

Graduate Attributes Assessment program

Graduate Attribute Assessment Program

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Abstract

Purpose – In this paper, the challenging and thorny issue of assessing graduate attributes (GAs) is addressed. An interdisciplinary team at The University of Alberta ——developed a formative model of assessment centered on students and instructor interaction with course content.

Design/methodology/approach – The paper starts by laying the theoretical groundwork on which this novel GA assessment tool is based, that is, competency-based education, assessment theory and GA assessment. It follows with a description of the online assessment tool for GAs that was developed in the course of this project.

Findings – The online assessment tool for GAs targets three types of stakeholders: (1) students, who self-assess in terms of GAs, (2) instructors, who use the tool to define the extent to which each GA should be inculcated in their course and (3) administrators, who receive aggregate reports based on the data gathered by the system for high-level analysis and decision-making. Collected data by students and professors advance formative assessment of these transversal skills and assist administration in ensuring the GAs are addressed in academic programs. Graduate attributes assessment program (GAAP) is also a space for students to build a personal portfolio that would be beneficial to highlight their skills for potential employers.

Research limitations/implications – This research has strong implications for the universities, since it can help institutions, academics and students achieve better results in their practices. This is done by demonstrating strong links between theory and practice. Although this tool has only been used within the university setting by students, instructors and administrators (for self-, course and teaching and program improvement), it could increase its social and practical impact by involving potential employers and increase our understanding of student employability. Moreover, because the tool collects data on a continuous basis, it lends itself to many possible applications in educational data mining.

Practical implications – The GAAP can be used and adapted to various educational contexts. The plugin can be added to any Learning Management System (LMS), and students can have access to their data and results throughout their education.

Social implications – The GAAP allows institutions to provide a longitudinal formative assessment of students' graduate attributes acquisition. It provides solid and valid evidence of students' progress in a way that would advance society and citizenship.

Originality/value – To date, the GAAP is the first online interactive platform that has been developed to longitudinally assess the acquisition of GAs during a complete academic cycle/cohort. It provides a unique space where students and instructors interact with assessment scales and with concrete data for a complete university experience profile.

Keywords Skills, Higher education, Assessment, Decision support systems, Data processing, E-learning

Paper type Technical paper



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1. Introduction

Graduate attributes (GAs) are notoriously difficult to assess, as they refer to generic and often abstract knowledge, skills and attitudes, which are not usually taught directly or formally in a university curriculum but are expected to be acquired by graduation. These GAs are deemed useful, indeed essential, for personal and professional growth (Halibas *et al.*, 2020). However, how does one assess such attributes as critical thinking, collaborative skills, confidence and the like, as well as the role played by an overall university education on developing these competencies?

The most common practice is still to rely on surveys, whether by higher education institutions themselves or accreditation bodies (Halibas *et al.*, 2020; Madhavi *et al.*, 2018; Belwal *et al.*, 2017). Some institutions, such as University of Ottawa, use a more complex Graduate Attribute Information Analysis (GAIA). However, data collection is done at the course rather than at the student level and is more suited to program evaluation than student assessment and improvement (George *et al.*, 2017a; George *et al.*, 2017b; George *et al.*, 2017c). Some universities, such as McGill University in Montreal, have created their own software tools, however, with limited success (Saunders and Mydlarski, 2015). Others still rely on commercially available general-purpose tools, such as the ABET Course Assessment tool (Bubacz *et al.*, 2016). It is being increasingly recognized that a broad range of assessments is required to fully determine the acquisition of GAs. (Winchester-Seeto and Rowe, 2017)

This article describes a project in which the challenging task of GAs assessment is addressed and proposes a unique and innovative practical solution. It starts by laying the theoretical groundwork on which a novel GA assessment tool is based, that is, competency-based education (CBE), assessment theory and GA assessment. It is followed by a description of the online assessment tool for GAs that was developed in the course of this project. The online assessment tool for GAs targets three types of stakeholders: students, who self-assess themselves in terms of GAs; educators, who use the tool to define the extent to which each GA is inculcated in their course; administrators, who have access to reports based on aggregate data gathered by the system for high-level analysis and decision-making. The presentation of this case study moves the discussion around GA assessment from a primarily theoretical issue to a practical one and serves as evidence for the possibility of concretely applying CBE principles to the difficult context of GA assessment using a novel and successful GA assessment tool. The level of sophistication to which this has been accomplished is, in our opinion, without precedent, and we believe the tool that the research group has developed may be of strong interest to all instructors and higher education institutions who have struggled through the years to assess GAs (see Figure 1).

In this paper, we present the Graduate Attributes Assessment Program (GAAP), at the center of the chart above. The GAAP can serve as a tool within a broader strategy of GA assessment (in addition, for instance, to an e-portfolio of assessment modes that account for the complexity and richness of GA assessment). We first discuss the theoretical construct that led to the GAAP from a *transformative assessment perspective* (Popham, 2008). Then, we present each component of the GAAP with details about their workings and their link to other components, namely, surveys, student interface and instructor interface). The complete GAAP was built around a strong algorithm that allows for instant analysis and reporting to both students and instructors, and it serves in the end as a portfolio item within a formative assessment framework of GAs.

2. High-level competency assessment in higher education

The various definitions of competency revolve around the skills and abilities to carry out a task successfully and to perform at a certain level of acceptable acquisition (Suleman, 2018). Competence within an academic context, or *academic competence*, is:

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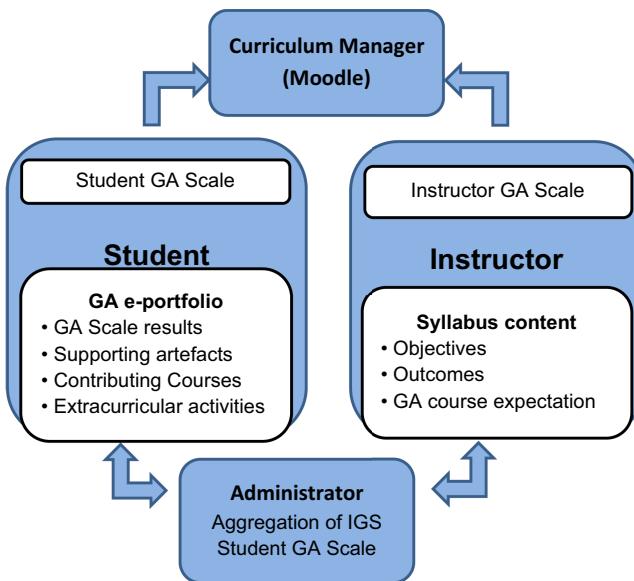


Figure 1.
Relationships between stakeholders in the assessment

[t]he multidimensional characteristics of a learner – including skills, attitudes, and behaviors – that factor into their academic success. These characteristics can be separated and considered in one of two primary domains: academic skills or academic enablers (DiPerna and Elliot, 2000; Elliot and DiPerna, 2002). Academic skills are both the basic and complex skills (e.g. reading, writing, calculating, and critical thinking) needed to access and interact with content-specific knowledge. Academic enablers, however, are the attitudes and behaviors (e.g. interpersonal skills, motivation, study skills, and engagement) that a learner needs in order to take advantage of education. (Van Wieren, 2011, p. 12)

Its use in university settings marks a turn in pedagogical theory and practice whereby focus is no longer on teaching and learning epistemic content, but rather on what the student can do. Competency and its sub-indicators are not new in the academic environment and have been used since at least the 19th century (Ipperciel and ElAtia 2014), if not earlier (Hodge, 2020). GAs, as shown in the table below, are a subset of competencies and belong to the broad trend associated with the use of “competency” as a pedagogical focal point.

In CBE, one attempts to master the learning outcomes as well as develop strategies, which provide flexibility to the process of learning. These concepts have been introduced as complementary to our traditional educational system, and, as a result, students study the same subjects whether in a CBE context or in traditional methods. However, content and course materials are not the primary focal points of learning in the CBE framework; rather, they are the means through which students achieve competencies (Limon, 2014). While CBE is not new [1], it is allowing higher education to rethink its teaching models and reassess how best a CBE model can benefit GA development within its practices (Bajis, 2020).

Because CBE has proved its merits in various professional programs, it should have some value in building axes of excellence that could be beneficial if adapted to fit within general university contexts. Assessment is one aspect in which CBE has made concrete advances and in which it diverges from the traditional/classical approaches to assessment in universities. In particular, CBE emphasizes a criterion-referenced evaluation (CRE, commonly known as CRM), whereas norm-referenced evaluation (NRE, also known as NRM) is the dominant model in universities (Sondergeld *et al.*, 2020).

A multifaceted concept ([Burke, 1974](#)), CRE is built around tests and measurement that are “designed to ascertain an individual’s competencies ([Lunz, 2010](#), p. 6).” The interpretation of scores in CRE focuses primarily on the individual examinees’ performance on specific tasks and criteria. This performance is judged solely on the basis of the established criterion for success and is not compared to other individuals in the same category. NRM, on the other hand, compares test results among individuals within a group. These individuals are also compared to a norm or a standard. NRM is a hallmark of classical university education whereby students’ GPAs are constantly being compared to a normal distribution (i.e. “grading on the curve”) and outliers identified.

In this regard, a CRE model taken from CBE can be of benefit in the way in which we conceive of GA assessment. Instead of comparing students’ results, it is more valuable to produce a meaningful assessment of GAs demonstrating the extent to which a competence has been acquired. For a CRE competency assessment model to be fully implemented and to work successfully, the primary stakeholders must be accountable to their progress ([ElAtia and Ipperciel, 2015](#)). Moreover, these stakeholders must take part and be involved in the development and progress at various stages of the assessment, including the elaboration, the implementation and use and the interpretation of scores.

2.1 Properties of competencies criteria

When fleshing out the CBE model for GAs in the context of higher education, it is useful to clarify the properties that competency criteria should possess. [Burke \(1974\)](#) produced a set of criteria for describing competency. This rather long set of criteria describes features that targeted competencies should include, as well as the properties of educational systems based in CBE. Here is a sample of such features and properties:

- (1) Competencies are based on an analysis of the professional role(s) and/or a theoretical formulation of professional responsibilities.
- (2) Competencies describe outcomes expected from the performance of professionally related functions, or those knowledge, skills and attitudes thought to be essential to the performance of those functions.
- (3) Competencies are treated as tentative predictors of professional effectiveness and are subject to continuous validation procedures.
- (4) Competencies are specified and made public prior to instruction.
- (5) Learners completing the CBE program demonstrate a wide range of competency profiles.
- (6) Learner progress is determined by demonstrated competence.
- (7) The extent of the learner’s progress is made known to them throughout the program.
- (8) Competency measures are specific, realistic and sensitive to nuance.

As is apparent from this list, competencies have traditionally been applied in a professional or vocational context in which tasks and roles are unequivocally and concretely identifiable. However, GAs are more general in nature and do not refer to a specific task in the context of a profession or a trade, but rather to skills, attitudes and knowledge that should be transferable and generalizable to other contexts. As a result, GAs must distill a specific set of criteria and properties from the concept of competency as defined in the literature.

The list also makes apparent that CBE promises better outcomes and more personalized learning for students. However, it is at times abstract, especially in the context of higher education, and, more practically, most institutions will find it costly to convert completely to a

CBE model and meet all the required criteria. That is why some institutions have pursued the path of adaptation toward CBE instead of instituting a wholesale reform. In this context, it is sensible to identify a list of core features of a CBE program. The following five statements address the most important issues of CBE in higher education and can be used as a summary of competency criteria. These core elements were described in the seminal work of Elam (1971).

- (1) Competencies are role-derived, specified in behavioral terms and made public.
 - (2) Assessment criteria are competency-based, specify mastery levels and are made public.
 - (3) Assessment requires performance as prime evidence but takes knowledge into account.
 - (4) Individual student progress rate depends on demonstrated competency.
 - (5) The instructional program facilitates development and evaluation of specific competencies.
-

Two focus points seem to emerge from the core elements of CBE: first, the way we describe competencies to the stakeholders of the educational system; and second, the way we assess competencies. The following sections will focus, respectively, on describing GAs as higher-level competencies and the assessment (and self-assessment) of competencies/GAs.

2.2 Graduate attributes

As was alluded to in the previous section, GAs aim to describe learning outcomes of a more general nature, as compared to competencies, although the relationship between GAs and outcomes is not always straightforward (Kennedy *et al.*, 2014; Soares *et al.*, 2017). For a better understanding, we can turn to one of the most commonly used definitions of GAs from Bowden *et al.* (2000):

Graduate attributes are the qualities, skills and understandings a university community agrees its students should develop during their time with the institution. These attributes include but go beyond the disciplinary expertise or technical knowledge that has traditionally formed the core of most university courses. They are qualities that also prepare graduates as agents of social good in an unknown future (Bowden *et al.* (2000) in Barrie 2004, p. 262).

While agreeing with the basic idea of this definition, we have modified it to better capture the nature of the learning objectives normally intended in GAs (Ipperciel and ElAtia 2014). In this context, we prefer to refer to the *knowledge, skills* and *attitudes* developed in university education for the purpose of preparing students for the changing complexities of their social and professional life. Based on this definition and the essential elements of a competency-based program discussed above, we can define a list of properties GAs have:

- (1) They can describe the knowledge, skills and attitudes students should develop
- (2) Institution, instructors and students should agree that the list of GAs is an outcome of education
- (3) There should be assessments based on a specified list of GAs institutions adopt according to their values
- (4) The list of GAs should include qualities deemed useful in the future life of students, in the work environment and in society at large.

This project uses the list of GAs suggested by University of Alberta's Office of the Provost ([Graduate Attributes at the University of Alberta, 2011](#)). These GAs are ethical responsibility,

communication, collaboration, critical thinking, scholarship, confidence and creativity. In previous research, we developed rubrics and rating scales for a GA assessment framework. The focus of the following section is on presenting a practical application of this criteria-based model for assessing GAs.

The proposed model uses the seven GAs listed above with their four sub-attributes, as presented in Table 1 below:

GAs can be grouped into three categories: (1) knowledge-type GAs, (2) skill-type GAs and (3) attitude-type GAs. Since varying attributes and sub-attributes can refer to any of these categories and do not necessarily follow a linear model, it is thus important to appropriately describe each of the attributes and sub-attributes to indicate to which of the three categories they belong.

The proposed approach uses a scale with intuitive labels. Levels 1–2 correspond to levels of pre-acquisition. Level 3 is the adequate level, minimum required for learning an acquisition. Levels 4–5 indicate levels of excellence that may go beyond what is expected in a university setting and may not be reached by all students. Labels proposed are emergent (level 1), basic (level 2), adequate (level 3), superior (level 4) and exceptional (level 5).

At the emergent level, GA acquisition refers to the awareness of individual (or atomic) elements that are needed to perform a specific task, such as the cognizance of facts, ideas or rules. At the basic level, GA acquisition involves manipulation and combination of the basic individual elements (facts, ideas or rules) in a coherent (molecular) whole aimed at performing a specific task. At the adequate level, the minimum standard/norm for performing a specific task has been met, and a GA is deemed functional in the academic context. At the superior level, a GA is acquired to the extent that it allows for new applications in, and generalizations to, unforeseen contexts. Finally, at the exceptional level, there is a consistency and spontaneity in the capacity to generalize GA application and adapt to new situations, including outside the academic environment.

Institutions tend to define a short list of GAs that are rather generic. To avoid indeterminacy, there is the need to define a series of sub-attributes for each generic GAs. And given the many cultures within a large institution and the different requirements of specific programs, it is also useful to define a specific interpretation of the sub-attributes peculiar to a faculty or a unit. This approach allows defining attributes and sub-attributes as general concepts applicable to the whole university while making room for specific interpretation of sub-attributes conforming to faculty or unit culture, values and needs. Descriptions have been provided in this project for each value that can be assigned to each sub-attribute,

Attributes	Sub-attributes				
Ethical responsibility	Global citizenship	Community engagement	Social and environmental awareness	Lifelong learning	Professionalism
Scholarship	Knowledge breadth and depth	Interdisciplinarity	Intellectual curiosity	Investigation	
Critical thinking	Analytic and synthetic reasoning	Interpretive proficiency	Information literacy		
Communication	Writing skills	Oral skills	Multilingualism		
Collaboration	Openness to diversity	Interpersonal skills	Visual communication		
Creativity	Imagination	Innovation	Adaptability and compromise		
			Divergent thinking		
Confidence	Leadership and empowerment	Independence	Initiative	Individual contribution	
				Artistic sensibility	
				Resilience	

Table 1.
The seven GAs with their sub-attributes

including for every level of acquisition based on the type of attribute. As suggested in Ipperciel and ElAtia (2014), a special consideration was given to the needs, interests and concerns of all stakeholders, which can change from one institution to the other, and from one context to the other.

2.3 Assessment of GAs as competencies: the GAAP

When assessing within a CBE framework, the emphasis is generally placed on mastery at the end of an instruction; it serves to ensure that the learner has achieved the required milestones or thresholds to perform at an acceptable level. Yet, within such a framework, the progress is not necessarily measured, and the chance to have feedback-based assessment is lost. We believe that the assessment of GAs should be continuous and should check for achievement throughout the learning process.

The GAAP model we are presenting is built around a formative assessment perspective whereby the learners are engaged in tracking their progress throughout their four years of study at a university. More specifically, the model was devised within a *transformative* perspective, which Popham defines as “a planned process in which elicited evidence of students’ status is used by teachers to adjust their ongoing instructional procedures or by students to adjust their current learning tactics (Popham 7, 2008).”

If we consider that assessment is a large umbrella underneath which various evaluations fall, then the assessment model for a CBE must be holistic. According to a widely used definition in higher education, “assessment is the systematic collection, review, and use of information about educational programs undertaken for the purpose of improving student learning and development (Banta *et al.*, 2014).” Understood in this way, assessment is a critical part of the CBE educational process. Based on usage, there are different types of assessments [2] that serve a better outcome for learning. In this respect, assessment can aid learning by (1) motivating students, (2) increasing the retention and transfer of learning, (3) helping students to understand themselves better (self-assessment) and (4) evaluating the effectiveness of the instructional process (Gronlund, 1998).

In the GAAP model, self-assessment is intended both for students and instructors. As students carry out the self-assessment for every semester throughout their academic progress, they can access their evaluation results immediately and throughout the whole process. It was designed in such a way as to allow students to reflect and to adjust their learning process based on the evidence collected from the evaluation they carried out. Our expectation is that by making the assessment at the end of each semester, students are provided with the chance to reflect on their GA progress and to adapt their course roadmap accordingly. The aggregation of evaluations forms in the end an e-portfolio with specific artifacts added by the students to support their assessment when needed. Upon graduation, they will have sufficient evidence to ascertain their progress through acquiring knowledge, sharpening necessary skills and building abilities and attitudes (Haladyna, 1997).

The adjustment to students’ or instructor’s plan and behavior should be based on the evidence provided by the assessment. As mentioned, the evidence in the case of our model is the aggregation of students’ self-assessment in terms of GA acquisition and related artifacts. The adjustment can be effected in different ways. For example, students can determine which GA they should focus on more and plan their courses accordingly. Similarly, in the case of instructors, the comparison between their expectation and the aggregated responses of students can provide some basis for adjusting course materials, activities, assessments and objectives.

Self-assessment is by nature formative, and its value has been demonstrated in previous studies (Tsang, 2020). Within the GAAP, both instructors and students are given the opportunity “to reflect on and evaluate the quality of their work and their learning, judge the degree to which they reflect explicitly stated goals or criteria, identify strengths and weaknesses in their work, and revise accordingly (Andrade and Du, 2007, p. 160).” In the case

of students, it provides detailed information on the level of mastery for each GA and their sub-attributes. Students must reflect on all of them while providing support in the form of artifacts. In the case of instructors, the process is more akin to a reflection on the course's objectives and learning outcomes as stated in the syllabus.

Both students and instructors should be able to appreciate the degree of their mastery and understanding of each of GA and its attributes by referring to the rubrics (i.e. can-do statements) and the definition provided for each value of sub-attributes. By providing examples, definitions and explanations, a level of understanding of what is being measured is ensured, which, in turn, addresses issues related to the validity of the measurement instrument and ensures the reliability of the data gathered from the assessments. The self-assessment tool will be presented in detail in the section below.

3. Description of the online assessment program

A central element of the project consisted in designing and developing an online GA assessment tool. The online assessment tool's purpose is to associate a value from 1 (emergent) to 5 (exceptional) to each of the GAs for each student and each course. These data, alongside user profile data, can be a productive foundation for further research in educational data mining and learning analytics.

It was important to give some thought to the possible challenges involved and to take them into consideration in the design. Using Rogers' theory of "diffusion of innovation" (2003), we know that adoption can be influenced by the following factors:

- (1) Perceived advantages
- (2) Compatibility with preexisting system
- (3) Complexity or difficulty to learn
- (4) Testability

When potential users negatively evaluate any of these factors, adoption of a tool may be compromised. And, indeed, related work (Rogers, 2003) has shown us some important adoption challenges. Aside from the importance of perceived advantages (which should be made clear while "selling" the tool to faculty and staff), the tool must be compatible with educational tools currently in use, which explains our design based on the Moodle platform. It must be intuitive, easy to learn and rely on visuals. It must be flexible enough to ensure testability, even though members of the institution do not always share a common understanding of GAs and sub-attributes. This is made possible, as it was alluded to earlier, by using detailed descriptions/interpretations for GAs and values assigned to them. These descriptions provide additional flexibility to different units, in that they can be modified, while adhering to a common set of GAs and sub-attributes.

Rogers (2003) also reminds us that likelihood of adoption is predicated on certain adopter traits, ability and motivation being foremost among them. This is why starting the study with volunteer users can promise more engagement than a mandatory case study.

The online assessment tool for graduating attributes targets three types of stakeholders. The first group of users includes students who self-assess in terms of GA acquisition levels. The second group consists of instructors who may use the tool to describe their courses in terms of GAs (in addition to the usual disciplinary content). A further target of the tool is the administrators who will have access to aggregate data gathered by the system for high-level analysis and decision-making.

As mentioned above, we have implemented our tool as a Moodle plugin. Moodle is an open-source online learning management system that is being used in various universities for managing courses and course activities. Implementing our tool in Moodle has various

advantages: (1) it is linked to the educational profile of users (students and instructors), (2) it is linked to the online courses students are enrolled in and (3) access to the plugin is straightforward for users: they only need to use a single integrated web application for all educational purposes. The first step in using the tool is filling out a survey, which builds a profile for each student. Then, users have access to the assessment portal for carrying out evaluation of the GAs. Students access a GA self-assessment page, whereas instructors are directed to a course assessment page for each semester. Each of these parts of the GAAP model is elaborated on in the subsections below.

3.1 Online survey

The first step toward gathering useful data for further analysis is the profile information. Two surveys were designed, one for students and one for educators. The design of the surveys is based on the intended use of the data. Profile information should be able to address the following questions:

- (1) How do students differentiate themselves from peers in other programs and/or departments in terms of GA acquisition?
- (2) To what extent does the year of study affect students' self-evaluation in terms of GAs?
- (3) Is there any correlation between extracurricular activities and GA acquisition? And if there is, which activities correlate with which GA?
- (4) Are there any predictive patterns between programs, extracurricular activities and GA acquisition?
- (5) Are there any clusters that can be identified based on the survey's data?
- (6) Does living on campus or off campus affect the GA acquisition? And if it does, how does it affect GA acquisition?
- (7) How do instructors from different disciplines plan their courses in terms of GAs?
- (8) Are there any clusters or predictive patterns that can be extracted from the instructors' profiles?

To answer these types of questions, we designed a survey for students and instructors to be filled at the beginning of each semester. Similarly to other features of the assessment tool, this survey can be accessed at any time during the semester and can be updated later in the process (see [Plates 1 and 2](#)).

3.2 GAAP: Student's interface

The main objective in the design of this application is to assess students in terms of GA acquisition. We have chosen to design and implement the assessment of GAs as a self-assessment online tool substantiated with "artifacts" (or concrete evidence in the form of documents, certificates, assignments, letters of reference, etc.). One important feature of the data in this project is their longitudinal nature, where patterns in GA values over the years of study can be recognized for each student. To implement this feature, students complete the assessment at the beginning of the first semester and at the end of each subsequent semester. This is useful in gathering information about the changes each student experiences through self-assessment over the years in their program.

The figure below shows a snapshot of the student's assessment tool. Each feature of the tool will be discussed in more detail in the following subsections, which will explain design choices (see [Plate 3](#)).

1. Gender:

2. Age:

3. What is your current year of study at the University of Alberta?

4. Did you complete any postsecondary education prior to your current program of study?
 Yes
 No

5. Have you completed a certificate, diploma or degree since last semester?
 Yes
 No

6. This term, do you live in on-campus or off-campus housing?
 On campus
 Off campus

7. Are you an international student?
 Yes
 No

8. What faculty are you enrolled in this term?

8.1. What department are you enrolled in this term?

8.2. Specify specialization within department, if applicable?

Plate 1.
Screenshot of the students' initial survey

1. Gender:

2. What is your position?

3. In which faculty do you teach?

4. What subject do you teach?

5. Years of university teaching at the undergraduate level:

6. What is your research discipline?

7. If you would like to expand on any of your answers to the above questions, please do so here:

Plate 2.
Screenshot of the instructor initial survey

To describe a student's GA acquisition profile, a value is assigned to each of the sub-attributes. It is also important to display each sub-attribute describing an aspect of the main attribute. For example, the value assigned to "Global citizenship" reflects an aspect of "Ethical responsibility." To do so efficiently, all sub-attributes of each attribute are grouped in a tab titled after the main attribute's name. This intuitively presents the relations between sub-attributes. The same design has been used for the instructor's assessment tool.

In the student's assessment tool, we again ask users to assess their level of mastery by choosing a value between 1 and 5 for each of the sub-attributes. To highlight the progressiveness of the values, we have opted for a slider input. These values in order are titled, "Emergent," "Basic," "Adequate," "Superior" and "Exceptional," as described above. Each value assigned to each sub-attribute is provided with a clear rubric-like description. This not only helps users have an understanding of what each value means for each sub-

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Assessment

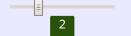
Ethical Responsibility Scholarship Critical Thinking Communication Collaboration Creativity Confidence						
Sub-Attributes	Value			Which courses and activities contributed ⓘ Adding or removing activities		
Global citizenship ⓘ	Emergent (1)		Exceptional (5)	< >	< Courses/Activities >	
Community engagement ⓘ	Emergent (1)		Exceptional (5)	< >	< Courses/Activities >	
Social and environmental awareness ⓘ	Emergent (1)		Exceptional (5)	< >	< Courses/Activities >	
Professionalism ⓘ	Emergent (1)		Exceptional (5)	< >	< Courses/Activities >	
<input type="button" value="Save Changes"/> <input type="button" value="Submit"/>						

Plate 3.
Screenshot of GA's self-assessments and rubrics

attribute but also prevents them from – misleadingly – interpreting the scale as a continuous gradation or intensity in the levels of GA acquisition (see [Plate 4](#)).

Aside from the values for each sub-attribute, there should also be a way of linking the assessment with the courses taken by students. One can rightly expect that some of the improvements in GA self-assessment would result from skills, knowledge or attitudes acquired in specific academic courses. But the only way to make sure is to ask the users to indicate which courses have had an impact on the improvement of the GAs. One way to gather this information would be to have an assessment for each of the courses. There are two issues with this approach. Firstly, it would be time-consuming, as it would require assessing every single sub-attribute of every single course. Secondly, it may lead students to believe

Assessment

Ethical Responsibility Scholarship Critical Thinking Communication Collaboration Creativity Confidence Attributes																								
Sub-Attributes	Value			Which courses and activities contributed ⓘ Adding or removing activities																				
Global citizenship ⓘ	Emergent (1)		Exceptional (5)	< >	< Courses/Activities >																			
<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 15%;">Value</th> <th style="width: 85%;">Description</th> <th style="width: 10%; text-align: right;">Hide Description</th> </tr> </thead> <tbody> <tr> <td>(1) Emergent</td> <td>Displays an awareness of global issues</td> <td style="text-align: right;">Hide Description</td> </tr> <tr> <td>(2) Basic</td> <td>Shows a willingness to participate in discussions on global issues</td> <td style="text-align: right;">Hide Description</td> </tr> <tr> <td>(3) Adequate</td> <td>Adopts behaviour that demonstrates strong beliefs in and sensitivity toward global solidarity/interdependence</td> <td style="text-align: right;">Hide Description</td> </tr> <tr> <td>(4) Superior</td> <td>Can explain and/or defend one's own beliefs in global solidarity/interdependence</td> <td style="text-align: right;">Hide Description</td> </tr> <tr> <td>(5) Exceptional</td> <td>Displays an ingrained commitment for global values</td> <td style="text-align: right;">Hide Description</td> </tr> </tbody> </table>							Value	Description	Hide Description	(1) Emergent	Displays an awareness of global issues	Hide Description	(2) Basic	Shows a willingness to participate in discussions on global issues	Hide Description	(3) Adequate	Adopts behaviour that demonstrates strong beliefs in and sensitivity toward global solidarity/interdependence	Hide Description	(4) Superior	Can explain and/or defend one's own beliefs in global solidarity/interdependence	Hide Description	(5) Exceptional	Displays an ingrained commitment for global values	Hide Description
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Value descriptions																								
Community engagement ⓘ	Emergent (1)		Exceptional (5)	< >	< Courses/Activities >																			

Plate 4.
Screenshot of the sub-attributes

they are assessing courses, when, in fact, the intention is to produce a self-assessment on levels of GA acquisition.

Another design choice has led to displaying the courses taken by the student in the assessment tool. After assigning a value to a sub-attribute, users can choose all the courses that have contributed to enhancing sub-attribute acquisition. To enhance the level of granularity and gather more informative data while trying to avoid information overload, we added two intensity parameters for each course, namely, “major impact” and “minor impact.”

In the assessment tool under “Contributing Courses,” as highlighted in [Plate 5](#), one may see how students can go over all their enrolled courses and choose their impact level on the sub-attribute they are assessing.

In the first student assessment, the “Contributing Courses” are not displayed, as the goal at this point is to establish a benchmark against which subsequent improvement through their university experience will be measured. After this first assessment, all other assessments are done at the end of the semester and include the “Contributing Courses” section; thus allowing students to monitor their self-perceived progress and indicate perceived course impact.

GA acquisition results from various activities: extracurricular as well as academic (i.e. relating to courses). Under the best conditions, data information would be gathered at each step of the assessment, in each semester. To do this, one would first need to establish the self-perception benchmark and then observe improvements as a result of each course taken during the semester by asking for an assessment at the end of every single course. Aside from being time-consuming, this design would require a method to aggregate different assessments into a single one, describing the student in that semester. Instead, in the model we have chosen, students are simply asked to assess themselves once every semester and mention which of their courses contributed to the sub-attribute they are assessing. By comparing the latest assessment with previous ones, it is possible to determine which sub-attributes have been improved upon as well as the courses contributing to the improvement.

The screenshot shows a user interface for an assessment tool. At the top, there is a navigation bar with tabs: Ethical Responsibility, Scholarship, Critical Thinking, Communication, Collaboration, Creativity, and Confidence. The 'Ethical Responsibility' tab is selected. Below the navigation bar, there is a table with three columns: Sub-Attributes, Value, and a button labeled 'Which courses and activities contributed'. In the 'Value' column, there is a horizontal slider with a scale from 'Emergent (1)' to 'Exceptional (5)'. A green square marker is positioned at the value '2'. To the right of the slider, there is a red-bordered box containing the text 'Choices of course impact' and three radio buttons: 'Major contribution' (selected), 'Minor contribution', and 'None'. Below the table, there is a table with columns 'Value' and 'Description'. The rows correspond to the values from 1 to 5, with descriptions such as 'Displays an awareness of global issues' for Emergent and 'Displays an ingrained commitment for global values' for Exceptional. At the bottom of the interface, there are buttons for 'Previous Course/Activity' and 'Next Course/Activity'.

Sub-Attributes	Value	Which courses and activities contributed
Global citizenship ⓘ	Emergent (1) 2 Exceptional (5)	Choices of course impact <input checked="" type="radio"/> Major contribution <input type="radio"/> Minor contribution <input type="radio"/> None
	Value	Description
(1) Emergent	Displays an awareness of global issues	
(2) Basic	Shows a willingness to participate in discussions on global issues	
(3) Adequate	Adopts behaviour that demonstrates strong beliefs in and sensitivity toward global solidarity/interdependence	
(4) Superior	Can explain and/or defend one's own beliefs in global solidarity/interdependence	
(5) Exceptional	Displays an ingrained commitment for global values	

Previous Course/Activity ↓ Next Course/Activity ↓

Community engagement ⓘ	Value	Exceptional (5)
Community engagement ⓘ	Emergent (1) 2	< Courses/Activities >

Plate 5.
Screenshot of course impact

3.3 GAAP: Instructor's interface

Student assessment is important, but it will neither be meaningful nor play a major role in improving an institution-wide GAs assessment plan if instructors are not an integral part of it. The instructor/students dichotomy provides depth, accountability and holism to the assessment. For this reason, the instructor's assessment is captured in the GAAP. The instructor is asked to indicate which GAs are being targeted in the courses and to what extent. This is important information that can help us determine if instructors' intended learning objectives are in line with the students' perception of course impact on specific levels of GA acquisition. As more assessments are conducted and more calibration added, the course assessment can also be used as profile information for the course (see [Plate 6](#)).

Similar to the student assessment tool, instructors can assess their course by assigning a value between 1 and 5 (emergent to exceptional) to each sub-attribute. The same rubric-like descriptions for values are used to help instructors in their assessment. The graph shown on the right side of the tool displays a visual rendering of the value assigned to each GA, that is, the average of sub-attribute values for each GA. With one glance, the radar graph presents a pattern that allows for a comparison between the GAs and indicates the course's foci.

4. Results of the case study

The GAAP was piloted for a third-year course within the bachelor of education at the University of Alberta. Both students and their professor attended the required information sharing sessions. In total, 32 undergraduate students, majoring in education, took part in the pilot study. This purposive sample of one section of students from the same course was used to reduce or remove the effect of disciplinary differences between students in disparate programs. Of the 32 participants, 25 were female and seven male; 24 were between 19 and 27 years old, and eight were between 35 and 40 years old. Students were instructed to perform a self-assessment of their current and personal development within 28 sub-attributes. Students used the rubrics to score themselves on each self-attribute. Students were asked to reflect on the learning outcome of the course, what they have learned so far and then assess themselves as part of the online application, with written descriptions of five levels of development. Students were able to carry out the assessment for two semesters. They received cumulative reports based on the two terms and the courses for which they carried out the GAs assessment.

Student's Summary of Assessment

Sub-Attributes	Major contribution	Minor contribution
Global citizenship	EDU 103, EDU 211, EDU 319	
Community engagement		SOC 310
Social and environmental awareness	SOC 310, EDU 103	SOC 414
Professionalism	BUS 202	
Knowledge breadth and depth		EDU 319
Interdisciplinarity	EDU 319	BUS 202
Lifelong learning		EDU 211, PHIL 112
Investigation	EDU 103	

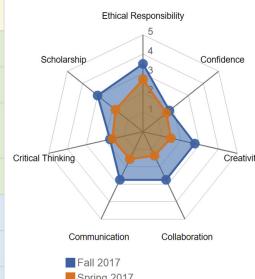


Plate 6.
Screenshot of the generated radar graph based on selfassessment results

The instructor, a 40-year-old woman, was asked to carry out the assessment while reflecting on the objectives of the course and the five Likert scale descriptions of each of the sub-attributes in the GAs. The instructor received reports pertaining to her course only. She was able to visually compare her responses to those of her students on the assessment of the GAs within the parameters of her course.

The data from the students and the professors were automatically anonymized and reports were produced instantly. In the two sections below, the overall reports and results of both students and instructor are presented.

4.1 Report for students

One important way to engage students with GAAP is to provide useful reports. [Plate 7](#) shows the report page available to students at all times. Each of the colors in the radar chart shows the value average reported in the student self-assessment. This shows students the improvements they have noticed in each attribute in each semester. At the same time, a list of courses contributing to the improvement of each sub-attribute is displayed.

Apart from the summary of students' self-assessment, reports on courses can be provided, which can be useful for selecting courses. Such a report can summarize the instructors' course assessments and the impacts reported for the course by previous students.

One of the possible applications of this project can be course recommendation to students. In this application, the purpose is to use recorded usage data from students and instructors in order to recommend future courses. There are various useful data to use in this regard, that is, the profile of each course created by the instructors, student self-assessments and student evaluation on the impact of each course on their GA acquisition and improvement.

4.2 Course report for instructors

Once the self-assessment is completed, instructors receive two anonymous (i.e. depersonalized) reports: one in the form of a table with details of each sub-attribute and the impact the course has had on student development (i.e. major or minor impact), and the other in the form of a radar graph that focuses on the GAs and superimposes students' on instructors' assessments. The radar graph allows instructors to visually compare their own perception of how GAs are addressed (or not) within the course and, on the other hand, the

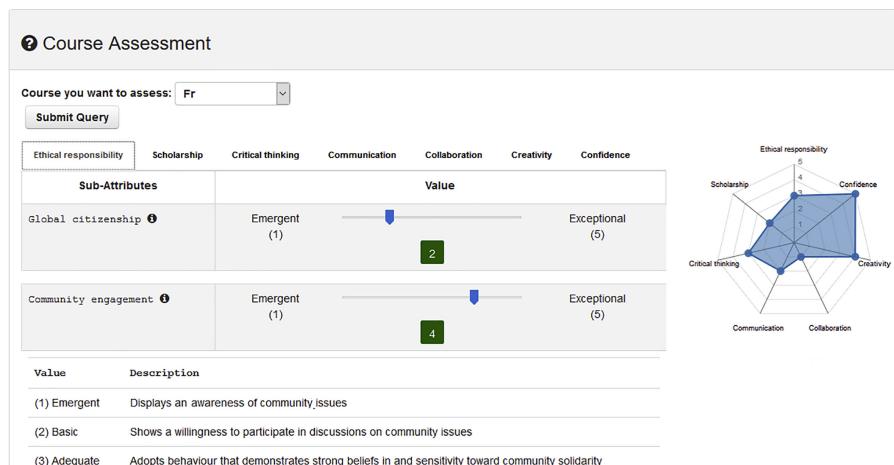


Plate 7.
Instructor's GA
assessment tool for
courses

students' perception of specific GAs addressed in the course. It allows for visual representation of convergence and divergence on GA acquisition within a course.

Providing reports to instructors is useful in various ways. First, it provides them useful feedback on the impact of their courses on student GAs acquisition. Second, it gives the instructors an incentive to participate in this program. It can also help them improve their course material according to the needs of students. **Plate 8** offers a snapshot of the report that is automatically provided to the instructors via the Moodle plugin.

As mentioned earlier in the student assessment tool, students indicate the contribution of each course in the development of each sub-attribute. The first part of this report shows the number of students who identified the course as having a major or a minor impact. This provides feedback to the instructors on how the course has been received by students in terms of impact. In the second part of the report, the instructor's course assessment is superimposed on the average student self-assessment in a radar graph. This graphical rendering can help instructors identify which GA still requires more attention or whether course activities should be modified in order to be more effective.

5. Discussion and conclusion

As described in this paper, we designed a plugin for collecting data and providing some meta-learning tools to the stakeholders. This design can be used as a platform for yet more complex usage. There are many possible applications in educational data mining, and some of them can be used in this project, which focuses on assessing GAs. These applications can target different stakeholders. Starting from the educators, the GAAP will help them with providing some feedback in the shape of reports about how the students have assessed each of the courses. The other possible application can be the grouping of students. This can be helpful for both learners and educators, when there is such a need. Grouping students is a task aiming at matching students in a way that each student's abilities complement the group's collective abilities in order to have balanced groups. GAs and student records in the GAAP are the data that can be used for accomplishing this task.

Furthermore, the interactive and iterative process with the GAAP between instructors and their students created an engaging space where these two stakeholders can learn from each

Course you want to check the report: EDU P 342 (LEC B1 Wi17) (2017-) ▾

31 out of 32 students having this course have completed their assessment of this semester.

Sub-Attributes	Number of students who checked 'Major impact' for this course	Number of students who checked 'Minor impact' for this course
Global citizenship	6	19
Community engagement	7	16
Social and environmental awareness	5	18
Professionalism	16	11
Knowledge breadth and depth	17	9
Interdisciplinarity	18	6
Lifelong learning	17	6
Investigation	13	10

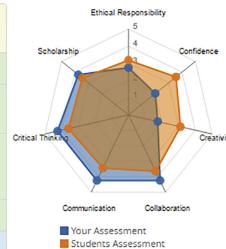


Plate 8.
Screenshot of
instructor's reports

other. [Kanuka and Cowly \(2017\)](#) found that instructors share disengagement and mistrust regarding the implementation of GAs. By providing a confidential space for the instructors in the GAAP, they were able to assess and reflect on their own courses as they target and relate to GAs and the university experience as a whole. In post-assessment interviews, instructors shared with the research team that they felt comfortable using the GAAP and addressing GAs within the learning outcome of their courses. They have control of their own profile and could generate course report. Students, on the other hand, have always been supportive of the GAs implementation and assessment ([Kanuka and Cowley, 2017](#)) as these transversal attributes can easily be mapped to employability attributes later, after their graduation.

From the perspective of administrators, we can provide more overarching feedback on how the courses in each department target the GAs and how successful they are in doing so. This information can help the institutional administrators in designing new courses or improving the existing ones.

GAAP also provides a platform for the researchers working in the education field. Significant research exists about the use of competencies and GAs which require data for evaluation and development of further research; GAAP will be an invaluable tool in collecting these data.

And finally, for learners, we must provide some useful applications to encourage them to use the GAAP. As a result, one useful application can be a course recommendation system. In the GAAP, we are recording the responses of different students over time, and based on these responses, we know which of the courses can be more useful in developing each of the attributes. We can use these data by generating recommendations to students, based on previous experiences. This also encourages students to make a more accurate self-assessment as it can help with more accurate recommendations.

Notes

1. cf. [ElAtia and Ipperciel \(2015\)](#) for an historical survey of CBE.
2. (1) Formative assessment: assessment used to monitor student progress during instruction.
(2) Diagnostic assessment: assessment focused on the common sources of error encountered by students, so that learning difficulties can be pinpointed and remedied. (3) Summative assessment: assessment at the end of instruction for the purpose of certifying mastery or assigning grades.

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