TO STUDY COMPUTATIONAL PSYCHOMETRICS ANALYSIS OF EDUCATIONAL BEHAVIOUR IN LEARNERS

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Abstract

Learning is a many-faceted process or phenomenon. Learning processes or phenomenon include theacquisition of new calculative or declarative knowledge, the development of motor and cognitiveskills through instruction or practice, the organization of new knowledgeinto general, effective representations, and the discovery of new facts andtheories through observation and experimentation. The Elo system helpful in educational systems when we interpretlearner's response. The success of current technology enhanced learning canbe increased by tailoring the content and the learning resourcesfor every learner; thus, optimizing the learning process. The calculated ratings are used further in the teachingprocess as a recommendation of coding exercises that try tomatch the user's current knowledge.From a psychometric point of view, assessment means to infer what alearner knows and can do in the real world from limited evidence observed in a standardizedtesting situation. From a learning analytics perspective assessment means toobserve real behavior in digital learning environments to conclude the learner statuswith the intent to positively influence the learning process. Although psychometricsand learning analytics share similar goals, for instance, formative assessment,while applying different methods and theories, the two disciplines are so far highlyseparated.

Keywords

Computational thinking, Computational Psychometrics, Elo rating system, Artificial Intelligence, Machine Learning, natural language processing, e-Assessment, Algorithmic trading, Recommendation systems

INTRODUCTION

Most recent advances in the improvement of ICT, increment in Artificial Intelligence, require another instructive and learning strategy for upgrading computing thinking. Computational thinking (CT) help up each field, it is at the head of summed up ideas including coherent reasoning, scientific reasoning, individual reasoning and so on. So as to create computing thinking, it is basic to isolate the given issue into modules or units that can be tackled separately, to distinguish pattern in every unit, to extract or eliminate non-essential ones. Using ML algorithms, able to use the regional sentence factor data to identify important characteristics and will analyze the various performance measure with an accuracy. Simulated artificial intelligence or Machine Learning playa key role in MOOC's and Education. It helps educatorin categorizing learner's performance and limitations, helps in understanding customized learner model based on the information level, versatile learning frameworks, knowledge level, adaptive learning systems, utilizing ML to give predictive models and helps observing learner progress. [1]

Fundamentally Artificial Intelligence or Machine Learning use past model information or past experience to program system for solving a given problem. Pattern recognition, face recognition, education simulation virtual models, computer vision, bioinformatics, natural language processing, etc. are just some of fields where machine learning can be applied at. There aren't just learners within bounded infrastructure anymore, looking at the notebook, while a teacher is teaching. The mode of teaching shift from offline to online, limited number of participants to infinite number of participants. Presently utilize computerized assets, for example, online classes, zoom classes or MOOC's and so on, not restricted to the boundaries of classroom. In education, for instance, AI/ML could be applied to help educators, foresee student performance, test learners, and so forth. [2]

Psychometrics analysis implies for estimating mental capacities or psychological abilities and attributes of learners and educators or teachers, using the standardized psychological test. Psychometrics came to offer a realistic, scientific approach that both satisfied and fortified the need to rank, order and select individuals.

Computational Psychometrics (CP) is an interdisciplinary field joining hypothesis-based psychometrics,learning and intellectual sciences, and information driven AI-based computational models as applied to huge scope or high-dimensional learning, appraisal, biometric, or mental information. Computational psychometrics is

oftentimes worried about giving noteworthy and important criticism to people dependent on estimation and investigation of individual contrasts as they relate to explicit zones of enquiry. [3]

LITERATURE REVIEW

It is necessary toextract the knowledge from educational world, efficient to the students, collect in big data. Forexample, to compare and store data in warehouse, of different versions of assimilation around the world. Because there willbe important attributes or characteristics present in everyone, that will not change, they are common. With the use of machine learning algorithms, they use theregional sentence factor data to identify importantcharacteristics that are not changed despite spatio-temporaldifferences, and will analyze the various performancemeasure such as accuracy. In detail, factor data analysis willbe done using decision tree which is one of the machinelearning techniques.

In research paper Machine Learning based Fast Reading Algorithm for Future ICT based Education, by Jeon, H., Oh, H., & Lee, J., they concentrate on new advances dependent on the improvement of ICT, huge information, and so forth., require another instructive strategy for upgrading computing thinking (CT), it helps in numerous concepts including logical thinking, mathematical thinking, and thinking in the engineer's perspective. In computing thinking concepts, dividing the given difficulty into sub parts considered units that can be independently solved and study, identify and distinguish patterns in every unit,take out essential conceptual, and to structure suitable algorithms.

It is important to remove the information from instructive world, proficient to the understudies, gather in large information. For instance, to think about and store information in stockroom, of various renditions of osmosis around the globe. Since there will be significant traits or attributes present in everybody, that won't transform, they are normal. With the utilization of AI calculations, they utilize the local sentence factor information to distinguish significant attributes that are not changed in spite of spatio-worldly contrasts, and will examine the different exhibition measure, for example, exactness. In detail, factor information examination will be finished utilizing choice tree which is one of the AI strategies.

ML can be considered a part of artificial intelligence (AI). Machine learning (ML) is, at its core, the process of granting a machine or model access to data and letting it learn for itself. In 1959, Arthur Samuel came up with the brilliant idea that we should not have to teach computers, but rather, we could let them learn on their own.

He coined the term "machine learning" to describe his theory, which is now a standard definition for the ability of computers to learn autonomously.

In research paper *"History of psychometrics"* by Buchanan, R. D., & Finch, S. J. (2014). Psychometrics can be described as the science of measuring psychological abilities, attributes, and characteristics. Such a ubiquitous and hybridized set of techniques has been said, not surprisingly, to have many proto-scientific and professional antecedents, some dating back to antiquity. Modern psychometrics is embodied by standardized psychological tests. American psychometrician Lee Cronbach famously remarked in the 1960s, 'the general mental test . . . stands today as the most important single contribution of psychology to the practical guidance of human affairs' [16, p. 113]. However, psychometrics has come to mean more than just the tests themselves; it also encompasses the mathematical, statistical, and professional protocols that underpin tests – how tests are constructed and used, and indeed, how they are evaluated. [3]

ML is programming through which computers to optimize a performance criterion using example data, pattern or experience. Implementing a ML algorithm means implementing a model that outputs correct information given that we have provided input data. You can think of a model as a black box; data go in at the beginning, and some other data go out at the end — but the processes in between are complex. For example, if we want to create a model that predicts what the house price in some region next year will be, based on situation on the market for the last three years, we would feed the model metrics such as house prices on the market in last three years, interest rates and salary rates. The output would be the house price prediction for the next year. The process through which a model learns how to make sense of input data is called "model training". Training is a key concept in machine learning. [4]

The best way to describe the potential of ML is to explore how people and companies are currently taking advantage of it. Some examples could be:

• Natural language processing: - Google extract and translate from a set of ML algorithms that updates the service over time based on input from users, like new words and syntax. Siri, Alexa, Cortana, and, most recently, Google Assistant all rely on natural language processing (NLP) to recognize speech and synthesis, allowing them to understand or pronounce words they have never encountered before.

• Recommendation systems (RS): - On Netflix, Amazon, Google, etc., everything that is recommended (based on searching pattern or activity). These sites deliver and search recommendations across platforms, devices, and apps. Machinesmatch buyers with sellers and their products, digital content with viewers who want to see them - all of whichimproves our online experiences significantly. Amazon has ML algorithms in place that it canpredict with high certainty what you'll buy and when you'll buy it. The company even owns a patent for"anticipatory shipping," a system that ships a product to the nearest warehouse so you can order and receive youritem on the same day (although it is unclear whether they have implemented it yet).

• Algorithmic trading (AT): - Process that involves random behavior, ever-changing data, anda variety of factors. While financiers cannot predict all of that behavior, ML algorithms can —and they respond to changes in the market much faster than a human.

There are plenty of other business implementations of ML, lot of them are in education area. Someof interesting areas are:

• Predict Learner Performance (A great application of ML is predicting learner performance. By"learning" about each learner, the ML model can find out weaknesses and suggests ways toimprove, such as additional lectures or study additional literature.)

• Test learners and Grade learners Fairly (ML can help creating computerized adaptive assessments. The ML based assessment provides constant feedback to teachers and learners about how theylearn, the support they need and the progress they are making towards their learning goals.)

• It improves Retention (in ML such as learning analytics, will also help to improve retention rates. Byidentifying "at risk" learners, institutions can reach out to those learners and get them the help they need to be successful.)

• It supports teachers and staff (ML based algorithms can help with classification oflearners handwritten assessment papers)

In Paper von Davier, A. A. (2017). Computational psychometrics in support of collaborative educational assessments - computational psychometrics (CP) is defined as a combination of data drivenAI/MLand mining methods,use stochastic process or theory (In probability theory and related fields, a stochastic or random process is a mathematical object usually defined as a family of random variables,) and theory-driven in

computational psychometrics in order to measure dormant abilities in actual time. This blended can be instantiate as "iterative and adaptive hierarchical" conclusion data algorithms embedded in a theoretical computational psychometric framework. [5]

In research paper *"Learning Analytics and e-Assessment—Towards Computational Psychometrics by Combining Psychometrics with Learning Analytics"* by Drachsler, H., &Goldhammer, F. (2020) - from a psychometric point of view, assessment means to infer what a learner knows and can do in the real world from limited evidence observed in a standardized testing situation. From a learning analytics perspective assessment means to observe real behaviour in digital learning environments to conclude the learner status with the intent to positively influence the learning process. Although psychometrics and learning analytics share similar goals, for instance, formative assessment, while applying different methods and theories, the two disciplines are so far highly separated. This chapter aims at paving the way for an advanced understanding of assessment by comparing and integrating the learning analytics and the psychometric approach of assessment. We will discuss means to show this new way of assessment of educational concepts such as (meta-) cognition, motivation, and reading comprehension skills that can be addressed either from data-driven approach (learning analytics) or from a theory-driven approach (psychometrics). Finally, we show that radically new ways of assessment are located in the middle space where both disciplines are combined into a new research discipline called 'Computational Psychometrics'. [6]

In paperVon Davier, A. A., Deonovic, B. E., Yudelson, M., Polyak, S., & Woo, A. (2019). Computationalpsychometrics approach to holistic learning and assessment systems, outlined a comprehensive holistic learningand assessment system and indicated how the computationalpsychometrics paradigm integrates all these complex pieces.This framework stems from the idea that when learning,assessment and navigation are developed together there willbe an enhancement to the students' opportunities for asuccessful, holistic educational experience. A holistic learningand assessment system has many interdisciplinary componentsin which each individual component is an area for researchand development: from the design, to data structures forbig data, to mobile platforms, recommendation engines, thedevelopment of APIs and psychometric and ranking modelsfor learning. Each of the areas described here includeinnovations, or at least extensions, of

existing capabilities.Several papers are now being written simultaneously wherethe details of these approaches and their evaluations are beingpresented. [7]

In research paper *"Elo-rating method: towards adaptive assessment in e-learning"* by Mangaroska, K., Vesin, B., & Giannakos, M. (2019, July) - the success of technology enhanced learning can be increased by tailoring the content and the learning resources for every student; thus, optimizing the learning process. This study proposes a method for evaluating content difficulty and knowledge proficiency of users based on modified Elo-rating algorithm. The calculated ratings are used further in the teaching process as a recommendation of coding exercises that try to match the user's current knowledge. The proposed method was tested with a programming tutoring system in object-oriented programming course. The results showed positive findings regarding the effectiveness of the implemented Elo-rating algorithm in recommending coding exercises, as a proof-of-concept for developing adaptive and automatic assessment of programming assignments. [8]

In Paper Pelánek, R. (2016). Applications of the Elo rating system in adaptive educational systems. *Computers & Education*, The Elo rating system was originally developed for rating chess players, nowadays it is widely used for ranking players of many other games. The system can be used in educational systems when we interpret student's answer to an item as a match between the student and the item. In this way we can easily dynamically estimate the skill of students and difficulty of items. We provide a systematic overview ofdifferent variants of the Elo rating system and their application in education. We compare the Elo ratingsystem to alternative methods and describe a specific case study (an adaptive practice of geography facts)to illustrate the application of the Elo rating system in education. We argue that the Elo rating system issimple, robust, and effective and thus suitable for use in the development of adaptive educational systems.We provide specific guidelines for such applications. [9]

CONCLUSION

Psychometrics field is a top-down and theory-driven approach, the learninganalytics field is more a bottom-up data-driven research domain. Although psychometricsand learning analytics pursue similar objectives, for example, formativeassessment, while grounded on different methods, theories and mechanisms, the two disciplinesare so far highly separated. The combination of both research domains opens a newresearch area in

the intersection of both disciplines, that is known as 'computationalpsychometrics'. Computational psychometrics will be a significant driver for assessmentresearch and practice in the upcoming years. Computational psychometrics canbe applied to affective, motivational, (meta)-cognitive, collaborative, and psychomotorlearning domains.Reviewing studies under category marked as B, showed how machine-learning algorithms can help schools or facultiesto reach out to students and get them the help they need to be successful as early as possible. Student retention is anessential part of many enrolment management systems. It affects university rankings, school reputation, and financialwellbeing. Student retention has become one of the most important priorities for decision makers in higher educationinstitutions, so there are lot of studies in that category. the Elo-rating method could effectively pairitems′difficulty with learners′proficiency, leading to recommendingrelevant items, and towards developing and scalingadaptive assessment in programming courses. Implementingit in practice, this could help educators to sustain higherlevels of motivation, performance, and engagement amongtheir students, which are critical components for successfuland life-long learning practices.A holistic learningand assessment system have many interdisciplinary componentsin which each individual component is an area for researchand development: from the design, to data structures forbig data, to mobile platforms, recommendation engines, thedevelopment of APIs and psychometric and ranking modelsfor learning. Each of the areas described here includeinnovations, or at least extensions, of existing capabilities.

REFERENCES

1. Jeon, H., Oh, H., & Lee, J. (2018, October). Machine Learning based Fast Reading Algorithm for Future ICT based Education. In *2018 International Conference on Information and Communication Technology Convergence (ICTC)* (pp. 771-775). IEEE.

2. Kučak, D., Juričić, V., &Đambić, G. (2018). MACHINE LEARNING IN EDUCATION-A SURVEY OF CURRENT RESEARCH TRENDS. *Annals of DAAAM & Proceedings*, *29*.

3. Buchanan, R. D., & Finch, S. J. (2014). History of psychometrics. *Wiley StatsRef: Statistics Reference Online*.

4. Carbonell, J. G., Michalski, R. S., & Mitchell, T. M. (1983). An overview of machine learning. In *Machine learning* (pp. 3-23). Morgan Kaufmann.

5. von Davier, A. A. (2017). Computational psychometrics in support of collaborative educational assessments. *Journal of Educational Measurement*, *54*(1), 3-11.

6. Drachsler, H., &Goldhammer, F. (2020). Learning Analytics and eAssessment—Towards Computational Psychometrics by Combining Psychometrics with Learning Analytics. In *Radical Solutions and Learning Analytics* (pp. 67-80). Springer, Singapore.

7. Von Davier, A. A., Deonovic, B. E., Yudelson, M., Polyak, S., & Woo, A. (2019). Computational psychometrics approach to holistic learning and assessment systems. In *Frontiers in Education* (Vol. 4, p. 69). Frontiers.

8. Mangaroska, K., Vesin, B., & Giannakos, M. (2019, July). Elo-rating method: towards adaptive assessment in e-learning. In *2019 IEEE 19th International Conference on Advanced Learning Technologies (ICALT)* (Vol. 2161, pp. 380-382). IEEE.

9. Pelánek, R. (2016). Applications of the Elo rating system in adaptive educational systems. *Computers & Education*, *98*, 169-179.