

Smarter Grants, Fairer Futures: AI in Higher Education Scholarship Distribution

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ABSTRACT: Scholarships and grants are essential tools in promoting equitable access to higher education, particularly for students from low-income households who may otherwise be unable to afford college. With increasing demand for tertiary education and limited financial resources, the challenge of distributing scholarships fairly, efficiently, and transparently has become more complex. Traditional scholarship systems often suffer from delays in processing, limited accessibility, subjective evaluation criteria, and administrative inefficiencies that disadvantage marginalized applicants. This commentary explores the transformative potential of artificial intelligence (AI) and machine learning (ML) in enhancing the scholarship allocation process in colleges and universities. These technologies can analyze large datasets to identify eligible candidates more accurately, streamline application reviews, reduce human bias, and enable real-time tracking and reporting of scholarship outcomes. Moreover, AI and ML applications can help institutions develop predictive models to anticipate students' financial needs, retention risks, and academic performance, making aid allocation more targeted and impactful. The integration of AI in scholarship systems aligns with several United Nations Sustainable Development Goals (SDGs), particularly SDG 4 (quality education), SDG 5 (gender equality), and SDG 10 (reduced inequalities), by promoting inclusive and equitable educational opportunities. However, the use of these technologies also raises critical concerns, including data privacy, algorithmic transparency, and the risk of reinforcing existing biases if not properly regulated. This paper recommends that higher education institutions ethically and effectively harness AI and ML in scholarship management.

KEYWORDS: Artificial intelligence, machine learning, scholarship allocation, higher education, educational equity, algorithmic fairness, data ethics

INTRODUCTION

Scholarships and grants are important for helping more people get higher education worldwide. They are especially needed because more people want to attend college, and many face financial challenges. The globalization of higher education has led to a dual focus: expanding access through mass higher education systems while simultaneously fostering elite, research-oriented institutions [1]. In many developing countries, scholarships are essential for enabling students from disadvantaged backgrounds to pursue higher education, particularly in fields like technology and engineering [2]. Additionally, grant activities are increasingly vital for supporting research initiatives and educational projects, with a notable trend towards interdisciplinary collaboration and international cooperation in grantmaking practices [3]. However, both developed and developing nations face significant challenges in implementing effective student funding systems, highlighting the need for innovative policies to address these barriers [4], [5].

Additionally, the challenge of equitable scholarship distribution is multifaceted, involving economic barriers, structural inequalities, and the need for inclusive policies. Marginalized communities often face significant obstacles, such as limited financial resources and discrimination, which hinder their access to quality education [6]. In India, for instance, scholarship schemes have been critical yet insufficient, with many failing to cover essential costs like maintenance, disproportionately affecting economically disadvantaged students [7]. Furthermore, existing scholarship policies often favor full-time students, neglecting the needs of part-time and nontraditional students, who may have comparable academic outcomes but face unique challenges [8]. To address these inequities, implementing more inclusive scholarship criteria, optimizing distribution processes through management information systems, and ensuring that scholarship programs are designed to meet the diverse needs of all students [9]. A collaborative approach is ultimately necessary to create a more equitable educational landscape [10]. Moreover, the study of Bourg et al., [11] discusses the challenge of equitable scholarship distribution by highlighting the need for generative AI to enhance trustworthiness and integrity in science, aiming to advance open and equitable access to scientific knowledge and resources.

Therefore, this paper explores how AI and ML can transform scholarship allocation systems to be more equitable and efficient, particularly in line with the SDGs. It provides examples, examines challenges, and recommends practical steps for responsible implementation in higher education institutions.

THE PROMISE OF AI AND MACHINE LEARNING IN EDUCATION

AI and ml are increasingly recognized as transformative in higher education, addressing challenges exacerbated by the shift to online learning during the covid-19 pandemic. these technologies enhance personalized learning experiences through intelligent tutoring systems and adaptive learning platforms, which tailor educational content to individual student needs, thereby improving engagement and outcomes [12], [13]. additionally, AI modernizes administrative processes, such as enrollment, admissions, and course scheduling, reducing workload and increasing operational efficiency [14], [15], [16], [17], [18]. moreover, AI and ml are utilized in predicting academic performance [19], [20].

the emergence of AI in decision-making processes, particularly in financial Aid and scholarships, reflects a significant transformation across various sectors, including finance. AI technologies, such as ml and predictive analytics, enhance decision-making by enabling institutions to analyze various datasets, identify patterns, and generate actionable insights with unprecedented speed and accuracy [21], [22]. this capability is particularly beneficial in financial contexts, where AI can optimize risk assessment, improve fraud detection, and personalize financial services, thereby streamlining operations and enhancing user experiences[23], [24].

APPLYING THE K-NEAREST NEIGHBOR ALGORITHM TO SUPPORT KIP SCHOLARSHIP RECIPIENTS IN INDONESIA

a good example of how ml can help scholarship systems is the study done by prahmana et al. [25] in indonesia. the researchers used the k-nearest neighbor (knn) algorithm to help new college students who received the kip lecture scholarship. this scholarship is for students from low-income families, and it helps them pay for college and living expenses.

many of these students find it hard to choose the right course because they may not have enough information or support. the researchers used data such as exam scores, interview results, and poverty level to help predict the best study program for each student. the machine learning model, knn, looked at students with similar backgrounds and recommended the most suitable course. this system helped students pick between study programs like information systems and informatics engineering at stmik kaputama. this method gave students recommendations that matched their interests and academic strengths. the results showed that this kind of AI system could make advising students more helpful, especially for those from underprivileged communities.

this example shows how ml can improve decision-making for scholarship students by giving financial Aid and helping them succeed academically. it also proves that AI can be used in real situations to support education goals and help meet sustAInable development goals like Sdg 4 (quality education) and Sdg 10 (reduced inequalities).

MAPPING AI-DRIVEN SCHOLARSHIP SYSTEMS TO THE SDGS

fig. 1 shows how using AI in scholarship allocation supports the sustAInable development goals (Sdgs). it maps how different parts of an AI-based scholarship system—like fAIr selection, data-driven decisions, and bias reduction—can help achieve goals such as quality education (Sdg 4), gender equality (Sdg 5), and reduced inequalities (Sdg 10). this figure helps show that AI is not just about using technology, but also about making education fAIr and open for everyone.

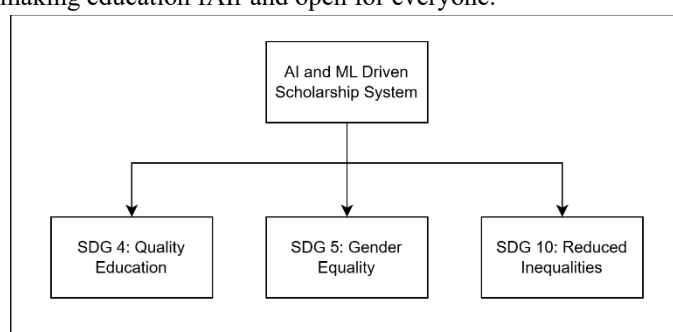


Fig. 1 Mapping AI-Based Scholarship Allocation to SustAInable Development Goals

SDG 4: QUALITY EDUCATION

improving access to higher education for underrepresented groups requires a comprehensive approach that tackles systemic issues and encourages inclusivity. studies show that marginalized groups, such as african american/black students, students with disabilities, and refugees, face major challenges like money problems, lack of support services, and programs that are not welcoming to them, which makes it harder for them to succeed in school [26], [27]. effective strategies include implementing student ambassador programs, which provide peer support and mentorship, fostering a sense of belonging, and enhancing retention rates among disadvantaged students [28]. additionally, blended learning models have shown promise in accommodating diverse learning needs, particularly for those in remote or marginalized communities, by combining online and in-person educational experiences [29].

while access to quality education is a central issue, fAIrness in how educational support is distributed—particularly across gender lines—is equally important.

SDG 5: GENDER EQUALITY

the application of AI in detecting and countering gender bias in scholarship award selection is increasingly recognized as a vital tool for promoting equity in higher education. research indicates that AI can effectively analyze student application data to identify potential biases in decision-making processes, as demonstrated by austin's study, which utilized algorithms to uncover human biases in scholarship recipient selection [30]. furthermore, the analysis of gender differences in the AI publication world reveals systemic disparities, such as citation differences and co-authorship patterns, which underscore the need for equitable practices in academic recognition [31]. additionally, AI has been employed to assess gender bias in letters of recommendation, highlighting linguistic disparities that can influence candidate selection, thus reinforcing the importance of AI in fostering fAIr evaluation criteria [32]. utilizing AI technologies can help institutions implement quantitative frameworks to mitigate bias and enhance diversity in scholarship awards.

SDG 10: REDUCED INEQUALITIES

prioritizing underserved communities for scholarships through data-driven insights involves leveraging advanced analytics and community engagement to address systemic inequalities. research indicates that integrating data mining techniques, such as decision trees and clustering algorithms, can streamline scholarship application processes and enhance decision-making, ultimately benefiting underprivileged students [33]. additionally, a holistic approach is essential; financial AIId alone is insufficient without addressing barriers like access to learning materials and student well-being [34]. furthermore, employing decision support systems can optimize scholarship selection by analyzing various criteria, ensuring that AIId reaches those most in need [35]. finally, utilizing disaggregated data through community partnerships can inform equity-oriented initiatives, fostering a more inclusive scholarship framework that addresses the unique challenges faced by marginalized groups (kAIIda et al., 2023). this multifaceted strategy underscores the importance of data-driven insights in promoting educational equity.

ADVANTAGES OF AI/ML IN SCHOLARSHIP ALLOCATION

integrating AI and machine learning (ml) in scholarship allocation offers significant advantages, particularly in enhancing the accuracy of predicting student success and financial need. various ml algorithms, such as decision trees and k-nn, have accurately identified candidates deserving of scholarships based on their academic performance and other relevant metrics [36]. furthermore, analyzing large datasets allows institutions to predict student performance effectively, which can help prevent dropouts and guide prospective students towards fields where they are likely to excel [37]. additionally, employing feature importance techniques enables the identification of key factors influencing scholarship eligibility, thereby refining the selection process and improving institutional reputation [38]. AI and ml streamline the scholarship allocation process and provide data-driven insights that enhance decision-making and optimize resource allocation [39]. the study of ismAIId et al. [40] states that machine learning models, particularly mlp-ann, significantly improve accuracy and precision in predicting financial AIId eligibility, thereby enhancing the decision-making process for scholarship allocation and ensuring fAIr access to financial resources for students. integrating AI-driven recommendations enhances scholarship allocation by accurately predicting student qualifications and financial needs [41]. also, the AI student success predictor enhances scholarship allocation by accurately predicting student success and financial need through advanced machine learning algorithms, achieving 93% accuracy in grade prediction and 92% in retention forecasting, thus enabling more informed and effective decision-making [42].

Table I. Common Problems in Traditional Scholarship Allocation and How AI/ML Can Address Them

problem in the traditional system	how AI/ml can help
manual selection prone to human bias [43]	AI models can use neutral data to recommend deserving students
limited reach to marginalized groups[44]	ml models can identify patterns in underserved populations
slow processing of applications[45]	automated systems can evaluate applications faster
lack of transparency in decision-making [46]	explAIInable AI can show why a student was accepted or rejected

one-size-fits-all criteria [47]	AI can customize decisions based on a variety of student data
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table i shows the common problems in traditional scholarship systems and how AI or machine learning can help solve them. one big problem is that manual selection is often influenced by human bias. this means people may give scholarships based on personal opinions or unfAIr reasons. AI can help by using data to choose students in a more neutral and fAIr way. another issue is that many scholarship programs do not reach students from poor or rural areas. with AI, schools can use data to find and support those who are usually left out. also, the traditional process takes a long time. reviewing many applications by hand is slow, but AI can make it much faster by automating the steps. sometimes students do not understand why they were not selected. AI systems can be designed to give clear explanations, so students know how the decision was made. lastly, many programs use the same rules for all students, which may not be fAIr. AI can look at different student situations and give more personalized decisions. overall, AI and machine learning can make scholarship distribution faster, fAIrer, and more inclusive.

ETHICAL, TECHNICAL, AND INSTITUTIONAL CHALLENGES

using AI and machine learning in scholarship allocation has many benefits, but also brings important challenges. one major concern is bias [48]. if the data used to trAIIn the AI system mostly includes students from well-known schools or wealthy families, the system might give less importance to students from poor or rural areas. this makes the process unfAIr instead of helpful. another issue is privacy [49]. AI scholarship systems need personal information like grades, income, and school history. students and their families should know how this data is collected and used. institutions must protect this data and ensure students agree before using their information. also, AI decisions must be easy to understand. if a student is rejected, there should be a clear explanation. students may lose trust in the system if the AI acts like a "black box" and no one knows how it makes decisions. there are also technical problems. some schools or universities do not have the equipment, internet connection, or trAIIned staff to run AI systems properly. they may need to hire experts or work with outside companies, which can be expensive. lastly, some schools may not be ready for change. teachers and staff may not trust technology or fear it will replace their jobs. the AI system might not work well or be accepted without good leadership and planning.

POLICY AND INSTITUTIONAL READINESS

before schools or universities use AI in their scholarship systems, they must prepare through good policies and planning. these policies should clearly explAIIn how the AI will be used and how it will treat all students fAIrly. schools must also have rules for protecting student information and checking the AI system regularly to ensure it works properly. trAIIning is also important. staff and faculty need to learn how AI works and how it affects scholarship decisions. this includes people from different departments like it, administration, and even social sciences. everyone must understand both the technology and the ethical responsibilities that come with it. creating a special team or committee that will manage and monitor the AI system is helpful. this group should include people with different skills, such as technology, law, education, and ethics. they will help ensure the system is fAIr, safe, and matches the university's goals. finally, the school needs the right technology and infrastructure. this means having computers, internet, and software that can support AI. without these, it will be hard to use the system properly, no matter how good the plan or policy is.

RECOMMENDATIONS AND ROADMAP FOR HEIS

here are some important recommendations to help schools and universities use AI fAIrly and helpfully. first, they must make sure that the data used by the AI includes students from different backgrounds—rural and urban, rich and poor, male and female. this helps avoid bias. in short, a balanced dataset in trAIIning must be utilized. second, the AI system should be designed to be fAIr and easy to explAIIn. if a student is selected or rejected, there should be a clear reason that people can understand. explAIInability in machine learning means that the reasons behind a decision should be understandable to everyone, not just data scientists. if students can see how their applications were evaluated, they are more likely to trust the process. this trust is crucial; students must believe that the system is fAIr and that their hard work has been considered appropriately. third, there should be a set of rules or guidelines that explAIIn how the AI will be used. a committee can help check the system, manage problems, and make sure it follows ethical standards. fourth, schools should involve students and teachers when designing and testing the system. their feedback is important to ensure the system is useful and respectful to all users. fifth, schools must allow students to appeal AI decisions. if a student disagrees with the result, a human should review it.

sixth, training staff to use and manage the AI system is important. staff should work together across departments to ensure the system fits well into the scholarship process.

seventh, schools should start small, maybe by testing the AI on one type of scholarship. after learning from this, they can expand it to more programs.

lastly, schools should try to connect their AI work with the sustainable development goals (Sdgs). they should check how their scholarship system helps promote quality education, gender equality, and reduced inequalities. this shows that the AI system is not only about saving time but also about making education fair and inclusive for all.

CONCLUSION

AI and machine learning can change how scholarships are given in higher education. these tools can help schools make better decisions by using data to find students who need support. this can help reduce unfairness, improve access to education, and support the goals of giving equal chances to everyone. but using AI is not always easy. there are problems with bias, privacy, and trust that schools must be careful about. schools need strong policies, trained staff, and the right technology before using AI. it is also important to include students, teachers, and other people in designing these systems, so that everyone's needs are considered. schools can progress by starting small and ensuring the AI system is fair and easy to understand. most importantly, AI in scholarship allocation should always support giving all students a fair chance to succeed in education and life, regardless of background.

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