities that the internet provides to enable academic dishonesty (Underwood & Szabo, 2003). There are many new ways to cheat in an online environment, including but not limited to: downloading papers from the internet and claiming them as one’s own work, using materials without permission during an online exam,

¹ Indeed, at the time of this writing, universities are facing unprecedented challenges due to the Covid-19 pandemic, and online instruction is rapidly expanding. As administrators, faculty, staff, and students attempt to adapt to changing situations due to social distancing needs, it is clear that online learning will grow and change rapidly along with this ever-evolving health crisis.

communicating with other students through the internet to obtain answers, or having another person complete an online exam or assignment rather than the student who is submitting the work (Jung & Yeom, 2009; Rogers, 2006). One evaluation method of particular concern to instructors is online testing. Both faculty and students perceive online testing to offer more cheating opportunities than in traditional, live-proctored classroom environments (Kennedy, Nowak, Raghuraman, Thomas, & Davis, 2000; Rogers, 2006; Stuber-McEwen, Wiseley, Masters, Smith, & Mecum, 2005), the main concerns being student collaboration and use of forbidden resources during the exam (Christe, 2003).

Although there is disagreement within existing research as to whether or not more cheating *actually* occurs in online exams compared to in-person exams, there *is* agreement that regardless of delivery method, cheating has always occurred (Barnes & Paris, 2013). Estimates of rates of cheating for university students range from 9% up to 90% (Davis, Grover, Becker, & McGregor, 1992; Genereux & McLeod, 1995; Maramark, Maline, Maline, Research, & Research, 1993; McCabe & Trevino, 1996; Mecum, 2006; Smith, 2005; Stuber-McEwen et al., 2005). In the online teaching context, multiple solutions have been discussed as ways to combat academic dishonesty in the online exam environment. One view is that an in-person proctored test at a testing center is the best practice for an otherwise online course because of the potential ease of cheating in an unproctored environment or an online-proctored environment (Deal, 2002; Edling, 2000; Rovai, 2000). Another view is that with the correct modifications and security measures, online exams offer a practical solution for students living far from campus or other testing facilities while still maintaining academic integrity. However, both proposed solutions come with their own disadvantages. Requiring students to travel to specific exam sites arguably

defeats the purpose of distance learning and may not be feasible for remote students, and hiring remote proctors can be expensive (Rosen & Carr, 2013).

The goal of this paper is to review and synthesize the current research on online education in relation to the methods being used to promote academic integrity. First, however, we will discuss broader issues about how and why academic dishonesty occurs, as well as its incidence in online and in-person courses. Understanding the varied and complex types and causes of academic dishonesty can inform the suite of methods that might be used to most effectively promote academic integrity. Given the increasing use of online courses within the postsecondary curriculum, it is our hope that this review will aid instructors and administrators in their decision-making process regarding online evaluations².

2. How and why students engage in academic dishonesty

Academic dishonesty (or “cheating”)³ includes behaviors such as the use of unauthorized materials, facilitation (helping others to engage in cheating), falsification (misrepresentation of self), and plagiarism (e.g. Akbulut et al., 2008; Şendağ, Duran, & Robert Fraser, 2012), providing an unearned advantage over other students (Hylton, Levy, & Dringus, 2016). Broadly, the behaviors are not consistent with an established University’s Standards of Conduct (Hylton et al., 2016), which communicates expected standards of behavior (Kitahara & Westfall, 2007). “E-dishonesty” more specifically refers to behaviors that depart from academic integrity in the online environment (Akbulut et al., 2008; Namlu & Odabasi, 2007). Even more specifically,

² As a supplement to this paper, we have made two infographics available via <https://osf.io/46eh7/> with a Creative Commons licence allowing reuse and distribution with attribution.

³ Given that the literature reviewed for this paper often uses the terms “academic dishonesty”, “departures from academic integrity”, and “cheating” interchangeably, this paper will follow this convention and not attempt to distinguish these terms.

concerns in relation to online *exams* typically include ‘electronic warfare’ (tampering with the laptop or test management system), impersonation, test item leakage, and use unauthorized resources such as searching the internet, communicating with others over a messaging system, purchasing answers from others, accessing local/external storage on their computer, or accessing a book or notes directly (e.g. Frankl, Schartner, & Zebedin, 2012; Moten et al., 2013; Wahid, Sengoku, & Mambo, 2015).

There are many reasons why individuals may choose to depart from academic integrity. By some accounts, a primary contributor is the existence of a ‘cheating culture’ (Tolman, 2017). If a university has an established culture of cheating -- or at least the *perception* of culture of cheating -- students may be tolerant of cheating, believe that cheating is necessary in order to succeed, and believe that all students are cheating (Crittenden, Hanna, & Peterson, 2009). Students directly shape cheating culture, and thus subsets of students in a university population may have their own cheating cultures (Tolman, 2017). It is plausible then, for online students to have their own cheating culture that differs from the rest of the university. However, if this subset of students is identified as being at greater risk for academic dishonesty, there is the opportunity for the university to proactively address academic integrity in that student group (Tolman, 2017).

Other accounts, based on what is referred to as the ‘fraud triangle’, posit that in order for cheating to occur, three conditions must be present: 1) opportunity, 2) incentive, pressure, or need, and 3) rationalization or attitude (e.g. Becker, Connolly, Lentz, & Morrison, 2006; Ramos, 2003). These three conditions are all positive predictive factors of student cheating behavior (Becker et al., 2006). *Opportunity* occurs when students perceive that there is the ability to cheat without being caught; this perception can occur, for example, if instructors and administrators

are thought to be overlooking obvious cheating or if students see others cheat or are given answers from other students (Ramos, 2003). The second condition, *incentive, pressure, or need*, can come from a variety of different sources such as the self, parents, peers, employers, and universities. The pressure felt by students to get good grades and the desire to be viewed as successful can create the incentive to cheat. Lastly, the *rationalization* of cheating behavior can occur when students view cheating as consistent with their personal ethics and believe that their behavior is within the bounds of acceptable conduct (Becker et al., 2006; Ramos, 2003). Similar to the ‘cheating culture’ account, rationalization can occur if students believe that other students are cheating, perceive unfair competition, or perceive an acceptance of, or indifference to, these behaviors by instructors (Varble, 2014).

Accounts based on the concepts of a cheating culture and the fraud triangle are both well supported, though other researchers have taken a more fine-grained approach, focusing on individual factors and university policies when examining why students engage in academic dishonesty (e.g. Akbulut et al., 2008). Akbulut and colleagues (2008), for example, propose that psychological factors are the most significant factors leading students to e-dishonesty. Feeling incompetent and/or not appreciating the quality of personal works or one’s level of mastery (Jordan, 2001; Warnken, 2004; Whitaker, 1993), a sense of time pressure (DeVoss & Rosati, 2002; Sterngold, 2004), a busy social life (Crown & Spiller, 1998), personal attitudes toward cheating (Diekhoff et al., 1996; Jordan, 2001), and the desire to get higher grades (Antion & Michael, 1983; Crown & Spiller, 1998) can cause an increase in academic dishonesty and e-dishonesty. Often, a reason why students enroll in online courses is the ease and convenience of an online format, but if students become over-extended, they may use inappropriate resources and strategies to manage (e.g. Sterngold, 2004). In addition, the isolation that students may

experience in an online course environment can also increase stress levels and lead them to be more prone to dishonest behaviors (Gibbons, Mize, & Rogers, 2002). However, other authors contend that the online medium may serve as a deterrent for academic dishonesty because it often supports a flexible schedule and does not lend itself to panic cheating (Grijalva, Nowell, & Kerkvliet, 2006; Stuber-McEwen, Wiseley, & Hoggatt, 2009).

In addition to individual factors, Akbulut and colleagues (2008) also describe institutional factors that can facilitate academic dishonesty. The institutional policies related to the academic standards of the university may have lax or insufficient sanctions and penalization of academic dishonesty. Further, even when sanctions and penalization are adequate, a lack of knowledge of these policies within staff, administrators, and students -- or insufficient effort made to inform students about these policies -- can result in academic dishonesty (see also Jordan, 2001). For example, McCabe, Treviño, and Butterfield (2002) found a significant correlation such that academic dishonesty decreased as students' and staff's perceived understanding and acceptance of academic integrity policies increased. Additionally, academic dishonesty was found to be inversely related to the perceived certainty of being reported for academic dishonesty and the perceived severity of the university's penalties for academically dishonest behavior. Relatedly, universities with clear honor codes had lower academic dishonesty than universities without honor codes (McCabe et al., 2002). Given these findings, universities should make academic conduct policies widely known and consider implementing honor codes to minimize the cheating culture(s). Specifically, for online courses, these findings suggest that the university's academic conduct policies and honor codes should be directly stated on course sites.

3. Incidence of cheating in online and on-campus courses

The belief that cheating occurs more often in online courses than in in-person courses -- particularly for high-stakes assessments like exams -- is widespread, with approximately 42% to 74% of students believing it to be easier to cheat in an online class (King & Guyette, 2009; Watson & Sottile, 2010). Thus, the question of whether students are cheating at greater rates in online classes is paramount in evaluating the reliability of online assessments as measurements of mastery in higher education. Though there have been many studies of academic dishonesty in in-person classes, few studies have attempted to compare cheating rates between in-person and online classes. The studies that do exist on online cheating rates look at cheating within some or all types of online assessments, while others specifically focus on exams. Because of this, the results across studies appear to be inconsistent, with some studies demonstrating that cheating occurs more often in online classes than in in-person classes (Khan & Balasubramanian, 2012; King & Case, 2014; Lanier, 2006; Watson & Sottile, 2010), others demonstrating equal cheating rates (Grijalva et al., 2006; Ladyshevsky, 2015), and some demonstrating that cheating occurs more often in-person (Stuber-McEwen et al., 2009). Table 1 provides a summary of these studies, and we highlight some of them below.

Four studies to date have found cheating rates to be higher in online courses than in in-person courses. Lanier (2006), for example, surveyed college students (n=1262) in criminal studies and legal studies courses and found that 41.1% of respondents admitted to cheating in an online course while 21.3% admitted to cheating in an in-person course. The study also found some preliminary evidence for differences in cheating rates between majors, though the sample sizes for some groups were too low to be reliable: business majors were the most likely to cheat (n=6, 47.1%), followed by “hard sciences” (n=20, 42.6%), and “social sciences” (n=282, 30%).

If these differences in cheating rates among majors were to be replicated, it would suggest that there may be different cheating cultures that exist within universities, in turn demonstrating the importance of considering group-level culture differences with respect to cheating. Similarly, Khan and Balasubramanian (2012) surveyed undergraduate students attending universities in the United Arab Emirates (N=224) and found that students admitted to higher cheating rates using technology or e-cheating. Although that study did not differentiate between online and in-person course formats, it does suggest an increase in cheating via the use of online technology.

Using the Student Ethical Behavior instrument with undergraduate students enrolled in a business course (n=1867), King and Case (2014) found higher cheating rates in online exams than in in person-exams. Specifically, researchers found that 15% of students admitted to cheating on an in-person exam, at about 2.9 times a semester, while 29% admitted to cheating on an online exam, at about 3.3 times a semester. Thus, not only were students cheating at higher rates in online exams as compared to in-person exams, but those that did admit to cheating were also cheating more frequently during a semester online than in person. Consistent with this finding, Varble (2014) analyzed the test scores of students enrolled in an online or an in-person, undergraduate marketing courses. Students took exams either online or in person. The study found higher mean test scores in the online test group with the exception of one test, than test scores in the in-person test group. The difference in scores was largely attributed to “remember” type questions which rely on a student’s ability to recall an answer, or alternatively that could be looked up in unauthorized resources. Given these findings, Varble (2014) concluded that cheating may have taken place more often in the online tests than in person tests.

In contrast, other studies have found lower rates of cheating in online settings as compared to in-person. Stuber-McEwen, Wisely, and Hoggatt (2009) surveyed in-person

(n=225) and online students (n=138) using the Student Academic Dishonesty Survey. The study revealed that online students reported engaging in less academic misconduct than in-person students. An important methodological feature to consider, however, is that the sample of online students consisted of more mature distance study learners than the in-person sample⁴. Similarly, Grijalva, Nowell, and Kerkvliet (2006) conducted a study using a sample of undergraduate students taking an online course (n=725). Utilizing a randomized response survey method, Grijalva and colleagues estimated that approximately 3-4% of students cheated, suggesting lower cheating rates in online classes.

While some studies have found cheating rates to be higher or lower in online classes, some have not found significant differences. Watson and Sottile (2010), for example, used the Academic Dishonesty Assessment with a sample of undergraduate and graduate students from different faculties (n=635). The study found that 32.7% of respondents admitted to cheating in an online course while 32.1% admitted to cheating in an in-person course. However, the data also demonstrated that students were significantly more likely to cheat by obtaining answers from others during an online quiz or test than in an in-person quiz or test (23.2% to 18.1%) suggesting that students in an online course tended to cheat more in an online exam, while students in an in-person course tended to cheat through other assignments. Additionally, students admitted that they were four times more likely to cheat in an online class in the future compared to an in-class format (42.1 to 10.2%) (Watson & Sottile, 2010). This study points to a potential importance of addressing cheating particularly in online exams in order to ensure academic honesty in online

⁴ In typical research conducted on academic dishonesty across online and in-person mediums, researchers define their samples as consisting of “undergraduate” and/or “graduate” students. An important consideration for future research is to specify the age ranges of the sample. It is possible that the frequency and type of cheating behavior by mature, nontraditional students and by traditional students may differ. One might hypothesize that mature students may be less motivated or have fewer opportunities to cheat than traditional students.

courses. In contrast, Ladyschewsky (2015) found that in a sample of post-graduate students (n=136), multiple-choice test scores in an unproctored online format were not different from scores from a proctored, in-person exam.

Table 1. Studies Comparing Academic Dishonesty in Online Classes and In-Person Classes

Authors	Sample	Method	Conclusion	Results
Lanier (2006)	n=1262, students in core criminal justice and legal studies courses	Survey	Higher cheating online	41.1% admitted to cheating in online courses while 21.3% of students admitted to cheating in an in-person class
Khan, Z. & Balasubramanian, S. (2012).	N=224 undergrad students	Questionnaire	Higher cheating online	37.5% of students admitted to cheating among friends during in-person exams, while 78% admitted to cheating using technology or e-cheating
King and Case (2014)	n=1867, undergrad students in a business course	Questionnaire	Higher cheating online	<p>15% of the students admitted to cheating on an exam in 2013. That group of students committed this act approximately 2.9 times each semester.</p> <p>29% admitted to cheating on an online exam in 2013. That group of students committed this approximately 3.3 times each semester.</p> <p>74% of students felt that it was either very easy or somewhat easy to cheat on an online exam. Only 7% reported that it would be difficult to cheat on said exams.</p>
Varble (2014)	n=47; in-person (n=19) and online (n=28) students in an undergraduate marketing course	Analyzed student test scores	Higher cheating rates online	<p>The mean exam score for online students was higher than that for in-person students.</p> <p>The difference in scores was largely attributable to “remember-type” questions.</p>
Watson, G. & Sottile, J. (2010).	n=635, undergrad and graduate students across all academic areas	Academic Dishonesty Assessment (ADA): 44 yes/no and multiple choice statements	Similar cheating rates	<p>32.1% of responding students admitted to cheating in a conventional class format while 32.7% admitted to cheating in an online course structure.</p> <p>However, the data suggested that students were significantly more likely to obtain answers from others during an on-line quiz or test. Responding students admitted that they were more than four times more likely to cheat in an online class compared to the traditional in-class format.</p>

Ladyschewsky R. K. (2015)	n=136, post-graduate students enrolled in a management and leadership course	Multiple choice test scores in unsupervised online format vs. supervised in person format	Similar cheating rates	There was no increase in mean test scores over time, and the mean test scores of the supervised online test were not significantly higher than those in the supervised in-person test.
Grijalva, Nowell, and Kerkvliet (2006)	n=725, undergrad students enrolled in online courses	Web-based randomized response survey method	Lower cheating rates online	Approximately 3-4% of students cheated, which was similar to findings for students in traditional courses.
Stuber-McEwen, Wiseley, & Hoggatt (2009)	n=225, on ground (n=87) and online (n=138) students	Student Academic Dishonesty Survey	Lower cheating rates online	Online students in this sample reported engaging in academic misconduct less often than their in-person counterparts.

There are likely several reasons for these inconsistencies in results. First, existing studies either compare on campus and online courses in relation to cheating rates throughout the entire course or specifically in relation to exams. These two types of approaches, although similar, may lead to different conclusions. If students are more likely, for example, to engage in academic dishonesty on high-stakes summative assessments like exams rather than formative assessments throughout the term -- and if online exams offer more opportunities for dishonesty -- then study findings would be expected to differ if they are focusing on differing assessment types. Additionally, when comparing dishonesty in online and on-campus courses, the differences might be minimal in relation to assessments that allow for plagiarism (e.g., essays that may be completed 'open book' over an extended time period; e.g., Watson & Sottile, 2010).

Different research sampling methodologies may result in inconsistencies across studies as well. As noted earlier, cheating culture has been proposed to be a core factor in encouraging academic dishonesty. However, there are likely multiple cheating cultures within an institution (Tolman, 2017). If a study solely examines students in a specific discipline, it may only reveal rates of cheating within that discipline's cheating culture, and may not truly represent the institution as a whole. Moving forward, it will be important for studies to gather a diverse sample of students within multiple faculties in order to assess rates of academic dishonesty (Tolman, 2017). By extension, cheating cultures likely differ across universities, so cross-university studies may be needed in cases in which broader public policy is the goal.

The inconsistent findings with respect to rates of cheating depending on course medium in the previously described studies also point to the difficulty of conducting research on academic dishonesty. As expressed by Tolman (2017), many students participating in these studies fear academic retribution from the university, thinking that it may impact their academic

standing or their grades if their answers are linked to them in any way. Thus, when designing these studies, researchers need to be aware of this challenge so that they can design their surveys to ensure internal validity of their study (Tolman, 2017). For example, ensuring that students feel comfortable admitting to potentially academically dishonest behaviors is of significant importance to this research, and it needs to be made explicitly clear that the surveys will be anonymous and will in no way be linked to the student. However, even with these efforts in place, students may not answer truthfully. Self-reported behaviors, especially when they do not align with the ethics of a student's university, are not always consistent with actual behavior and it is important to keep this in mind while assessing these studies. Other than self-preservation, students may not accurately self-report their cheating behavior because they might not consider their behavior as cheating, or have an inaccurate view of what cheating really is. As found by Raines et al. (2011), some students do not consider their behavior as cheating unless they are caught in the act. Students may also be unaware that their behaviors are academically dishonest, with some believing it to be normal, for example, to crowdsource answers or to search the internet for the answer. Therefore, it is important to clearly define what researchers consider cheating and academic dishonesty in order to minimize false negatives in their survey.

4. Online Cheating Prevention: Assessment Structure

Preventing academic dishonesty before it occurs is one way of maximizing academic integrity at universities. Prevention methods can maximize integrity by minimizing the opportunity, incentive and pressure, and rationalization of cheating. Exams, group assignments, and research proposals all vary substantially in the nature of considerations related to academic integrity. Whereas some assessments benefit greatly from collaboration and outside sources, other assessments (especially tests and exams) require care to balance needs for academic

integrity and accessibility. Below and in Table 2, we highlight considerations for both assessment structure and assessment delivery -- with particular focus on online exams -- and encourage readers to consider deeply the implications for the use of these tools within their course and context. It is also important to note that many of these considerations are closely related, and many of these work in tandem to facilitate an honest assessment.

Table 2. Assessment Structure and Delivery Considerations to Facilitate Academic Integrity

Assessment Structure	Considerations
Item Format	Any item may be copied and shared easily. Multiple-choice questions may be especially vulnerable to unwanted sharing during time-limited assessments as they can be easily photographed by secondary devices and shared to websites/apps designed to make both the items and response options easily searchable.
Item Content	Items can vary in terms of the degree to which conceptual understanding is necessary for accurate responding. Item responses that require simple content identification, as compared to conceptual understanding, may be especially vulnerable to prohibited searching and collaboration.
Declaration of Academic Integrity	Prior to accessing an assessment online, it is possible in some software to present an attestation of academic integrity that must be acknowledged prior to beginning the test. We recommend that this attestation/declaration specifically outline common practices that may be misunderstood as being prohibited. For example, the attestation/declaration might specifically include statements such as "I will not copy/paste/share these items with anyone, including online." "I will not consult any outside resource, including but not limited to, the internet, another person, textbooks, or notes." We recommend that students are made aware of this attestation in advance so that they understand the parameters for appropriate academic behaviors in the context of a given assessment.
Alternate Versions	Especially as multiple deliveries of an assessment might be required to accommodate students in different time zones and course deliveries, having alternate forms of assessments is helpful when collaboration and sharing are a concern.
Universal Design for Number of Assessment Submissions Counted	If there will be multiple assessments of similar learning objectives, consider implementing a structure within the larger context of the course where one assessment (or more, as appropriate) can be dropped, placing a heavier weight on the other similar assessments. This can reduce pressure for any one assessment, and thus may reduce pressure to cheat.
Assessment Delivery	Considerations

Limited Window of Availability	Assessments that are time-limited should have a set start and end time. In cases such as exams/tests where time is limited, students should ideally begin the assessment within a short time window, and all students should end the exam at the same time (unless accommodations require otherwise). This limits the risk of students sequentially taking an exam to benefit from the sharing of items.
Time Limits	When time-limits are required, assessments should be designed in such a way that corresponds with the availability of the assessment. For example, if the assessment is designed to take 1 hour, the time limit for the assessment should also be 1 hour (with accommodations provided as needed). This helps to create a context where consulting unauthorized materials is impractical.
Disable Copy/Paste Within the Assessment Software	If the assessment software allows, the functions to copy, paste, and screenshot should be disabled to limit sharing.
Preventing Going Back to Earlier Items	Items can be presented one-at-a-time, or in a limited number, per each screen. Once each item (or subset of items) are completed, test-takers cannot return to those items. This limits the ability for test-takers to share and return to items. Note that this may pose new challenges for test-takers: a common test-taking strategy is to return to previous challenging items.
Item & Response Option Randomization	Both test items, and response options for multiple choice-style items, can be randomized across deliveries of the assessment to limit simultaneous completion of items.

The considerations provided in Table 2 have been discussed at length by other scholars. For example, given the financial and logistical concerns that may make cheating *detection* through online proctoring and other technological solutions unfeasible (e.g. Cluskey, Ehlen, & Raiborn, 2011), some advocate for changes to exam formatting that can, in turn, prevent and deter cheating at little cost (Serwatka, 2003; Shuey, 2002; Vachris, 1999). Further demonstrating the importance of assessment-specific considerations, Cluskey and colleagues (2011) have proposed online exam control procedures (OECPs), or non-proctor alternatives, to promote academic honesty. These OECPs include; offering exams at one set time, offering an exam for a brief period of time, randomizing the question sequence, presenting only one question at a time, designing the exam to occupy a limited period of time allowed for the exam, allowing access to the exam only one time, requiring the use of a lockdown browser, and changing at least one third of exam questions every term (Cluskey et al., 2011). These methods will likely not eliminate cheating entirely; however, the inclusion of these methods may decrease the rates.

The procedures are designed to reduce academic dishonesty through exam format by reducing the *opportunity, incentive and pressure*, as well as *rationalization and attitude* to cheating. As discussed previously, the academic fraud triangle posits that all three of these factors lead to academic dishonesty (Becker et al., 2006; Ramos, 2003; Varble, 2014). Thus, in relation to online exams, minimizing these factors may serve to encourage academic honesty. Of course, some of these suggestions do conflict with each other; for example, limiting the number of exam attempts may limit the opportunity to cheat, but allowing for multiple exam attempts may reduce the pressure to cheat. We suggest that it is important to consider a balance. Cheating prevention methods are limited if students' needs or attitudes have not also been addressed.

5. Online Cheating Prevention: University Policies

As highlighted previously, institutional factors that can increase academic dishonesty include lax or insufficient penalization of academic dishonesty, insufficient knowledge of policies and standards across students, instructors, and administrators, and insufficient efforts to inform students about these policies and standards (Akbulut et al., 2008; Jordan, 2001). In order to ensure academic honesty at Universities, administrators and staff must clearly define academic dishonesty and what behaviors are considered academically dishonest. Students often demonstrate confusion about what constitutes academic dishonesty, and without a clear definition, many students may cheat without considering their behaviors to be academically dishonest. Thus, the more faculty members discuss academic honesty, the less ambiguity students will have when confronting instances of academic dishonesty (Tatum & Schwartz, 2017).

In addition to making students aware of what constitutes academic dishonesty, it is also important to make students aware of the penalties that exist for academically dishonest behavior. It has been shown that academic dishonesty is inversely related to the perceived severity of the university's penalties for academically dishonest behavior (McCabe et al., 2002). When faculty members are aware of their institutions policies against academic dishonesty and address all instances of dishonesty, fewer academically dishonest behaviors occur (Boehm, Justice, & Weeks, 2009).

Faculty and staff can influence the cheating culture of their university simply by discussing the importance of academic honesty with their students. These discussions can help shape and change a student's beliefs on cheating, hopefully reducing their ability to rationalize academically dishonest behavior. Discussions with students on the importance of academic

dishonesty may help reduce feelings of overestimated cheating frequency among peers, and may prevent students from rationalizing cheating behavior. Honor codes, for example, are effective at reducing academic dishonesty when they clearly identify ethical and unethical behavior (Jordan, 2001; McCabe & Trevino, 1993; McCabe, Trevino, & Butterfield, 2001; McCabe et al., 2002; Schwartz, Tatum, & Hageman, 2013) and are associated with perceptions of lower cheating rates among peers (Arnold, Martin, & Bigby, 2007; Tatum & Schwartz, 2017). Further, these codes reduce students' ability to rationalize cheating (Rettinger & Kramer, 2009), increase the likelihood that faculty members and students will report violations (Arnold et al., 2007; McCabe & Trevino, 1993), and increase the perceived severity of sanctions (McCabe & Trevino, 1993; Schwartz et al., 2013). In addition to implementing honor codes school-wide, honor codes can also be implemented into specific courses and have been shown to reduce cheating and improve communication between students and faculty by increasing feelings of trust and respect among the students (Konheim-Kalkstein, 2006; Konheim-Kalkstein, Stellmack, & Shilkey, 2008).

6. Online Cheating Detection: Online Proctoring

There are also currently various means of *detecting* cheating in online exams. We have chosen to discuss these means of detection separately from methods use to *prevent* cheating as the implementation tends to occur at a different level and for a different purpose (e.g., technological systems that detect cheating while it is occurring or shortly after, rather than solutions at the level of exam question format that are designed to stop cheating before it occurs). However, we do note that if students are aware of the cheating detection systems in place, the systems may have a preventative effect. The exam cheating detection systems described below have been developed, in part, because holding exams in-person at a registered location with live proctors is often not feasible due to financial, travel, or other logistical reasons

(Cluskey et al., 2011). The general types of online proctoring include video summarization, web video recording, and live online proctoring. Each is described below and summarized in Figure 1.

Figure 1. Four Types of Proctoring 1) In-person, 2) Video Summarization, 3) Web Video Recording, and 4) Live Online Proctoring

6.1 Video Summarization

Video summarization software, also referred to as *video abstraction*, utilizes artificial intelligence to detect cheating events that may occur during the exam (Truong & Venkatesh, 2007). Students are video recorded using their own webcam throughout the exam. If a cheating event is detected, the program will flag the video for future viewing by a proctor. Thus, the time demands of proctors are reduced, yet students are monitored. Video summarization programs can generate either keyframes (a collection of images extracted from the video source) or video skims (video segments extracted from the video source) to represent potential cheating behavior (e.g. Truong & Venkatesh, 2007). Both of these forms convey the potential cheating event in order for future determination by a human proctor. However, video skims have an advantage over keyframes in that they have an ability to include audio and motion elements which convey pertinent information in the process of invigilation (Cote, Jean, Albu, & Capson, 2016).

The main advantage of choosing an invigilation service like this one is that it reduces the hours that proctors must put in into invigilating the exam, with companies like ProctorU stating that only 7-9% of exams will need to be reviewed by the professor or teaching assistants (ProctorU, n.d.-b). However, detecting cheating behavior without live human interaction is a difficult process. Modeling suspicious behavior is complex in that cheating behavior does not typically follow a pattern or type, thus making it difficult to recognize accurately (Cote et al., 2016). Therefore, some suspicious activity may not be detected, and administrators may not be able to guarantee that all cheating behavior has been deterred or detected.

6.2 Web Video Recording

In relation to online exams, *web video recording* refers to situations in which the student is video recorded throughout the entirety of the exam for later viewing by an instructor. Like

video summarization methods, detection software can be used in order to flag any suspicious activity for later viewing. Administrators and instructors may feel more confident in this service as they can view the entire exam, not only the flagged instances. However, reviewing all exams individually may not be feasible, and most exams are not reviewed in full. As stated on the ProctorU website, almost 30% of exams require review, but 90% of these go ignored by administrators (ProctorU, n.d.-a). Unlike video summarization programs, web video recording programs do not have specific proctors review all flagged instances, and instead rely on review by the administrators and instructors themselves. Knowing that the recording is occurring may deter students, but as with detection based on artificial intelligence, it is not guaranteed that all cheating behavior will be detected. It is important to note that with this method, as with the previous method, there is no opportunity for intervention by a proctor if an event is flagged as a possible violation of academic integrity. Thus, there may be ambiguous situations that have been flagged electronically with no opportunity to further investigate, and no way to mitigate risk if there is potentially suspicious activity occurring.

6.3 Live Online Proctoring

The final type of online proctoring, and arguably the most rigorous, is referred to as *live online proctoring* or *web video conference invigilation*. This method uses the student's webcam and microphone to allow a live-proctor to supervise students during an online exam. Services can range from one-on-one invigilation sessions to group invigilation sessions where one proctor is supervising many students. Many administrators may feel the most comfortable using this kind of service as it is closest to an in-person invigilated exam. However, even with a live proctor supervising the student(s), cheating behavior can go undetected. Arguably, there are even more ways for cheating to go undetected in an online exam as the proctor does not have a constant

360° view around the student. At the beginning of a session, students are typically required to show their testing environment to their proctor; however, cheating materials can be pulled out during an exam unnoticed in the surrounding environment. If the proctor does not suspect cheating behaviors, they will not request another view of the entire room. Live online proctoring is also typically the most expensive of the options.

7. Online Cheating Detection: Other Technological Solutions

In order to detect academic dishonesty in online exams, many technological measures in addition to proctoring have been put in place. As previously mentioned, these methods may act both as preventative and detection methods in order to minimize cheating. Challenge questions, biometrics, checks for text originality, and lockdown browsers, are currently available technological options that instructors and institutions might consider.

7.1 Challenge Questions

Challenge or security questions are one of the simplest methods for authenticating the test taker. This method requires personal knowledge to authenticate the student and is referred to as a ‘knowledge based authentication’ method (Ullah, Xiao, Lilley, & Barker, 2012). Students are asked multiple choice questions based on their personal history, such as information about their past home addresses, name of their high school, or mother(s) maiden name (Barnes & Paris, 2013). Students must answer these questions in order to access the exam, and the questions may also be asked randomly during the assessment (Barnes & Paris, 2013). These questions are often based on third-party data using data mining systems (Barnes & Paris, 2013; Cote et al., 2016) or can be entered by a student on initial log-in before any examination. When a student requests an examination, the challenge questions are generated randomly from the initial profile set-up

questions or third-party information, and answers are compared in order to verify the student's identity (Ullah et al., 2012).

This relatively simple method can be used for authenticating the test taker; however, it cannot be used to monitor student behavior during the exam. Additionally, students may still be able to get around the authentication process by providing answers to others in order to have another person take the exam, or to collaborate with others while taking the test. Thus, this method should be used in concert with other test security methods in order to ensure academic honesty.

7.2 Biometrics

The use of biometrics, the measurement of physiological or behavioral features of an individual, is an authentication method that allows for continuous identity verification (Baca & Rabuzin, 2005; Cote et al., 2016). This method of authentication compares a registered biometric sample against the newly captured biometrics in order to identify the student (Podio & Dunn, 2001). There are two main types of biometric features: those that require direct physical contact with a scanner, such as a fingerprint, and those that do not require physical contact with a scanner such as hair color (Rabuzin, Baca, & Sajko, 2006). Biometrics commonly use 'soft' traits such as height, weight, age, gender, and ethnicity, physiological characteristics such as eyes, and face, and behavior characteristics such as keystroke dynamics, mouse movement, and signature (Cerimagic & Rabiul Hasan, 2019). Combining two or more of the above characteristics improves the recognition accurateness of the program and is necessary to ensure security (Cerimagic & Rabiul Hasan, 2019; Rabuzin et al., 2006).

Biometric-based identification is often preferred over other methods because a biometric feature cannot be faked, forgotten, or lost, unlike passwords and identification cards (Prabhakar

& Jain, 2002; Rudrapal, Das, Debbarma, Kar, & Debbarma, 2012). However, the biometric features that are considered should be universal, unique, permanent, measurable, accurate, and acceptable (Frischholz & Dieckmann, 2000). Specifically, ideal biometric features should be permanent and inalterable, and the procedure of gathering features must be inconspicuous and conducted by devices requiring little to no contact. Further, the systems are ideally automated, highly accurate, and operate in real time (Jain, Bolle, & Pankanti, 1999). However, no biometric feature to date meets all of the above criteria to be considered ideal, thus, it is important to measure multiple features in order to get the most accurate verification of identity (see Rabuzin et al., 2006 for an overview of all biometric features). Multimodal biometric systems use several biometric traits and technologies at the same time in order to verify the identity of the user (Rabuzin et al., 2006). The multimodal system tends to be more accurate, as combining two or more features improves recognition accurateness (Cerimagic & Rabiul Hasan, 2019).

Fingerprint recognition is one of the most broadly used biometric features as it is a unique identifier (Aggarwal, Ratha, Jea, & Bolle, 2008) and has a history of use in many different professional fields, most notably by the police. Additionally, fingerprints have become a commonly used identifier for personal handheld devices like phones. However, the use of fingerprint biometrics for student identification during online examinations can require additional resources such as fingerprint scanners, cellphones equipped with fingerprint technology, or other software at the student's location, which may limit its current practicality (Ullah et al., 2012). Similarly, face recognition uses image recognition and pattern matching algorithms to authenticate the student's identity (Zhao & Ye, 2010). This biometric is also good candidate for online exams; however, it may not always be reliable due to the complexity of

recognition technology and variability in lighting, facial hair, and facial (Agulla, Anido-Rifón, Alba-Castro, & García-Mateo, 2008; Ullah et al., 2012).

Audio or voice biometrics are used for speech recognition as well as authentication of the speaker. Human voice can be recognized via an automated system based on speech wave data (Ullah et al., 2012). A voice biometric is highly unique, in fact it is as unique to an individual as a fingerprint (Rudrapal et al., 2012). However, as with facial recognition, varying conditions such as speech speed, environmental noises, and the quality of recording technology may result in unreliable verification (Ullah et al., 2012). Finally, keystroke dynamics -- the analysis of patterns in which an individual types, utilizes typing error patterns, typing speed, and the length of time specific keys are held down – can be used to authenticate the user (Bartlow & Cukic, 2009).

7.3 Checks for Text Originality

If using assessments that require a written answer, using software to check for the originality of text (such as “TurnItIn”) can help to identify work that was taken from sources without proper citation. With this method, submitted work is compared against other work held in the software’s bank to check for originality. Benefits of this method include being able to compare submitted work against work that is publicly available (as defined by the software company) to check for important degrees of overlap, as well as comparing submitted work against other assignments that have been previously submitted.

Although checking for text originality can be helpful in detecting both accidental and intentional plagiarism, there are concerns about the ethics of this practice, including copyright infringement of student work (e.g. Horovitz, 2008). Instructors are typically able to specify within the software whether submitted work will be stored for later comparisons (or not), and

this information, along with the broader use policies, should be included specifically in the syllabus or other relevant communications with students. Additionally, when using originality-checking software, it is important to know that high overlap with other works is not necessarily indicative of plagiarized work, and there can be high rates of false positives. For example, submissions with high rates of appropriate references can return a high score for overlap simply because those references are standard across many works. Thus, instructors should refer to the full originality report so that they can use judgment as to whether high scores are actually reflective of plagiarism.

7.4 Lockdown Browsers

Lockdown browsers prevent the use of additional electronic materials during exams by blocking students from visiting external websites or using unauthorized applications on the same device as the one being used to take the assessment (Cote et al., 2016). These programs take control of the entire computer system by prohibiting access to the task manager, copy and paste functions, and function keys on that device (Percival, Percival, & Martin, 2008). Though likely helpful, lockdown browsers cannot guarantee that external information will not be accessed. Students may still access information using another computer, a cell phone, class notes, etc., during an assessment. In addition to using external material, students may also cheat by making the lockdown browser program inoperative (Percival et al., 2008). For these reasons, it is proposed that these programs should be used in concert with other exam security measures in order to prevent and detect cheating behaviors during exams.

8. Conclusion

This paper began by providing a review of current thought regarding the definitions of academic integrity, the behaviors that constitute departures from academic integrity, and the reasons why students may feel motivated to engage in these behaviors. We suggest that when examining academic integrity in the online environment, it will be necessary for researchers to further consider these topics, with particular focus on how behaviors and motivations may differ due to the online environment and due to the individual characteristics of individuals who enrol in online courses. Further, as shown, research to date has produced mixed findings in relation to whether academic dishonesty may be more or less prevalent in the online environment, but we have noted that future research can clarify the issue by examining cheating culture, cheating on different types of assessments, as well as, again, considering the individual characteristics of the students such as age and reason for enrolling in the course. Finally, we detailed methods for both preventing and detecting cheating behavior, with a focus on online exams. We emphasize here, though, that these methods must be considered in concert with broader consideration of the reasons and motivations that students may engage in academic dishonesty in the first place.

Academic integrity remains an integral element of higher education. The principle values that constitute academic integrity not only uphold the reputation of a university and the value and meaning of the degrees it confers, but they also create a shared framework for professional work that is extended beyond the academy. Thus, as online studies continue to expand in post-secondary education, we believe that it will be important to have evolving scholarship and discussion regarding the maintenance of academic integrity in the online environment.

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[BLINDED FOR REVIEW]

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Queen's University is situated on traditional Anishinaabe and Haudenosaunee Territory.