

# Using Learning Analytics within an e-Assessment Platform for a TransFormative Evaluation in Bilingual Contexts

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**Abstract:** Learning Analytics (LA) has the potential to be used as a unique and viable learning, teaching and research tool to analyze data from longitudinal assessment. The online language assessment platform, *Profil Linguistique*, is an innovative and useful tool, in that (1) it adapts to students learning abilities and progress and gives them the chance to monitor their progress, (2) it uses data mining to provide reports to teachers and administration who subsequently adapt the general language program in a Canadian university. From a theoretical point of view, the testing construct identified as the basis of this online assessment tool would engage students in progressing in their language competence in parallel with the courses they are taking. It is a provocative and unique way to integrate and look at assessment as a teaching tool by using LA.

## 1 INTRODUCTION

Educational applications of data mining and learning analytics are a growing trend in higher education due to the vast amounts of data becoming available from the growing number of uses within e-learning environments (ElAtia and Ipperciel 2015; Zaiane and Yacef 2015; Bakhshinategh et al. 2018). Learning analytics (LA) is data analytics in the context of learning and education. It involves collecting data about learners' activities and behaviours, as well as educational environments and contexts, and using statistics and data mining techniques to extract relevant patterns that reveal how learning took place. According to Diaz and Brown (2012), LA is the "use of data, statistical analysis, and explanatory and predictive models to gain insights and act on complex issues (...) about the learners (3)." LA can be used to report measures and patterns related to learning activities, or to optimize learning activities and strategies and/or learning environments. Two types of data can be used for implementing LA. First, data generated by the learners themselves, and often referred to as digital footprints. This type of data would enable us

to implement techniques to carry out data mining analyses leading to a holistic understanding of students' behaviour. Second, data supplied by learners in the form of surveys and other demographic and background information. This data provides a foundation for building an information system about students. Both types of data are necessary to learn about how learners react, behave, interact and use a specific e-learning environment. LA also provides (1) insights on how effective are such environments and (2) feedback for both future improvement and potential wider use. In this research project, we are using LA to empirically study students data collected from an on-line interactive assessment framework that targets language competence. The objectives of LA can be to report measures and patterns related to learning activities, or to optimize learning activities and strategies and/or learning environments.

For the last two years, a research team at the University of Alberta worked on developing an assessment model within an e-learning environment that comprise of individualized diagnostic, formative and summative evaluation modules using "Moodle" as an e-delivery platform and the Canadian Language Benchmarks as competence indicators. This assessment model, named '*profil linguistique* (PL)' provides a learner-centered and an integrated

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approach to students own evaluation of language achievement and is meant to supplement content-based courses. The PL allows us to offer a language program anchored in a continuous contact with the language (Berman and ElAtia 2008) within content-based courses (ElAtia 2011, ElAtia and Lemaire 2013) and which takes into consideration learners strategies, motivation, constructive feedback and self-engagement within the theories of language acquisition, (Cohen 2012, 2011, 2010). The premise is that by taking their language learning in-hand in the PL, students will have a holistic idea of their progress and most importantly would identify their linguistic weaknesses and elaborate personal strategies for linguistic improvement. From a research perspective, data produced and collected from the PL constitutes a solid foundation for carrying LA studies that will bring new insights into understanding how students interact with various learning materials within bilingual e-learning environments. We hope to improve our understanding of the strategies used by students to solve problems, to correct mistakes and to circumvent difficulties. Within an LA framework, the objectives of this research are to:

- (a) Understand what helps students succeed when using this independent e-learning model; how to use analytics to improve the design and applicability of each parts in the PL in such ways as to promote student success in engaging in their own language learning, be it French or English;
- (b) Use data to understand the various subgroups within the students' population; to build a comprehensive behavioral pattern for practical direct input into regular classes.
- (c) Develop specific data mining techniques to extract, sort, store, cluster and analyze data, determine patterns to seek from the data, and maximize what is available to support students, teachers and administration.

## 2 BILINGUAL ASSESSMENT AND ENGAGEMENT

### 2.1 Context of the Study

The Official Languages Act went into effect in 1969, giving French and English equal official status within Canada. Bilingualism has since been promoted not only at the federal level and the working of government but also provincially

through the French immersion language programs. However, outside of certain centers, namely Quebec and New Brunswick, French is in a minority context within an English-dominant environment. The competence in French in the English speaking part of Canada is heavily influenced by several factors as shown in figure 1. The language identity plays a big part in the language development of students across Canada.

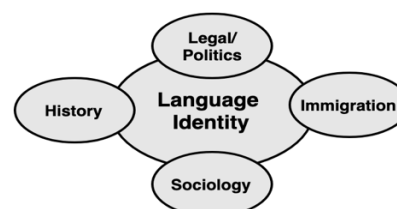


Figure 1: Elements Impacting Language in Canada.

While French Immersion programs are common across Canada, students wanting to carry out their higher education choose to do so amongst a very few bilingual programs and institutions such as Glendon College at the York University and Campus Saint-Jean at the University of Alberta. However, within these bilingual programs, mastering the two official languages is a requirement for admission and students are faced with the challenge of having to work on their second /other language (either French or English) in order to graduate with the required language competency. Program administrators face a challenge in this situation because there is little space within the majority of a 4 year program to add language courses. The *profile linguistique* (PL) was conceived as a testing and teaching tool that can be carried out by students and support staff outside of class time, and monitored by teachers and administrators to offer a language support opportunity to students in parallel to their content-based course work. Assessment, in all its facets from diagnostic, formative and summative, is used to motivate and engage the learners.

Students in these bilingual programs face few challenges that we hope the PL address:

- linguistic heterogeneity
- heavy content base coursework
- language competence plateau

This study took place in a large university in Western Canada, within its bilingual campus, located within an English dominant environment, and consequently, the students are in a francophone linguistic minority context within an historical French minority. Upon acceptance to university, students take an online French and English

placement test in order to identify their proficiency level and to place in the appropriate class. The purpose of PL is going beyond a placement test: it aims to create an online platform that would allow for individualized language learning experience using LA outside of classrooms.

## 2.2 Assessment for Language Learning

Assessment is generally an applied research field that interconnects (a) learning styles and preferences, (b) teaching strategies, and (c) evaluation techniques. Assessment can serve both learning and teaching; in fact, assessment can be a powerful tool where assessment becomes a platform in service of learning. Formative assessment can be used as a tool to advance learning where students take their learning into their own hands. Students' performance exceeds expectations once they are engaged.

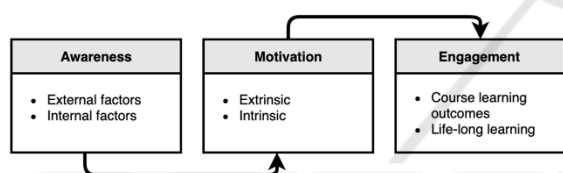


Figure 2: TransFormative Triangulation.

The PL is anchored in a *transformative* assessment framework (Popham 2007), where the emphasis is on evidence-based assessment and understandings of students' language progress from three primary stakeholders: students, instructors and program administrators. The purpose is not only to do a survey, gather information, and establish a starting point about students' progress, but also to create a loop of constructive feedback and assessment that all stakeholders can use to improve and change learning patterns throughout a two-year cycle. Figure 2 summarises the theoretical basis for the PL: from raising awareness, to motivating students do better, to finally an engagement on their part to learn.

As a first step, it is rudimentary to establish a baseline for learning; we are then positioned to determine progress against this baseline and provide evidence of development (Astin, 1985, 1991; Banta and Palomba, 2015). Importantly, assessment can thus become a platform in the service of learning. This is captured in the diagnostic assessment phase, which contains both a detailed survey and a competence test. The second, and substantive phase, is the formative part of the PL, that contains 5 modules, each containing a series of assessment

tools. Formative evaluation can be used as a tool to advance learning, with its focus on students taking on responsibility for their own learning (ElAtia and Lemaire 2013). Indeed, evidence supports that students' performance exceeds expectations once they are engaged in their learning (Kuh 2009; Berman and ElAtia 2008). Teachers, on the other hand, can change their pedagogical approaches to address students' needs, based on the feedback they receive from students (Popham 2007, 2011). During a learning process, consciously being aware and actively engaged in the progress of learning has proved central to learners fully endorsing the objectives and outcomes they are exposed to in a course (Harper and Quaye 2009; Schmidt 1990, Ellis 2008). Building on this principle of engaged learning (versus more static, passive learning), instructors and administrators clearly must draw students' attention to the details of the learning process itself—and continual formative assessment certainly aids this. The PL serves this purpose by explicitly focusing on the student as an active part of the learning process, it is a tool that can help students awaken to awareness, thus facilitating engagement. As students do the assessment, they become aware of their progress; whether for extrinsic or intrinsic purposes, they will be motivated to improve their standing; and by doing so, they will become more engaged and reflective of their own learning, be it at the course level or at the extracurricular one. Astin (1984, 1993) in conjunction with Lawton et al (2012) and Lyster (2010) insist on the effectiveness of pedagogical techniques that learners would not otherwise use, were they not centered on heightening awareness of the learning process. In turn, this leads to motivation to improve the implementation and learning the PL provides an independent, non-intimidating, self-monitoring platform that generates visual reports (securely and confidentially) that users can build on for a more engaged learning/teaching of languages within an academic program. The assessment within PL demarcates itself from other tools by allowing users to (1) visually track progress, (2) pinpoint acquired/not yet acquired attributes, and (3) build a portfolio of artifacts as evidence of acquisition.

### 2.2.1 Canadian Language Benchmarks

Know in French as the *Niveaux de compétences langagiers canadiens* are the national standards in English and French for describing, measuring and recognizing second language proficiency of adults in Canada. They are founded on models of

communicative competence; they are descriptive scales of language ability both (ESL and FSL). The Benchmarks are written on a 12 scale reference points along a continuum from basic to advanced proficiency. These 12 benchmarks reflect progression of the knowledge and skills that underlie basic, intermediate and advanced ability among adult ESL and FSL learners. Because they are a Canadian products, that has been developed while taking in consideration the cultural, social, economic, political consideration in Canada, we used them as our point of reference for developing the content materials for the PL. The benchmarks are also used by various employers in requiring special French or English language competence. For the PL, we created modules and various testing tools that target level 5 to 9 of the benchmarks; we did not take into consideration level 10 to 12 because they relate more to graduate education than to the undergraduate one.

### 2.3 Description of the *Profil Linguistique*

This triangulation model was used during a year-long formative assessment model where learning analytics and educational data mining were implemented to single out elements within students' profiles that could predict their success. The online platform of the PL was created in 2012 using Moodle as the learning management systems; as dynamic and computer adaptive platform with a data collection model for process mining. The PL is a bilingual comprehensive online assessment portal that has three components as shown in figure 3 below:

1. The initial assessment phase contains (1) an extensive survey about the language background of the students and (2) a diagnostic test that serve to identify the competence of the students both in English and French.

2. The formative assessment phase contains five modules calibrated with the Canadian Language Benchmarks (CLB). Each module contains various quizzes and tests that students can independently use outside of class to target specific learning objectives they want to improve for either French or English.

3. The achievement phase contains a high stakes competency test of language for academic purposes and for specific purposes such as business and nursing.

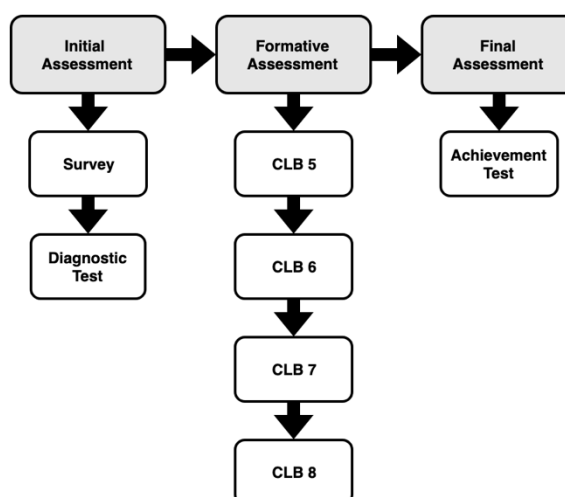


Figure 3: Components of the *Profil Linguistique*.

## 3 ONLINE ASSESSMENT PLATFORM

### 3.1 Learning Management System

The university where the study is undertaken, uses Moodle as its learning platform. Moodle is designed to provide educators, administrators and learners with a single robust, secure and integrated system to create personalised learning environments. It is an open source product, meaning that the source code is openly available and that there is an entire community of people contributing to the improvement of the project – whether it be by fixing bugs or creating new modules. eClass, powered by Moodle, is the university's centrally supported learning management system. eClass houses the university's credit and non-credit courses. To access these courses, users must (1) have a Campus Computing ID (CCID) account and (2) be enrolled in these courses. CCID accounts are created mainly for university students within a few days after their application. Figures 4, 5 and 6 show the progress of the within the PL.

Even though PL is an assessment tool, it is developed in eClass as a private non-credit course and used to evaluate upcoming students. For the purpose of generating data, we have made students that are currently enrolled in language courses at the university as PL's participants for the duration of this research. These students are enrolled and grouped by their own cohorts at the course-level; thus allowing teachers to monitor the progress of the students and provide input and feedback on the

content of the assessment modules. Upon entering the course, students can choose between French and English – whichever language they are assigned to be assessed in.

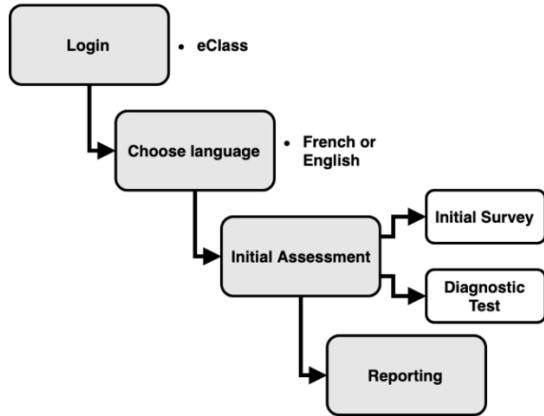


Figure 4: Gradual Progress in the PL.

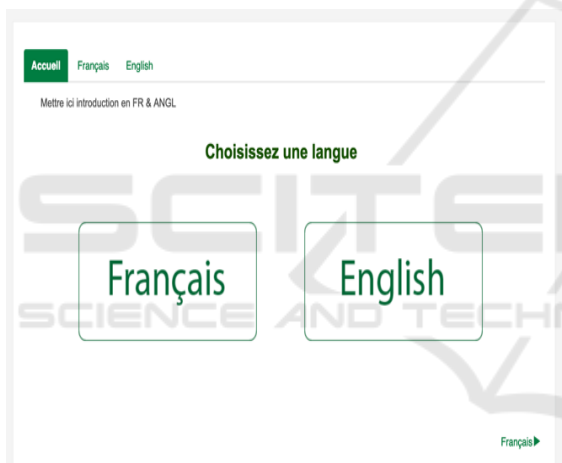


Figure 5: Initial Log in screen.

Once in their learning space, students can choose the language of their choice for the assessment. They have the option to work on either language depending on their preferences and language needs, i.e. francophone tend to work on English more, and the English speakers tend to work on their French more.

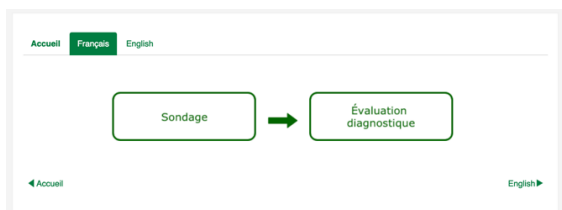


Figure 6: The Diagnostic Assessment Phase.

The screenshots in figure 5 and 6 above describe the first steps in the diagnostic assessment. The survey is mandatory before the test. A part from the written production that would need to be graded by teachers, students, upon completing their assessment, receive a table of their work broken down by item. The administration gets a different aggregate report that would allow it to advise students on future task to undertake to improve language production.

#### 4 INITIAL DATA RESULTS

To analyze data, we used (1) Python, a programming language popularly used in data science, (2) Pandas, a Python data analysis library, and (3) Microsoft Excel to produce graphs. In eClass, we downloaded the data from the survey and DA in CSV file format. To generate reports, the participants are de-identified and instead, have been assigned a random unique ID.

Concurrently, we carried analyses using the survey as our first point of reference to understand how students navigate through the various assessment modules in the PL, their answers and feedback, to investigate clusters, identify outliers, and map out rule associations that would shed light on how the various groups and subgroups students interact within e-assessment models.

The focus of this article is the initial phase. Using the survey and the diagnostic assessment, we were able to identify unique trends that would explain students’ behaviour while interacting with the language diagnostic tests.

The figures below show how we were able to

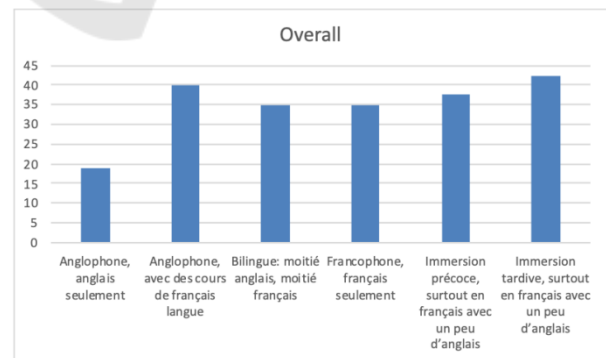


Figure 7: Overall Performance by Type of background Education.

In Figure 7 above and Figure 8 below, we look at the performance by type of prior education program in the elementary and secondary level. The cluster

analysis shows that the previous language of instruction of students does in fact predict their competence in various parts of the PL.

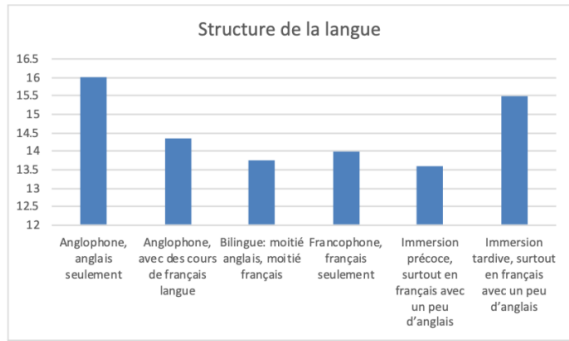


Figure 8: Partial Performance by Type of background Education.

The type of education that students had before joining this program has an impact on their language competence. Their performance in the test clearly can be clearly predicted by which program they attended. Moreover, performance in particular parts in the diagnostic test can be traced to their background education. By doing so, the PL can help us identify trends among certain groups; and consequently, be able to adapt the teaching material and to target specific component of language acquisition that each group needs to work on, or strengthen. Such reports will help the administration identify where resources should be allocated in order to help students in the program attain the adequate degree of language competence.

In graphs 9 and 10, we delved into specific parts of the diagnostic test. The purpose was to be able to generate reports for individual examinees. Both graphs show the performance broken by parts. Students will be able to find out which of the language component they master, and which one still need some work. By comparing each student to the mean, they can visualise their progress, become aware of their current language status with the hope to motivate them to do better and seek help from the various resources that are available to them in their programs. They can then pursue the formative modules within the PL.

Overall, the initial results showed us various clustering and trends that we were unsuspecting of. It helps us revise the theory of immersion students vs. the French as second language students.

GRADE VS. SECTIONS

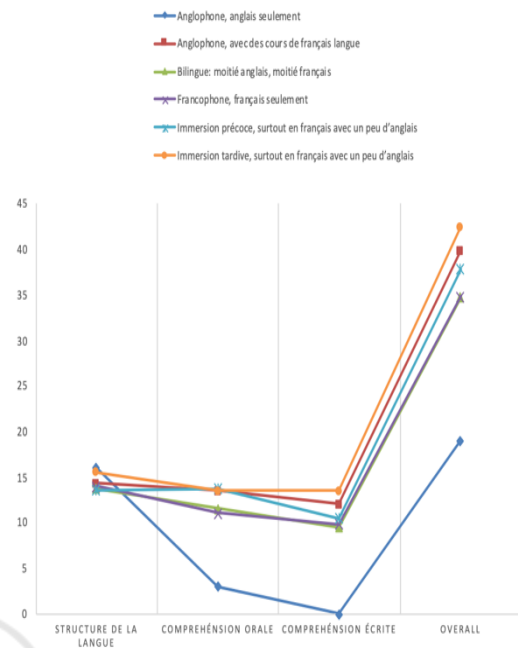


Figure 9: Overall Performance within the 4 Parts of the Diagnostic Test.

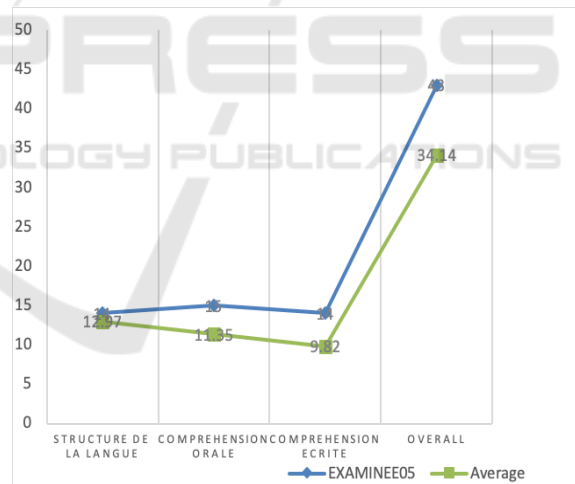


Figure 10: A Comparative Visual of one subject with the Group.

## 5 CONCLUSIONS

We aim to build an LA model that would allow us to carry in-house research that would benefit students, the university and academic communities. This is the first round of analysis that we carry on the PL. We realise that one of the drawbacks is the small pool of examinees. However, we are confident as

more students are using the PL, we will accumulate data that will help us understand behaviour, performance and needs of our students.

This project will open new doors for improving our understanding of students' interaction within e-learning models specific to language competence. As a result, we will, longitudinally and comprehensively, be able to explore data relating to students. The development of a data warehouse model and data mining algorithm for the LA model will have utility for secondary and post-secondary language programs across Canada. Using this complete assessment framework and the ensuing LA model, both the substantive and the qualitative results, will allow program teachers and administrators to holistically follow students' progress throughout their academic careers and to customize their programs for optimal success. Our initial data and analysis does support our thesis and we plan to carry out more extensive analysis as more robust data is collected.

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