Improved Assessment Workflow for Distance Education
Advancing Education Program, OCE Project Outcomes Report

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Demonstration Highlights

- Collaborative demonstration of the use of Crowdmark for individually proctored remote exams at two different institutions: the University of Waterloo and the University of Guelph.
- Included iterative process of needs assessment for both institutions and Crowdmark product enhancement to meet these needs.
- The results of this demonstration reveal several benefits with the use of Crowdmark for the distribution of remote exams across a number of outcome measures: administrative time, financial cost; proctor experience; and instructor time and effort and grading efficiency/quality.
- Institutions may find more or less benefit depending on institutional processes, exam formats, and scale of distribution.

1. Project Overview

1.1 *The Problem*

Current systems for distributing, collecting, grading and returning student's coursework (assignments, essays, exams, reports, projects) are inefficient. Many of the University of Waterloo's and University of Guelph's final exams are hand-written or have hand-written sections. Exams for remote students are coordinated and take place either at a designated exam center or with an individual proctor. Exam packages are shipped via courier to and from the proctor locations. The need for secure delivery and return of a paper exam to ensure exam integrity contributes to delays in the processing of remote students' exams and final grades, as well as significant shipping and labour costs borne by the educational institution. This process also puts additional pressure and time constraints on instructors teaching online courses, as they must submit their exams earlier than for face-to-face courses, in order to account for up to two weeks for shipping to students writing at a distance.

Further, once these paper exams are received by the instructor there are other inefficiencies that make grading exams painful. Consider, for example, a typical first year midterm exam at the University of Waterloo: 1,000 students each handwrite 10 pages of work. This produces 10,000 pages to be reviewed by a team of teaching assistants overseen by the lead instructors. Flipping each page takes about 3 seconds and flipping through 10,000 pages takes more than 8 person-hours. After the exams have been scored, the team tallies up the totals from pages inside the booklets. Often, the exams are sorted into alphabetical order. The score totals are entered into a spreadsheet. With midterm exams, the graded exams are handed back to students by name, often leading to a loss of 20-minutes of class time.

The education challenge addressed by this project is to improve the efficiency, quality, scalability and analysis of student coursework and exam distribution and evaluation. The core technology achieving these gains has already been validated in the traditional bricks-and-mortar university setting by Crowdmark. Given the existing relationship between the University of Waterloo, the University of Guelph, and Crowdmark, it was determined that there was an opportunity to expand the use of the platform into distance education applications, with some modifications and enhancements.

1.2 *Vendor selection*

Crowdmark has developed a web-based platform to support the efficient and rigorous assessment of coursework. The platform provides the opportunity to distribute exams remotely through a process of uploading exams to an online platform, which can then be downloaded and printed by proctors anywhere in the world. Proctors can then upload completed exams back to the Crowdmark platform, where they become instantly available to the instructor for grading. The partnership between Crowdmark, University of Waterloo (Waterloo), and University of Guelph (Guelph) was marked by a collegial and collaborative process of needs identification for these two specific use cases, which informed the design, development, and testing of Crowdmark system enhancements that were satisfied Waterloo and Guelph's needs, as well as other universities across Ontario. This was achieved through an iterative process of discussions to identify needs and requirements and cross-institutional meetings, followed by prototyping, piloting with small samples of online course exams (Phase I and Phase II of the demonstration), feedback and further refinement of the Crowdmark system to meet needs, and a final demonstration (Phase III and IV). In all phases the Crowdmark process was compared to the traditional courier method across a number of outcomes.

1.3 *Project Objective*

There are three principle objectives and methods of measurement of this demonstration project:

1. Identify and implement product enhancements that will specifically address distance education use cases, for example: addition of system roles unique to distance education (e.g. proctor, coordinator roles), enhanced submission possibilities (e.g., cell phone photos).

   Approach: This was achieved through an iterative process of needs analysis, discussion, and in-person meetings with Crowdmark, Waterloo and Guelph, followed by prototyping and piloting with small samples of online course exams at Waterloo and Guelph (Phase I and Phase II of study).

2. Validate benefits of online collaborative grading in the distance education scenario in Ontario.

   Approach: Assessed through surveying instructors and graders who have used Crowdmark at Waterloo

3. Identify a streamlined path to market to bring online collaborative grading technology developed in Ontario to the education sector in Ontario.
   Approach: Crowdmark serves 34% of the full-time undergraduate student population in Ontario. The new workflows have generated improvements in managing exam sittings for

students with special needs. The workflows were also referenced in Crowdmark's recent successful submission in response to a campus-wide RFP from Ryerson University.

2. Overview of Demonstration

Our approach to achieving the primary aim of the project – to assess the benefits of utilizing Crowdmark for distribution of remote exams -- was carried out over two phases and 4 terms. Phase I (Winter 2017, Spring 2017) was focused primarily on ensuring that Crowdmark was able to meet the needs of Waterloo and Guelph for exam distribution and piloting the first round of system enhancements on a small sample of courses/exams at both institutions. The Crowdmark process in the first phases involved the creation of individual 'sessions' (student exam and proctor pairings). Data was collected on administrative time and financial resources allocated to exam distribution through Crowdmark, relative to the traditional courier method. In Phase II (Fall 2017, Winter 2018) a new process was implemented, enabling bulk upload and a more automated process of creating 'sessions'. In Phase II the demonstration was also expanded to a larger samples of student exam and proctor pairings. The demonstration is characterized by the following workflow:

2.1 *Phase I: Product Enhancement & Pilot Using Single Session Method*

1. *Needs Assessment*: Extensive discussions between Crowdmark, Waterloo, and Guelph regarding current exam distribution processes and requirements for distribution of distance exams through Crowdmark
2. *Feature Enhancement*: Crowdmark enhanced/added features to the platform to meet current Waterloo and Guelph requirements. Enhancements included creating:
    - *New Coordinator role* (ability to create/edit/delete sessions, ability to send proctor invitation view proctor activity status)
    - *New Proctor role* (ability to get notification regarding an upcoming session, to download examination booklet, and to upload completed booklet)
    - *Bulk upload capability* (ability to create sessions manually and bulk upload from CSV)
3. *Prototyping and refining enhancements:* Waterloo and Guelph staff test enhancements, followed by feedback to Crowdmark and further minor tweaks and debugging
4. *Pilot testing*: Testing enhanced Crowdmark with small set of individually proctored final exams in the two use contexts, Waterloo and Guelph.
5. *Iteration*: feedback on results to Crowdmark after each term
6. *Two Phases*: Phase I (two terms) involved a process of creating *single sessions* (student exam-proctor pairings) in Crowdmark, such that exam administrators set up session one at a time. Phase II reflected further refinement of product enhancements and the addition of a *bulk upload* creation of sessions in Crowdmark, enabling exam administrators to create many sessions at once.

During this system enhancement and pilot phase the different steps in each process were identified and operationalized. These two processes are represented in Figure 1. While there are some other duties involved in exam distribution, such as support provided to students, instructors, and proctors during these processes, what is illustrated here (and tracked in our demonstration) are just those steps in the process that are *unique* to these two methods, in other words, just those steps that

would be altered as a result of using Crowdmark over couriers. We identified where proctors struggled with the Crowdmark method and touch on this *qualitatively*; however, we did not *quantitively* track support requests for couriered exams (e.g., missing/late exams due to various constraints on couriering, such as weather, late requests, etc.,).

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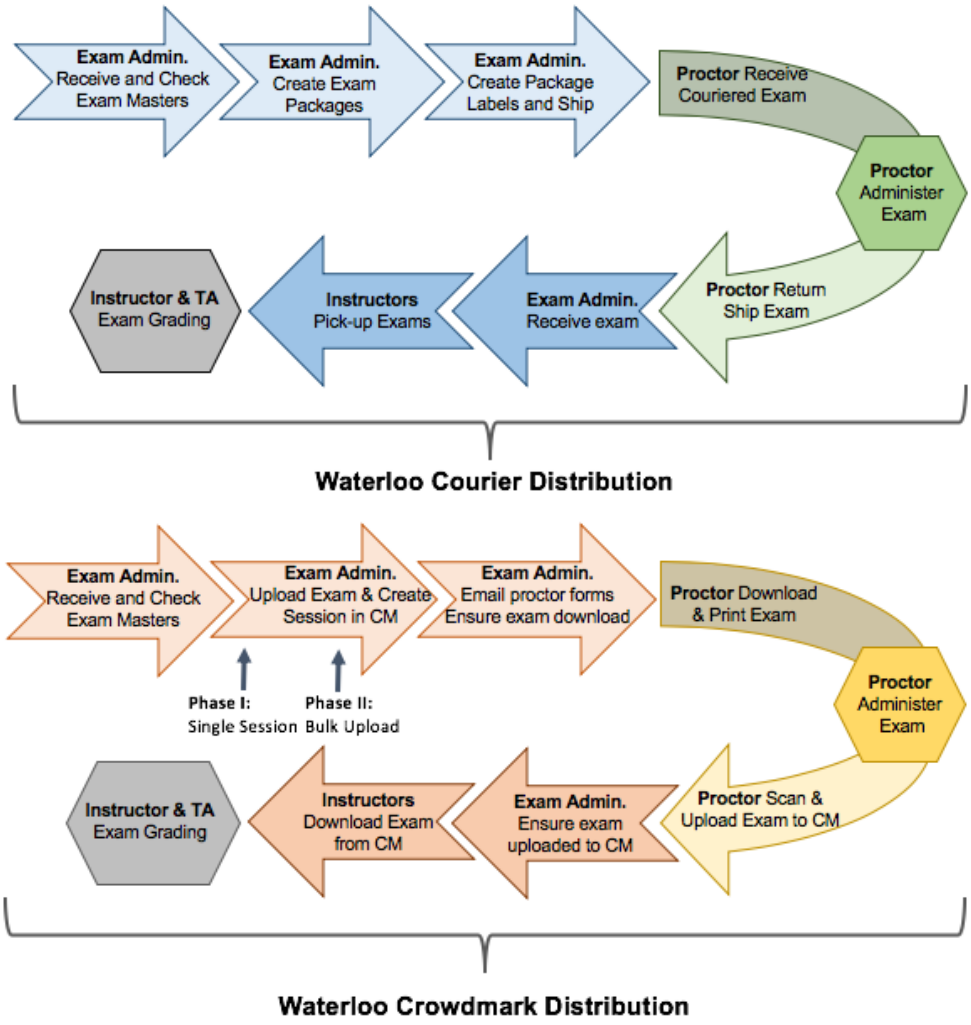

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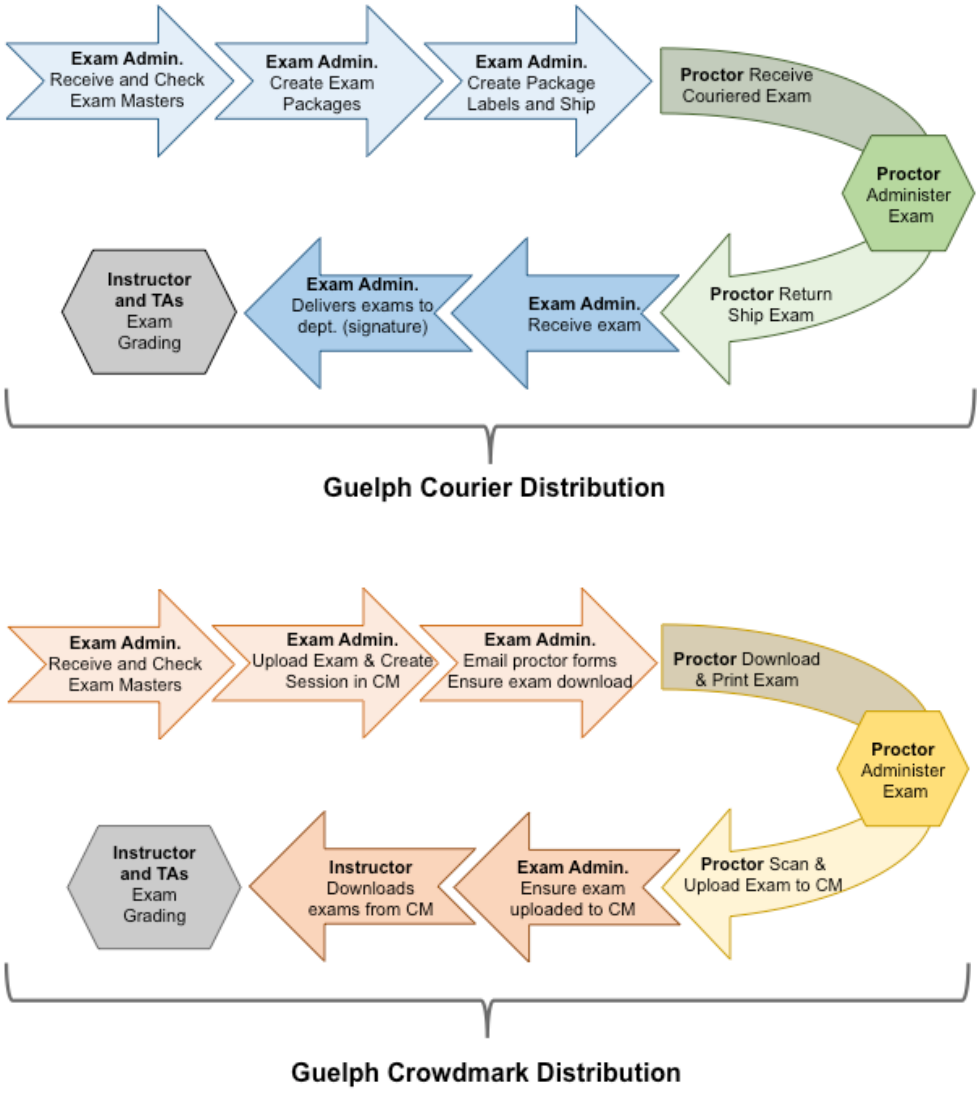

Figure 1. Flow chart of the courier and Crowdmark exam distribution processes for a.) Waterloo and b.) Guelph.

2.2 Phase II: Full Scale Demonstration Using Bulk Upload Method

In Phase II system enhancements were completed and included the process of bulk upload. This bulk upload feature enables the bulk creation of multiple individual exam sessions in Crowdmark by uploading a csv file containing all exam session information (i.e., student info, proctor info, and exam date and time and connection to named assessment). This feature was created to save additional administrative time and effort and was important for both Waterloo and Guelph. In this phase Waterloo and Guelph were able to distribute a larger sample of final exams. Data was collected on administrative time and financial resources allocated to exam distribution through Crowdmark, relative to the traditional courier method. In addition, the duration of the exam distribution process was measured for these two different distribution methods. Surveys were also sent out to both Crowdmark and courier proctors to assess their subjective experience working with these two exam distribution systems.

Because the exam processes differ between Guelph and Waterloo, these two institutions approached the demonstration in a slightly different manner. Therefore, the specifics of the demonstration will be reported in separate sections, covering the demonstration procedure, outcomes, and conclusions for Waterloo and Guelph.

3. Demonstration Procedure

3.1 Performance Indicators

Objective Performance Indicators

To assess the benefits of using Crowdmark both Waterloo and Guelph tracked the following performance indicators: amount of administrative time, duration of process, and financial expenditures.

Amount of administrative time required to process and distribute exams was tracked for both the Crowdmark method and the traditional courier method. This tracking involved timing each step in the distribution process that is unique to Crowdmark and unique to the courier method for a subset of exams. Processes that are the same between the two methods (i.e., proctor declarations, reviewing exam masters for formatting, and correspondence between staff and students or proctors) were not timed. Average administrative time per exam was then calculated by taking an average across the sample.

Duration of time for each process was calculated as the number of days between administrative staff sending out the request to instructors for exam masters and the point at which the instructor is able to access and grade the completed/returned exam.

Financial expenditures were tracked for each process. This measure did not include the staff salaries as an expense, as this resource is captured under the administrative time measure. For the courier method expenditures included shipping cost and printing costs and were provided to the research associate in the form of annual expense report. An average cost per proctored exam was then calculated from these reports. The only direct expense for the Crowdmark method is the cost of the license. For some universities, such as Waterloo and Guelph, a hard copy of the final exam must be mailed back, regardless of distribution method, so we included an estimated Crowdmark financial cost that reflects both cases, with and without returning a hard copy of the exam.

Subjective Performance Indicators

In order to assess the impact these two methods of exam distribution have on proctors, Waterloo included a subjective measure in the form of a survey, which provides both qualitative and quantitative feedback on proctors' experience. To validate the claim that Crowdmark fosters more efficient and effective grading and feedback, a secondary aim of the project, in phase IV Guelph and Waterloo sent out a survey to instructors and graders, soliciting feedback on their experiences

working with Crowdmark and what impact they find it has on the quality, quantity, efficiency, and ease of grading and providing feedback.

3.2 Selection Criteria and Demographics

Selection Criteria

For the purpose of this demonstration, in order for exam/proctor pairings to be included in the Crowdmark distribution method they had to meet the following criteria:

- administered by individual proctors, not exam centers (due to challenges associated with having one or two proctors print and scan/upload hundreds of exams)
- exam format meets following criteria: did not require materials Crowdmark was unable to accommodate at that time (i.e., scantrons or additional resources, materials, exam booklets); did not pose printing challenges for proctors (i.e., not printed on legal size paper, 8.5 x 11 only)
- instructor interest
- proctor compliance (i.e., proctor is willing to work with the platform, is able to download, print, scan and upload)
- In their courses, Guelph limited their selection to just the students within Canada, while Waterloo selected courses with students that were within Ontario, other provinces in Canada, the US, and overseas.

Demographics

In Phase I, Winter term 2017 (first term), Crowdmark was piloted at Waterloo and Guelph, after training staff on the platform. Table 1. shows a summary of the demographic information for student/proctor locations and exams included in the demonstration across all 4 phases, for both Waterloo and Guelph. In Phase I, first term, both Guelph and Waterloo started with small pilot samples. In the second term of Phase I, Crowdmark was piloted with larger samples.

In Phase II, the agreed upon Crowdmark enhancements were completed, which included the feature of bulk upload. Waterloo further increased their sample size. As bulk upload was a newer feature, Guelph opted for a more conservative sample in this phase.

a.)

Waterloo *Phase (Term)*	Crowdmark Student/Proctor Pairings	Disciplines	Student/Proctor Locations
Phase I: Pilot Single Sessions			
Phase I (1st)	2	French	Canada, France
Phase I (2nd)	8	Math, French	Canada, United States, China, New Zealand
Phase II: Bulk Upload			
Phase II (1st)	15	Statistics, Math, French, Spanish	Canada, United States, France, Hong Kong, China
Phase II (2nd)	15	Statistics, Actuarial Science, Computer Science, Math	Canada, United States, Hong Kong, China, South Korea, United Arab Emirates
Total	**40**	**6 different disciplines**	**8 different countries**

b.)

Guelph *Phase (Term)*	Crowdmark Student/Proctor Pairings	Disciplines	Student/Proctor Locations
Phase I: Pilot Single Sessions			
Phase I (1st)	4	Statistics	Canada
Phase I (2nd)	17	Statistics	Canada
Phase II: Bulk Upload			
Phase II (1st)	4	Business	Canada
Phase II (2nd)	2	Statistics	Canada
Total	**27**	**2 different disciplines**	**1 different country**

Table 1. Demographics for the 4 phases of the demonstration for a.) Waterloo and b.) Guelph.

4. Findings

4.1.1 *Administrative Time*

Administrative Time involved in the Courier Method

The amount of administrative time required for just those processes that were unique to the courier method was calculated by tracking individual staff members time at each phase in this process (as illustrated in Figure 1). A single estimate of administrative time for the courier method was created by averaging the collected time data across the 4 terms. On average, the process specifically required for couriering exams requires about 19 minutes of administrative staff time per exam at Waterloo and about 16 minutes of administrative time per exam at Guelph. On average Waterloo distributes a little over 200 individually proctored exams (excluding exams administered on campus and at exam centers) per term, while Guelph distributes about 390 individually proctored exams. Based on our tracking of administrative time, the processes that are specific to couriering these individually proctored exams takes about 64 hours of administrative time at Waterloo. This is in addition to time and processes that are shared between the two methods. These courier specific processes take about 53 hours at Guelph. In the following demonstrations, we compare the amount of administrative time for the Crowdmark method to these baseline measures of the courier method at both universities.

Phase I: Pilot with Individual Sessions in Crowdmark

In the small-scale pilot of Phase I the amount of administrative time was tracked for just 2 Crowdmark sessions at Waterloo and 4 Crowdmark sessions at Guelph. The Crowdmark method took about the same time as the courier method, about 19 minutes at Waterloo and 17 minutes at Guelph. This was the first time through the Crowdmark process for administrative staff, so this time reflects both Crowdmark process as well as staff learning how to use the system (see Figure 2).

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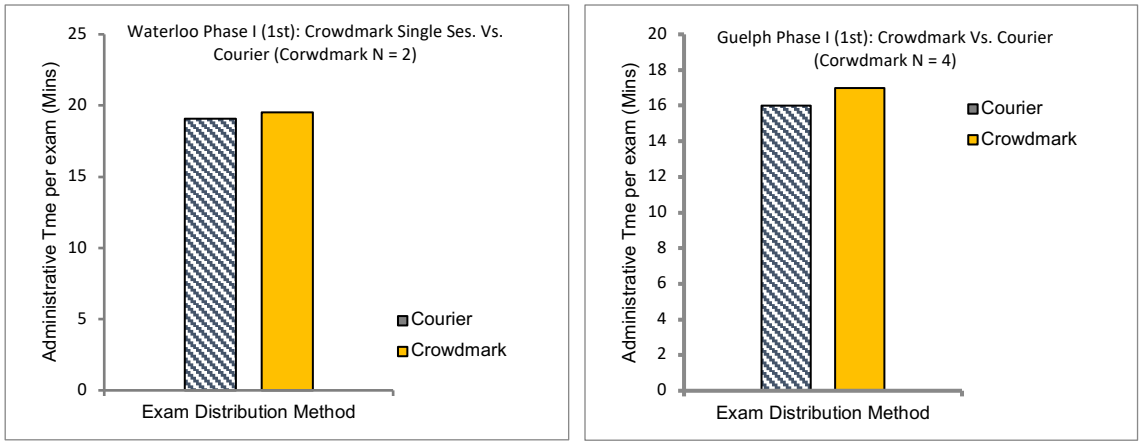

Figure 2. Phase I, first term using Crowdmark single session method. Administrative time expenditure with courier and Crowdmark distribution for a.) Waterloo and b.) Guelph.

In the second term of Phase I more student/proctor pairings were included in the pilot at both universities. In this second term using the single session process in Crowdmark, administrative staff were familiar with the Crowdmark system and some of the product enhancements had been added, which improved the process. The results show a much clearer benefit for the Crowdmark method, with this method taking about 10 minutes per exam at Waterloo and Guelph, resulting in an administrative time savings (relative to the courier method) of about 9.5 minutes per exam at Waterloo and about 6 minutes per exam relative to the courier method at Guelph (see Figure 3). When these times are projected at scale (about 200 exams at Waterloo and about 390 at Guelph per term) see a projected administrative benefit of about 31.6 hours per term for Waterloo and 40 hours per term for Guelph.

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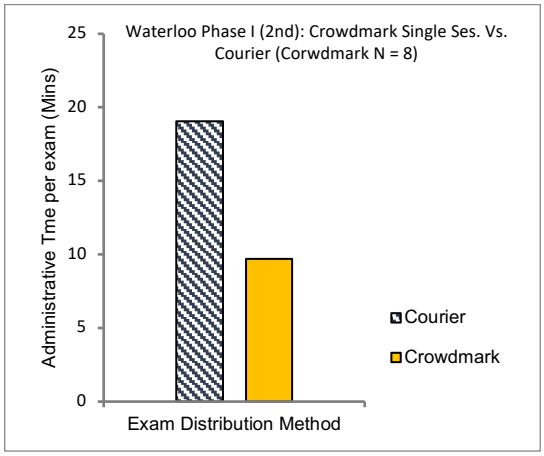

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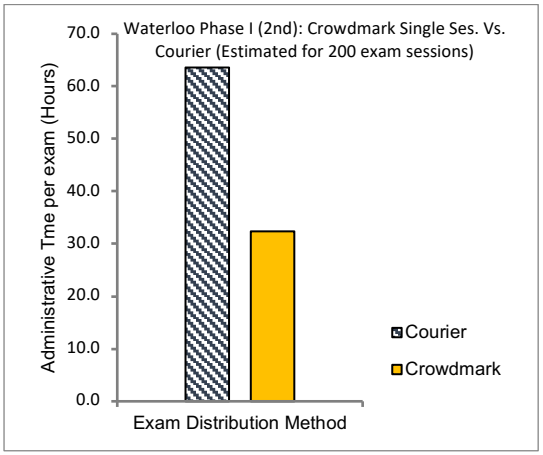

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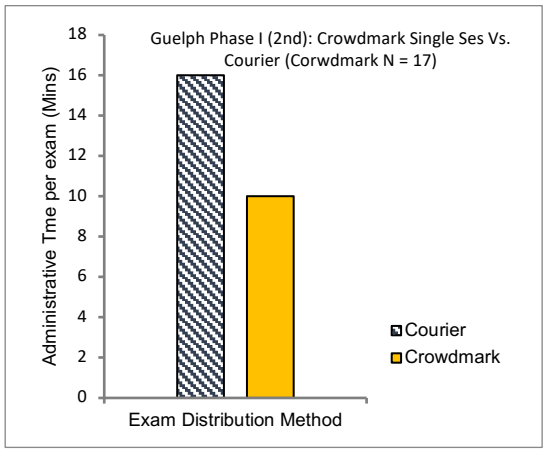

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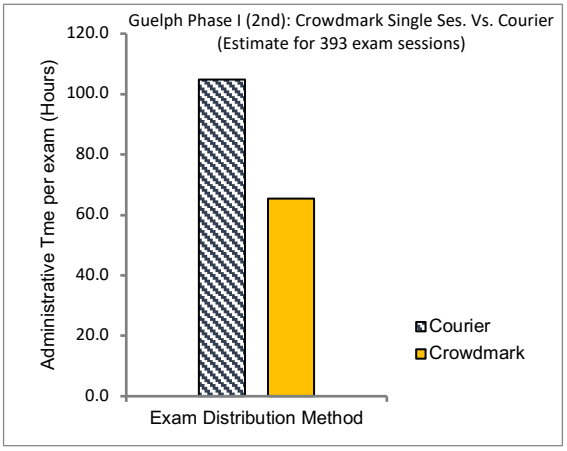

Figure 3. Administrative time in Phase II for courier and Crowdmark method. a.) Waterloo administrative time per exam. b.) Waterloo administrative time when the results are projected at scale (~200 exams per term). c.) Guelph administrative time per exam. d.) Guelph administrative time when the results are projected at scale (~393) exams per term.

Phase II: Bulk Upload

In Phase II, all agreed upon Crowdmark feature enhancements were implemented and functioning well, which included the important addition of the *bulk upload* feature. The measurements in the first

term of Phase II reflect staff learning the new process and some of the time required to implement new processes. Similar to the pattern of results between Phase I, we see evidence of a learning curve with the addition of the new bulk upload feature at Waterloo. In the first term of Phase II at Waterloo, the administrative time benefit with Crowdmark decreases, as the time per exam increased to 17 minutes (Figure 4). When applied at scale to 200 exams, there is a minimal projected time benefit of about 7 hours per term, relative to the courier method. For Guelph we see a bit of a learning curve, such that administrative time for the Crowdmark process increases to 12 minutes per exam, however, there is still a time benefit, relative to courier method of about 4 minutes. At scale, this is an estimated administrative time savings of about 26 hours per term.

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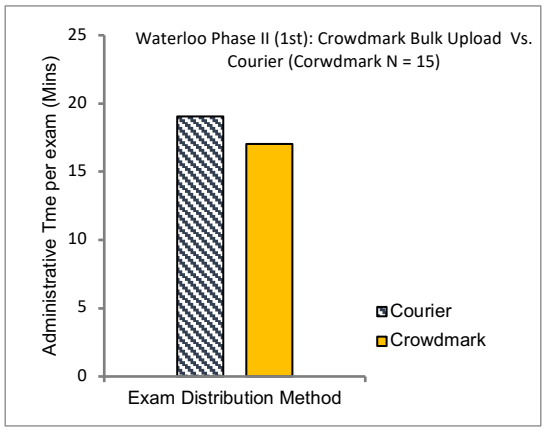

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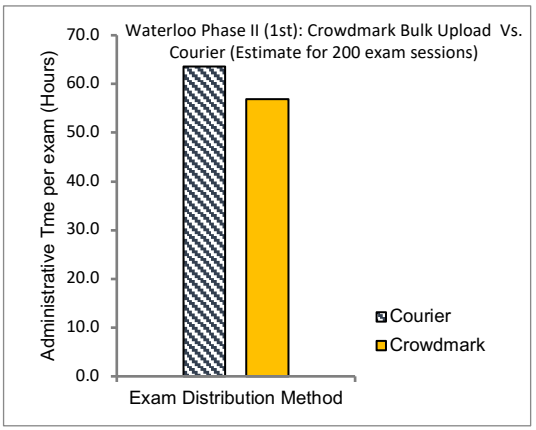

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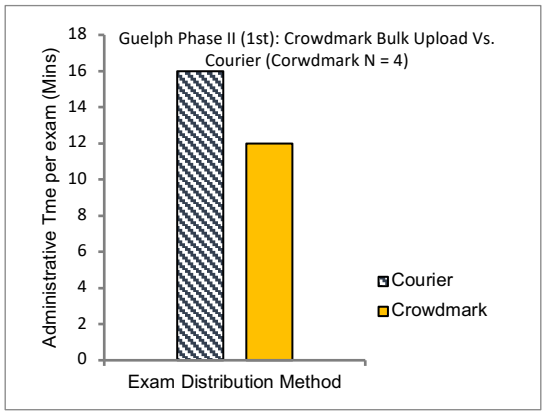

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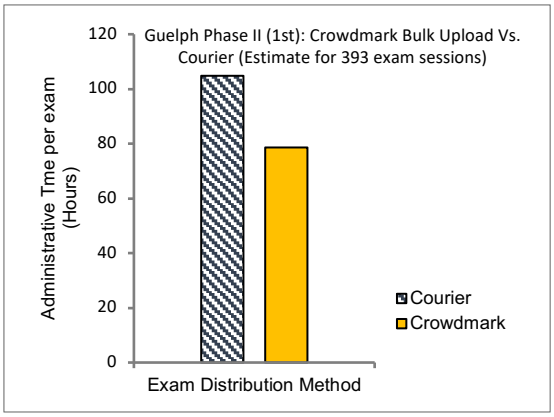

Figure 4. Administrative time for courier and Crowdmark process in first term of Phase II. a.) Waterloo first term using new bulk upload method; b.) Waterloo projection of benefit at scale (200 exams per term). c.) Guelph first term using new bulk upload method; d.) Guelph projection of benefit at scale (393 exams per term).

In the second term of Phase II, we see a clear administrative time benefit with Crowdmark at both Universities (see Figure 5), with staff benefiting from prior experience in the previous term. For Waterloo, the Crowdmark process only took about 9 minutes per exam. That is a time savings of about 10 minutes per exam, essentially cutting administrative time in half, relative to the courier method. At scale, this is projected to amount to a time savings of about 34 hours of administrative time per term when using the bulk upload feature. For Guelph, the second term using the Crowdmark

bulk upload feature also took about 10 minutes per session, reducing administrative time per exam by 6 minutes. At scale for Guelph, this time savings is projected to be about 40 hours of administrative time.

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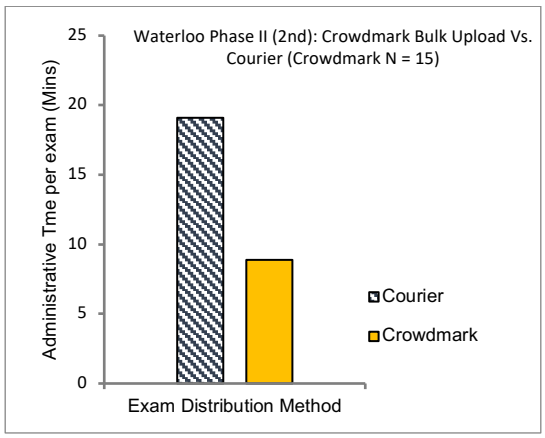

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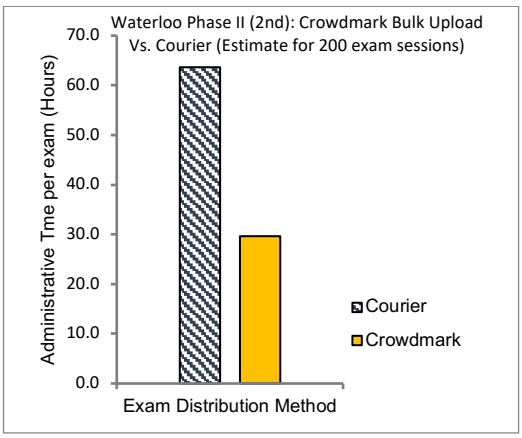

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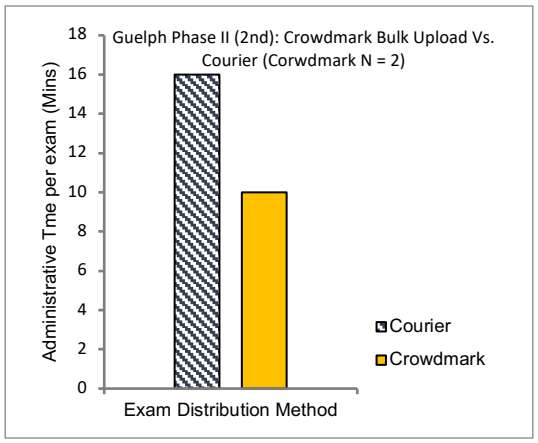

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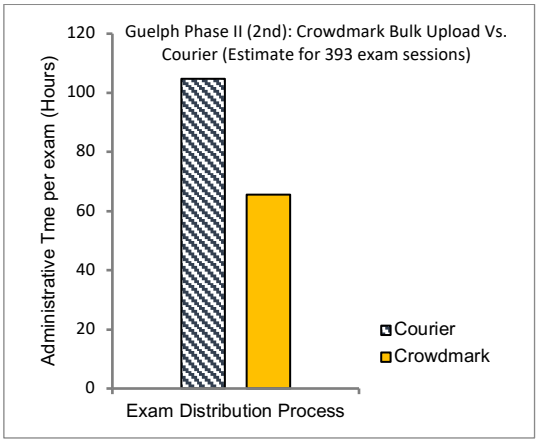

Figure 5. a.) Waterloo second term using bulk upload method; d.) Waterloo projection of benefit at scale (200 exams per term). c.) Guelph first term using new bulk upload method; d.) Guelph projection of benefit at scale (393 exams per term).

4.1.2 Duration of Exam Distribution Process

One of the touted benefits of Crowdmark is that it shortens the duration or lag time between assessment and grading. For final exams, a shorter duration means that instructors and graders can start marking individually proctored exams as soon as the proctor has successfully uploaded the exam. On average, the courier method takes about 90 days from the examination specialist at Waterloo sending out the request for exam masters, to when instructors pick-up their exams (about a one-month window, the middle date for this window was used). Using Crowdmark, the duration of time from the examination specialist at Waterloo sending out the request for exam masters, to the proctor uploading the completed exam was, on average 67 days (see Figure 6). So that means, instructors can receive their exams and start grading 23 days sooner when using Crowdmark, relative to waiting for the courier. This difference is actually attenuated by the fact that Waterloo's process

requires that instructors send their exam masters in early to ensure that they can be packaged and shipped in time. While, administrators would still check the exams before submission to Crowdmark and still require some time to coordinate and communicate with proctors before the exam, there may be a further reduction in lead time, as a result of not needing to package and ship the exams (see Figure 6).

Guelph also finds Crowdmark shortens the duration of exam distribution, from the exam admin receiving exams from instructors to exams being returned. The courier distribution takes about 56 days, while the Crowdmark distribution methods takes about 35 days, reducing distribution duration by 21 days. Note that Guelph's process involves delivery of exams right to the instructor, while Waterloo instructors pick up exams at the Centre for Extended Learning. This may account for some of the discrepancy in distribution duration between the two universities.

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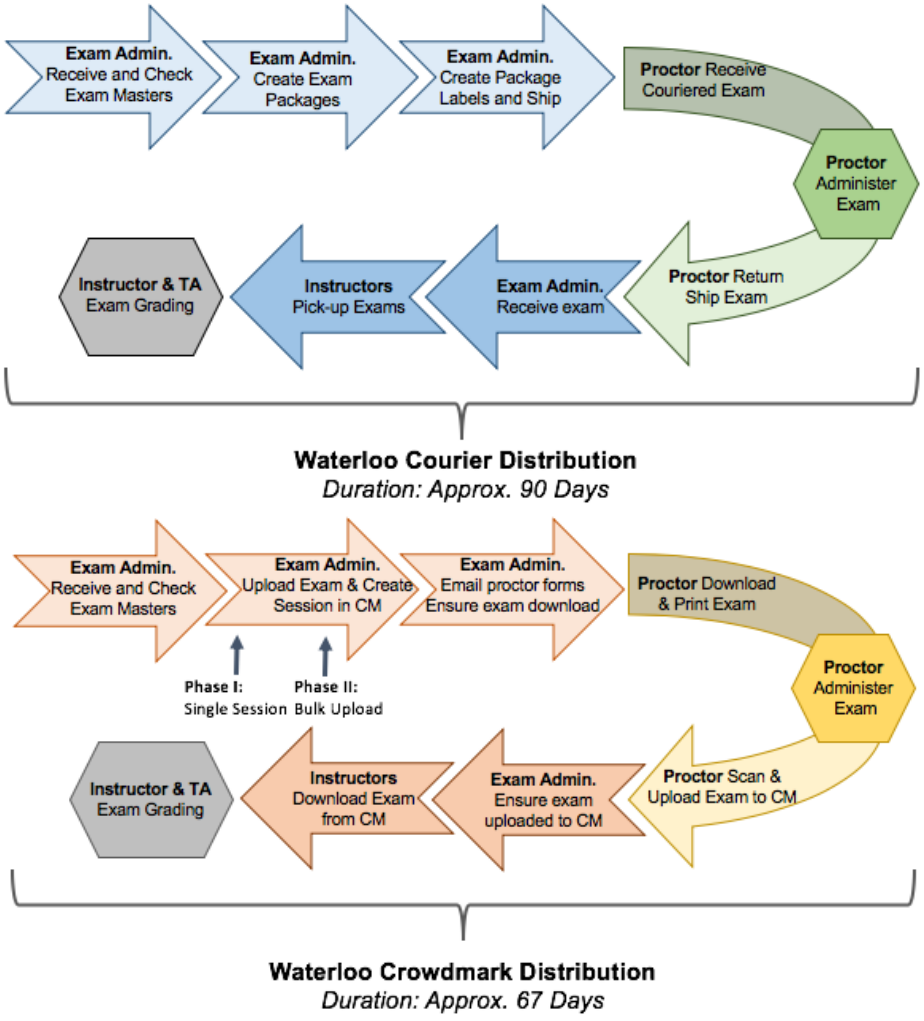

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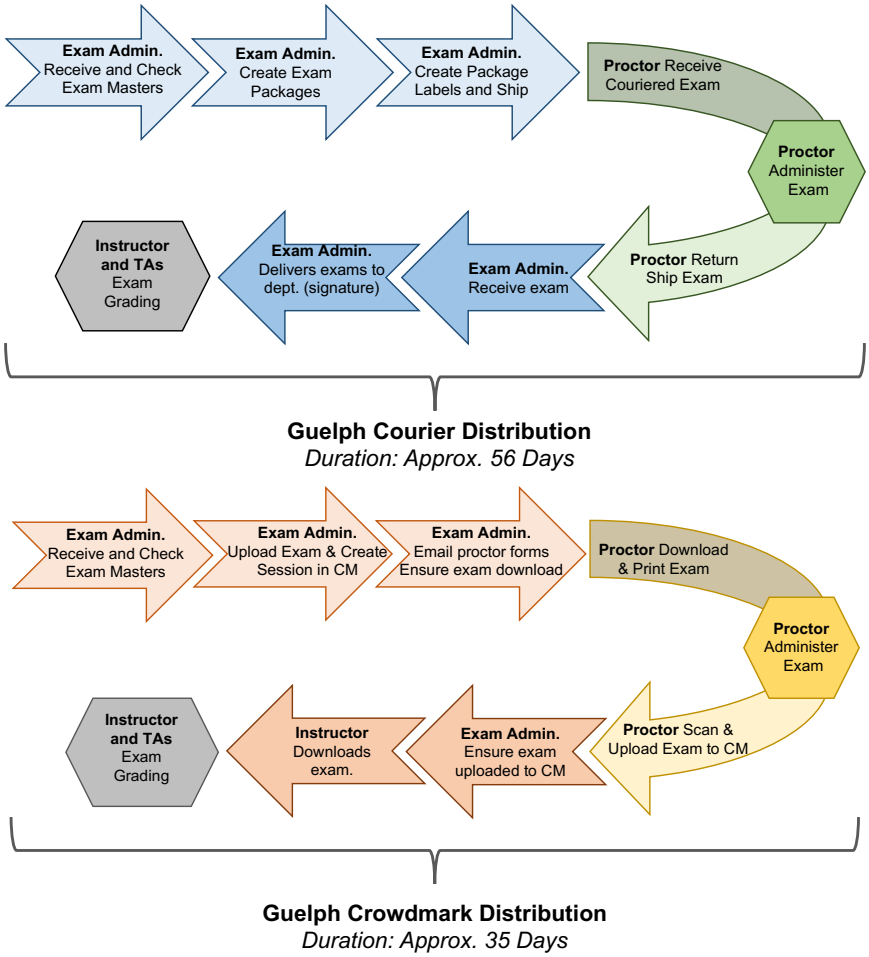


Figure 6. Courier and Crowdmark Method Process. Showing duration of each process in days for a.) Waterloo and b.) Guelph.

4.1.3 *Financial Expenditure*

The financial expenditure of the two exam distribution methods was calculated based on additional costs associated with these two methods, other than that associated directly with administrative time over a single academic year (three terms). Administrative pay is not included in expense reporting here. The expenses associated with the courier method include: printing, couriering to the proctors, and return couriering from proctors. The expense of the Crowdmark method was calculated using the license fee of $3.25 per student, per course (this fee includes all Crowdmark features, not just exam distribution). [1] We calculated these costs across 3 terms (Phase I, 2nd term, Phase II, 1st term and 2nd term).

Waterloo Financial Expenditure. Waterloo currently requires that all completed final exams be returned, so Crowdmark proctors were required to courier their exams back. Thus, we calculated the Crowdmark expense both with and without this courier cost, as this may cease in the future at

[1] This rate was provided by Crowdmark to University of Waterloo in August 2018.

Waterloo and may differ across institutions. Table 2. shows a detailed breakdown of these costs across the 3 terms. We see a substantial financial benefit for the Crowdmark method, such that the projected cost of distribution using Crowdmark ($2,031.25) is a little less than 10% the cost of using the courier method ($22,726.55). Even when proctors are required to ship the completed exam back to Waterloo, there is still a notable cost savings for the institution with the Crowdmark method ($13,156.73), which is about 60% of the cost of the courier method.

a.)

Waterloo

Method	Expense at Waterloo		Avg. Per Exam	Phase I (S17) (Exams = 243)	Phase II (F17) (Exams = 207)	Phase II (W17) (Exams = 175)	Total (Exams = 625)
Courier	Print exam		$1.02	$228.91	$230.09	$178.52	$637.52
	Courier exam to proctor		$22.98	$5,331.32	$2,999.84	$2,632.39	$10,963.55
	Return courier exam from proctor		$17.80	$4,325.59	$3,684.76	$3,115.13	$11,125.48
		Total	**$41.81**	**$9,885.82**	**$6,914.69**	**$5,926.05**	**$22,726.55**
Crowdmark	User license (per student, per course)	**Total**	**$3.25**	**$789.75**	**$672.75**	**$568.75**	**$2,031.25**
Crowdmark *with return hard copy of exam	User license (per student, per course)		$3.25	$789.75	$672.75	$568.75	$2,031.25
	Return courier exam from proctor		$17.80	$4,325.59	$3,684.76	$3,115.13	$11,125.48
		Total	**$21.05**	**$5,115.34**	**$4,357.51**	**$3,683.88**	**$13,156.73**

b.)

Guelph

Method	Expense at Guelph		Avg. Per Exam	Phase I (S17) (Exams = 813)	Phase II (F17) (Exams = 161)	Phase II (W17) (Exams = 205)	Total (Exams = 1,179)
Courier	Print exam		$.96	$780.48	$154.56	$240.00	$1,131.84
	Purolator fees to proctor *domestic rate		$4.06	$3,300.78	$653.66	$832.30	$4,796.74
	Return courier exam from proctor *domestic rate		$4.06	$3,300.78	$653.66	$832.30	$4,796.74
		Total	**$9.08**	**$7,382.04**	**$1,461.88**	**$1,904.60**	**$10,725.32**
Crowdmark	User license (per student, per course)	**Total**	**$3.25**	**$2,642.25**	**$523.25**	**$666.25**	**$3,831.75**
Crowdmark *with return hard copy of exam	User license (per student, per course)		$3.25	$2,642.25	$523.25	$666.25	$3,831.75
	Return courier exam from proctor		$4.06	$3,300.78	$653.66	$832.30	$4,796.74
		Total	**$7.31**	**$5,943.33**	**$1,176.91**	**$1,498.55**	**$8,628.49**

Table 2. Expense report for Crowdmark and courier methods for a.) Waterloo and b.) Guelph

Guelph Financial Expenditure. Guelph's procedure for calculating expenditures was similar to Waterloo's, however, Guelph only included average costs for shipping exams within Canada, which accounts for the fairly low courier costs relative to Waterloo's costs. Table 2. shows the breakdown of

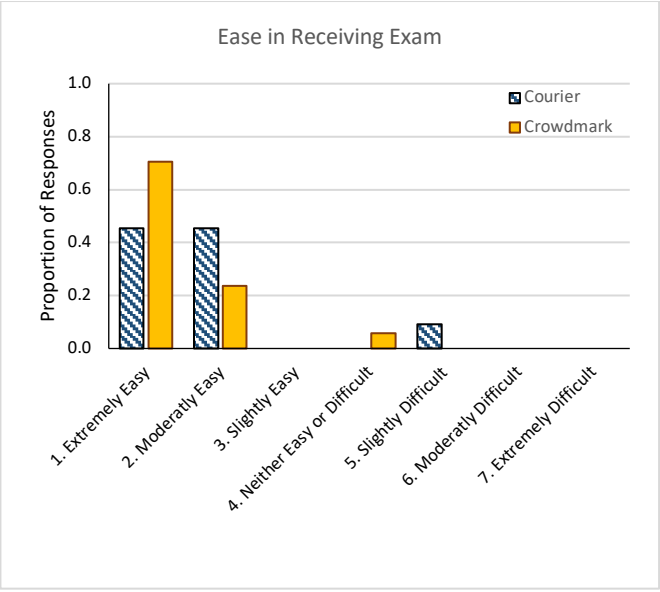
these costs within Canada across the three semesters. We see a financial benefit for the Crowdmark method, such that the projected cost of distribution using Crowdmark ($3,831.75) is a little less than 28% the cost of using the courier method ($10,725.32). Even when proctors are required to ship the completed exam back to Guelph, there is still a potential cost savings for the institution with the Crowdmark method ($2,096.83).

While we did not include the cost of administrative time, in terms of employee salary, it should be noted that there is an additional financial benefit associated with the reduction in administrative time for the Crowdmark method, as discussed in the previous section. Hourly wages may vary greatly between staff and across different institutions, so we did not include this in our calculations here.

4.1.4 *Proctors' Experience*

A request to fill out a survey on the experience of proctoring for Waterloo was sent out to sixty proctors, across the four terms. This sample included all proctors who received exams through Crowdmark and to a random sub-set of proctors who received exams through the courier distribution method. From this pool, twenty-eight proctors filled out the survey (17 courier and 11 Crowdmark proctors). Proctors were asked to rate their sense of ease/difficulty (7-point Likert scale, where 1 is very easy and 7 is very difficult) with the process of *receiving* the exam (through either the Crowdmark or courier) and *returning* the exam (either through Crowdmark upload or courier). Figure 7. shows the distribution of responses in these two groups of proctors. The process of receiving exams was rated similarly across the two methods, with both courier and Crowdmark proctors reporting that receiving exams was either extremely or moderately easy (average rating: Crowdmark, M = 1.4; courier M = 1.8). A greater proportion of Crowdmark proctors, however, reported the processing of returning exams to be easy, relative to courier proctors, whose responses were more distributed across the spectrum, from extremely easy to extremely difficult (average rating: Crowdmark, M = 1.8; courier M = 3.1).

a.)



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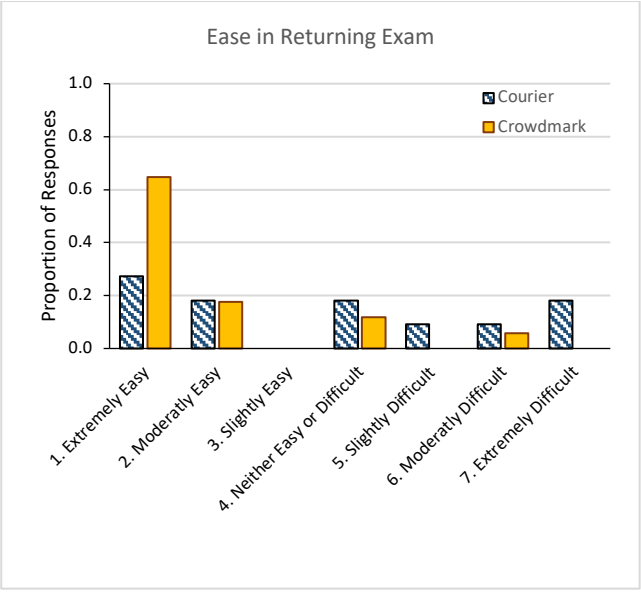


Figure 7. Waterloo Proctor survey results. Proctors report on the degree of a.) Ease in receiving exams and b.) Ease in Returning Exams

Proctors were also given the opportunity to respond to an open-ended question about what was easy or difficult about their experience. One Crowdmark proctor who rated receiving the exam to be slightly difficult explained that this was because the exam was received through Crowdmark relatively close to the exam date. Typically, couriered exams are received ahead of time, as additional time is built into the courier process to account for delays and a reduction in this lead time may be possible when using the Crowdmark method of exam distribution. This proctor experienced some uncertainty or concern about receiving the exam in time, highlighting that this difference between the two processes could have been better explained to the proctor. The courier proctor who rated this process as neither easy nor difficult mentioned the inconvenience of having to pick-up the couriered exam during regular office hours. Most Crowdmark proctors mentioned that they appreciated not having to wait for a courier and the convenience of being able to simply download the exam, as illustrated in the quotes below:

"[V]ery easy, just had to sign in and click the download button"

"Fast and reliable. Not waiting around for a courier"

There is a bit more variability in the proctors' experience of returning/uploading the exams. For the Crowdmark proctors, this likely reflects the degree to which proctors ran into technical difficulties uploading the exams, as illustrated in the following quotes:

"I recall that some pages did not upload. I had to repeat the process."

"I had printed it double-sided, but my scanner jammed when I was trying to scan it that way to upload… Then I had to put them in the right order… inadvertently scanned the two pages without the QR codes...so I had to do it all again."

One person, who reported this return process to be extremely difficult explained that this was due to the fact that in this demonstration proctors not only had to upload the exams, they also had to send the completed hard copy of the exam back by courier. Returning hard copies of completed exams to the University is currently part of Waterloo's Exam Retention Policy, whereby instructors are obligated to retain student exam responses for one year, enabling students to petition, review, and challenge a final grade. This part of Waterloo's process diminishes the degree of benefit to proctors and added an element of confusion:

"I thought the uploading was to save the hassle of actually sending it… As a person who works full time it is difficult to get to a post office during that time frame, so I was happy to upload it. What is the point of sending it by mail and uploading then?"

The courier proctors negative experience with returning exams primarily revolves around the process of coordinating the return shipping, as outlined in these representative quotes:

"Between phone calls to different couriers and finding the place, it took me almost 2 hours. I would have preferred to have everything on line... than to loose time for a courier that cost more than the proctoring..."

"the most inconvenient part of returning the exam was taking it to the post office for return"

Guelph also sent out this survey to 24 proctors, but only received responses from 4. Two of the four, experienced proctors (though new to Crowdmark) found accepting the invitation, as well as downloading and uploading the exam, moderately to extremely easy. One proctor did experience a glitch with the software that was quickly fixed by Crowdmark support, which the proctor seemed to appreciate, as indicated in the quote below:

"well supported – questions answered in a timely and helpful fashion"

"in the end it did save time"

Although the experience went quite smoothly for the majority of proctors who responded, the experience/transition wasn't completely smooth or preferred by all. One Guelph proctor indicated that they would in future expect a higher fee for the extra work involved printing, scanning, and uploading the exams.

Taken together, these results from Waterloo and Guelph suggest that changing processes does not have a large negative impact on proctors. In fact, proctors may even prefer the Crowdmark process, specifically because it may eliminate the hassle associated with return shipping for proctors at some institutions. That being said, there are some additional costs and tasks that are offloaded onto proctors, which may be an issue or pose a challenge for some proctors.

4.1.5 *Providing Students with Feedback: Instructors' and Graders' Experience*

Instructor and Grader Survey. An invitation to fill out a survey on grading in Crowdmark was sent out to all instructors and TAs/graders who had used Crowdmark at Waterloo. Ninety-nine participants responded, thirty-five female. Of these respondents, sixty two were instructors and thirty-five were graders, from various disciplines (see Figure 8.).

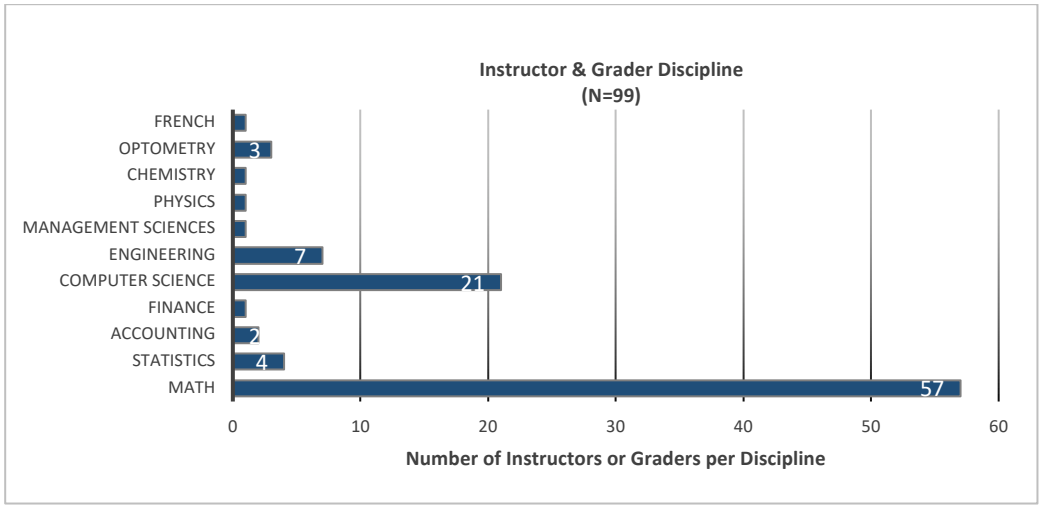
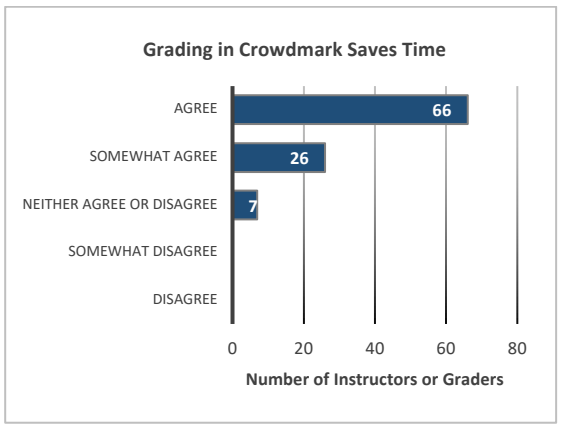


Figure 8. Waterloo Instructors and graders Crowdmark feedback survey respondent, by discipline.

Overall, Crowdmark was rated quite highly by instructors and graders who have used it, with more than half the participants agreeing that when they use Crowdmark they find: they save time; they make fewer errors; and grading is easier. Ninety-eight percent of instructors and graders report that they find Crowdmark more convenient than other grading methods. Finally, eighty-nine percent report that Crowdmark's overall usability was relatively easy (see Figure 9).

a.)



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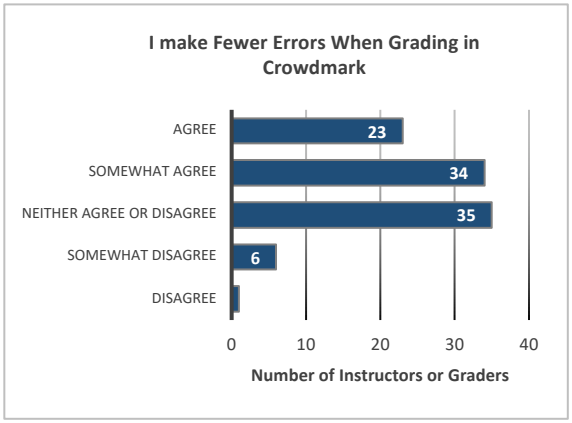

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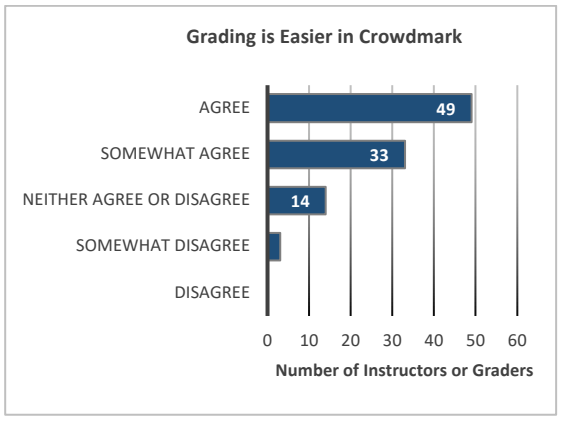

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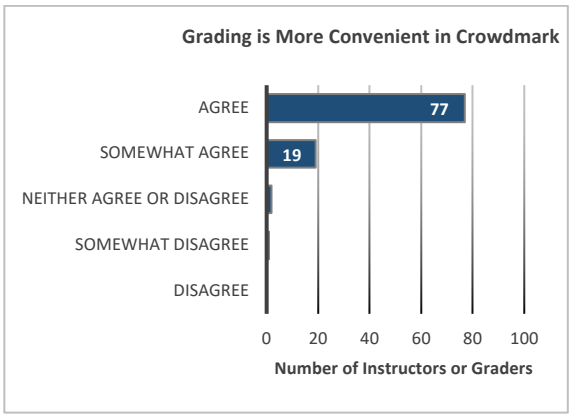

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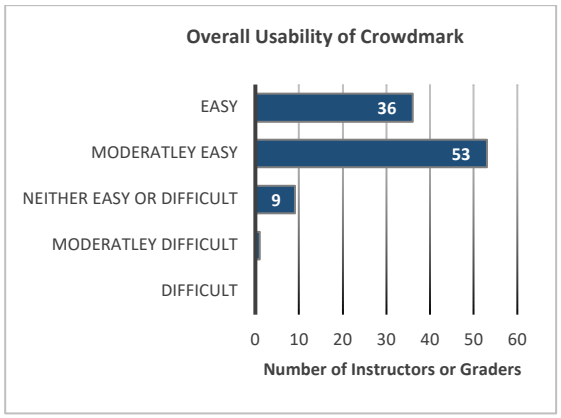

Figure 9. Waterloo instructor and grader survey responses. Response frequency, reflecting the degree to which respondents agreed that grading in Crowdmark a.) saves time, b.) leads to fewer grading errors, c.) makes grading easier, d.) makes grading more convenient and e.) how over usable Crowdmark was, overall.

Instructors report that using Crowdmark results in fewer grading errors because of how easy it is to check and see errors, as outline in the following quotes:

Being able to write a very detailed explanation once, and include it in subsequent marked papers saves me a lot of time. I also don't have to worry about addition errors between questions.

Regarding errors - I'm not sure if the use of Crowdmark results in fewer marking errors initially, but I find it much easier to check for such errors and to fix them when they do happen. Much easier to click through all questions

Instructors report that quality of grading is improved because it is easier for them to supervise TA grading and the annotation libraries keep feedback consistent:

"It allows me as the instructor to do quality control on TA marking. It also helps with exam re-grading requests. And it makes it near impossible for a student to change their answer and ask for a remark."

It's very valuable to be able to EASILY monitor the work of tutors and TAs.

my teaching assistants love the flexibility offered by the system as they can grade when they want. I can also monitor their progress effectively and conduct spot checks of their work easily.

Annotation libraries are very helpful and help instructors standardise feedback as much as possible. Keyboard shortcuts also made me finally think that Crowdmark is superior to physical marking.

While instructors find Crowdmark generally helpful, they would like a to see the addition of some features, such as higher level overview of grading and an easier method for identifying outliers:

Crowdmark is a great help overall; though, I find that the interface of the tool is still somewhat cumbersome to use. For example, it is not easy, as an instructor, to gain highlevel overview over the grading status.

When marking large exams with 25+ individual markers, as the instructor I want to be able to monitor the stats for my grad student markers and identify markers that are outliers: too lenient or too harsh, or not enough grade variation, etc.

According to instructors and graders Crowdmark is a valuable tool that facilitates grading efficiency, ease and quality.

5. Expansion of Crowdmark Usage in Ontario's Education Sector

Since the start of this project Crowdmark's usage across Ontario's higher education sector has expanded to include seven institutions: University of Waterloo, University of Guelph, Queens University, University of Toronto, Ryerson University, University of Western Ontario, and York University. During the course of this demonstration project Crowdmark conducted an online webinar for eCampusOntario (July 12, 2018) and had informal introductions to distance education staff at other universities across Ontario. In addition, Crowdmark executive staff attended the eCampus Ontario showcase in Fall of 2017, where they met with Chief Executive Officer of eCampusOntario, David Porter, and engaged in discussions with various institutions about the use of Crowdmark for distributing exams and grading assessments.

6. Discussion

6.1 Summary

The present demonstration was a success, insofar as the aims identified at the outset were achieved. The first aim was to identify and implement agreed upon product enhancements that would specifically address distance education use cases and meet the needs of these two large Ontario universities, Waterloo and Guelph and would be likely to benefit other institutions. The demonstration revealed some meaningful benefits associated with the use of Crowdmark for remote final exams for both institutions, instructors, and graders, as well as proctors. Specifically, the institutions benefit from the use of Crowdmark in terms of a reduction in administrative time, financial cost, and total duration of process (lag time), relative to the traditional courier method. The reduction in total duration of the process would benefit online instructors at Waterloo and Guelph, potentially enabling them to submit their final exams a little later than required by the courier method. Further, because Crowdmark makes completed exams available to instructors as soon as they are uploaded by the proctor, instructors are able to start grading these distance exams earlier than when using the courier method. Proctors' reports on Crowdmark were generally positive, as a greater proportion of proctors who used Crowdmark rated the distributed exam process as easier, relative to the courier method, particularly with respect to the process of returning completed exams.

The second aim of the demonstration was to make some strides towards validating the benefits of online collaborative grading in Ontario. We heard from a number of instructors and graders, across various disciplines, who reported that they found Crowdmark's online grading platform reduced errors in grading, increased grading quality and instructors' ability to monitor graders, and generally made grading easier and more efficient. The capability of the software to facilitate grading at a distance was also noted as a valuable feature of the software.

Finally, through this collaborative demonstration, Crowdmark has established a strong relationship with Waterloo and Guelph and has made many more connections within the higher education sector in Ontario.

6.2 Additional Considerations

While this demonstration was a success, there are some additional considerations worth mentioning, which may influence the magnitude of benefit for an institution considering the use of Crowdmark for remote final exams. Neither Waterloo nor Guelph were able to eliminate couriering exams during this demonstration and thus engaged in both Crowdmark and courier methods. This poses some challenges, in that administrative staff need to be trained in both processes and running two separate processes can be more challenging than running one older, more familiar system, which was the experience at both institutions. At this time neither Waterloo nor Guelph are able to switch to using Crowdmark exclusively for the following reasons:

- Waterloo found that a small percentage of proctors were unable to print larger than 8.5 x 11 or size A4; however, many instructors prefer and insist on submitting exams on legal size paper.

- Staff perceived that more time was required to communicate, instruct, and follow up with proctors using Crowdmark, than with those using couriers. This may, in part, be due to the fact that this was a new process and included an additional step of emailing confidential forms to proctors (e.g., pay forms), which typically are included in the couriered exam packages.
- During the time of the demonstration Crowdmark was not able to accommodate exams with scantrons, which a significant portion of final exams requires. Since the demonstration, however, Crowdmark has added this feature and it is now able to accommodate exams with multiple choice/scantrons.
- It should be noted that the cost of printing the exam was not eliminated, it was shifted to the proctor, who absorbed the cost. For a single exam this may be a small expense for a proctor, but this is an important consideration if an institution is considering utilizing Crowdmark for examinations at large exam centres.
- Waterloo also has exam centers across the country, which host between 4 and 125 exams/session. Replacing this system with Crowdmark would pose additional challenges, insofar as proctors at these exam centers would need to be able to access Crowdmark to download exams, as well as print, collate, and staple exams for a large number of students. These exams would then need to be individually uploaded back to Crowdmark. This is a much more involved, lengthy process for those proctors at these larger exam centers, relative to the traditional courier method. Because the Crowdmark method offloads printing exams to the proctors, there is an additional cost to the proctors and potential for point of error due to mis-collating.
- Proctor compliance. Some proctors may not have access to a printer or scanner or some may struggle with the technology side of this process. Waterloo did have one proctor who refused to use Crowdmark and required the exam be couriered. Guelph had a proctor who was absent due to weather and their emergency replacement was not familiar with Crowdmark and couriered back the printed exam.
- Waterloo and Guelph often use the same institution but different individuals to proctor, who share a departmental email address. In these scenarios where the Crowdmark account is associated with the shared email address, future proctors need to be aware that an account was already created, and change the password, to avoid potential security and/or access issues.
- Additional system enhancements were discussed that would be necessary for any largescale implementation of Crowdmark. Crowdmark was willing to discuss any enhancements that would benefit the majority of their customers.
- A number of proctors attempted to upload some of the extra documents accompanying exams, which had no QR codes and encountered problems as Crowdmark is only configured to accept the number of pages originally specified in the exam. Additional instructions or on-screen messaging will help some of these individuals.
- Additional discussion needs to be held regarding data storage and retention

In addition, the financial benefit of using Crowdmark was not maximized for Waterloo and Guelph, as both institutions presently require hard copies of completed exams to be couriered back to the institution, reducing the cost savings. That being said, this institutional requirement may be changed in the future, as this policy may not be necessary when using the Crowdmark

method, where completed exams are saved online and can be printed or stored electronically at the home institution if need be.

6.3 Future Directions

As a next step Waterloo has started to use Crowdmark for the administration of midterm exams. To date, Waterloo has not been able to hold midterms for online courses due to the time required to courier exams to and from proctors, which considerably delayed feedback. Several instructors are excited by the prospect of midterms being available in more online courses.

In addition, although not part of the initial research plan, Guelph piloted the use of the proctor coordination feature to set up final exams for students writing with their Student Accessibility Services on campus. An important feature was added to Crowdmark in the final phase of this demonstration, which is the capability of auto-grading multiple-choice questions, as standalone questions or part of a mixed exam, which Guelph was able to utilize in the last phase of the demonstration.

6.4 Conclusions

Crowdmark may confer a number of advantages:

- for institutions, in terms of administrative time and financial cost associated with the distribution of remote exams
- for instructors, in terms of decreasing lead time and early submission of exam masters, ability to start marking sooner, and increased ease and efficiency in grading
- for proctors who find the process of return shipping an exam to be a hassle

Institutions with similar exam distribution scale and process may find similar benefits and points of further consideration, in terms of if/when to use Crowdmark for the distribution of final exams for remote or online courses. As exam processes change and evolve, it is expected that Crowdmark will need to change and evolve to meet additional requirements, and Waterloo looks forward to assisting in this evolution.