On Taiwan universities' "two-one" academic dismissal policies: A quantitative fairness analysis of NCCU's four policies

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Abstract

Academic dismissal policies are commonly used by universities worldwide as a measure of quality-control. Taiwanese universities base their policies solely on the credit fail rate (CFR) in individual semesters, or S-CFR. The most common S-CFR used is 50%, called *er-yi*, literally "two-one", meaning the failing of half or more of the credits taken in a semester. Though actual policies vary among universities, the core design crucially relies on the concept of S-CFR. This study first compares dismissal policies between universities in the U.S., the Netherlands, and Taiwan, to demonstrate how the "two-one" design lacks processes of consultation and review. We then argue that the disregard of cumulative GPA (C-GPA), semester GPA (S-GPA), and the cumulative credit pass rate (C-CPR) may lead to biased consequences, as students with relatively, but clearly, better overall academic performance are dismissed. We further validate the rational arguments with a quantitative analysis of the data of students' academic performance (N = 22,703) from National Chengchi University over 11 years with three different policies. Evidence found strongly suggests that the core design common in such policies, i.e., the S-CFR, should be reconsidered.

Keywords: Academic dismissal policy, University education, Semester credit fail rate (S-CFR), Quantitative analysis

1 Introduction

Academic dismissal policies of universities in Taiwan are based on three factors. The first and the most important factor is the credit fail rate (CFR) in a semester (S-CFR), and the most widely used S-CFR is 50%, known as *er-yi*, literally "two-one" in Mandarin Chinese (Her & Lin, 2017, p.99). Some universities also use *san-er* (literally 'three-two'), meaning the failing of two thirds or more of the credits taken in a semester. The S-CFR *san-yi* (literally 'three-one'), i.e., failing one third or more of the credits taken in a semester, is attested but rare.

Secondly, dismissal policies may also vary in the number of failing semesters considered, which ranges from one to three semesters. Before the 1990's, all universities in Taiwan were imposed a common policy by the Ministry of Education (MOE).[1] This policy was based on a single *two-one* S-CFR, i.e., a student was dismissed if s/he failed one half or more of the total course credits taken in any semester (Her & Lin, 2017, p.80). Nowadays, only the military and police academies have maintained such a policy. The majority of other Taiwanese universities now have dismissal policies based on the S-CFR of two semesters, which means that a student is dismissed is s/he fails the stipulated S-CFR for two semesters. Some universities also have policies based on S-CFRs of three semesters.

The third important factor that affects the severity of a dismissal policy is, in cases where two or three failing semesters are considered, whether the semesters are consecutive or cumulative. As an example, dismissal policies based on two S-CFRs of two-one come in two different varieties, with very different consequences. In one variety, dismissal occurs only if the two failing semesters are consecutive, which means students are allowed to have two or more failing semesters, as long as no two failing semesters are adjacent. In the other variety, a student is dismissed if s/he fails any two semesters cumulatively. Thus, the record of a failing semester can never be cleared in the cumulative system, whereas in the consecutive system such a record is cleared immediately following a non-failing semester. Most Taiwanese universities now use the consecutive system, which understandably is considered much more lenient than the cumulative system.

As a summary, academic dismissal policies generally involve three factors. First, the stipulated S-CFR may vary among *two-one*, *three-one*, and *three-two*; second, the number of semesters considered may vary among one, two, and three semesters; and third, in cases involving two or more semesters, are the semesters counted consecutively or cumulatively? The strictest policy commonly perceived is a single *two-one* S-CFR, which means that a student is dismissed if s/he fails more than half of the taken credits in a single semester. The most lenient policy is three consecutive *three-two* S-CFRs, i.e., a student is dismissed only if s/he fails two-third or more of the semester credits three times in a row.

[1] The nation-wide policy was stated in the MOE directive *Common Guidelines in Treating University Student Status*, which was abolished in 1998.

In spite of the broad and apparently drastic variations in terms of the three factors, such policies are widely viewed, in academia and in society alike, as a fair and just mechanism to weed out the students with the weakest performance. Such a view, though hardly substantiated, is especially strong among university administrators and teachers, while the majority of students are rather indifferent to the academic dismissal policies, as only a very tiny percentage of students ever come close to the edge of being dismissed (Her & Lin, 2017, p.97; Her, Tsai, Lin, & Yeh, 2021, p.94). Nevertheless, since the Taiwanese society has traditionally been under a significant Confucian influence that places heavy emphasis on education, being dismissed from university due to poor academic performance carries a serious stigma. Such a stigma may have grave consequences socially and psychologically, as there have been a fair number of student suicides related to academic dismissal (Her & Lin, 2017).

There have also been court cases where the dismissed students challenged the university's action, but always to no avail, as the court inevitably cites the principle of university autonomy and ruled against interference. Specifically, the constitutional court's Interpretation No. 563 in 2003 has made clear that universities' policies of academic dismissals are within the university rights to autonomy. Consequently, there are some articles in local law journals discussing the constitutionality of academic dismissals (Her & Lin, 2017; Her et al., 2021). Such court cases and law articles, though having little to do with the examination of the (un)fairness of the individual dismissal policies, are nonetheless considered as endorsements for the dismissal policies and have further enhanced the perception that the dismissal policies are not only legal but also fair and reasonable.

The status quo was somewhat jolted at the end of 2011 when National Taiwan Normal University (NTNU) announced the abolishment of its academic dismissal policy. In 2017, an academic article appeared in the country's leading journal in education, *Bulletin of Educational Research*, and for the first time challenged the constitutionality of the dismissal policies from an educational perspective, arguing that such policies are unfair and counterproductive and thus against the very purpose of university education (Her & Lin, 2017). The status quo was again shaken in 2019 when the news broke that National Chengchi University (NCCU) also abandoned its academic dismissal policy. To date, according to our own survey, 23 universities and colleges abolished their academic dismissal policy, while some 140 institutions of higher education still maintain such a policy.

These recent changes have motivated research from an educational perspective to investigate the effects of such policies. Keng (2016), using actual data from a national university in southern Taiwan, finds that under a stricter policy, students tend to select courses that are less demanding, and teachers also tend to be more lenient in grading the students on the edge of failing. More importantly, a recent empirical study by Her et al. (2021) has demonstrated that such policies are hardly reasonable or appropriate because the

students dismissed may not be the ones with the poorest academic performance compared with their peers. Other studies have also demonstrated that the disparity in dismissals generally disfavors students with financial burdens, freshmen and sophomores, transferred-in students, and students with heavier course loads (Li, Wu, & Chin, 2018; Lin, Wu, & Chin, 2018; Tao, Wang, & Wang, 2018; Wu & Tao, 2018). However, to the best of our knowledge, no studies have ever done a comparison of Taiwan's policies with those in the higher education of other countries to see if there are areas of weakness in the former. This is the gap we aim at filling in the current study. In addition, we will also further explore the academic performance data employed in Her et al. (2021) and reanalyze it using more advanced quantitative methods to examine the fairness issue in academic dismissals. Due to the limitation of space and the scope of the paper, for more discussions on the earlier views in terms of the legality and constitutionality of academic dismissal policies, please refer to Her and Lin (2017), Her, Lin, and Lin (2019), and Her et al. (2021).

This study addresses the following two research questions, which represent qualitative argumentation followed by empirical quantitative evidence. First, can a comparison between Taiwan's "two-one" dismissal policies and dismissal policies of other countries such the US and the Netherlands inform us on the unfairness and shortcomings in the former? Second, can quantitative methods such as PCA and k-means clustering reveal a more global picture of the unfairness inherent in the "two-one" dismissal policies?

The organization of the sections in this paper reflects the logic behind our argumentation, which can be summarized as follows. We take it for granted that fairness and honesty are universal values in a democracy; therefore, all universities, big or small, public or private, in a democratic country must honestly consider the fairness issue in dismissing students from university. A student's academic performance, whether brilliant or dreadful, involves complicated circumstances that cannot and, should not, be simple-mindedly reduced to the student's own merits or faults alone (Her & Lin, 2017). Thus, before bestowing an exceptional honor or issuing an ultimate punishment of dismissal, a review by an independent panel to oversee the fairness issue and the circumstances involved is only prudent and appropriate, if not absolutely necessary. In section 2, we first offer a broad comparison of universities' practice of academic dismissals between the US, the Netherlands, and Taiwan, pointing out that the lack of such a review process prior to the dismissal punishment is a distinctive feature of Taiwan's dismissal policies with a rigid *two-one* design.

Furthermore, in universities worldwide, including Taiwan's universities, the most common way to measure students' academic performance is via the grade average points (GPA) and sometimes also the credit pass rate (CPR). Thus, dismissal policies where students with better academic performance in terms of GPA and CPR are dismissed cannot be seen as fair. We provide a rational argumentation to demonstrate how Taiwan's S-CFR-based *two-one* design is inherently unfair due to its total failure to take into account students' semester cumulative grade average points (S-GPA), cumulative grade average points

(C-GPA), and cumulative credit pass rate (C-CPR). In section 3, we verify the rational analysis in section 2 with a quantitative analysis based on large-scale longitudinal data from a major university in Taiwan.

Section 4 discusses why our argumentation in section 2 as well as the results of this quantitative analysis in section 3 can be applied across the board to all *two-one* policies in Taiwan. In section 5, we offer some concluding remarks and urge universities to reexamine their *two-one* dismissal policies and seriously consider following the example of NCCU and NTNU to replace such policies with a constructive mechanism of advising and consultation.

2 Academic dismissal policies in the US, the Netherlands, and Taiwan

In the comparative analysis, we select academic dismissal policies from the US, Europe (being represented by the Netherlands), and Taiwan. We have chosen the US because of its great influence on Taiwan in nearly all aspects of society and culture. In Taiwan's higher education in particular, a great portion of university academics have graduate degrees from foreign universities and the US is by far the number one country. Higher education authorities and university administrators thus often look to the US for inspiration and justification for perspective and existing educational polies. Thus, a comparison of such important educational practice as Taiwan's academic dismissal policies with other countries', the US is arguably a necessary inclusion (Chen, 2017; Chou, 2000; Hsu, 2018).

The research team then decided that an European perspective should likewise be conducive to the discussion as it would provide a more balanced view to the comparison with the US. We have ultimately chosen the Netherlands because it stood out in our survey among the countries in the European Union for having a national policy on academic dismissals from universities. As mentioned in the introduction, before the 1990's, Taiwan's MOE also had a national policy of dismissal from university based on a single two-one S-CFR (Her & Lin, 2017, p.80). Given such similar practice of a national mandate, the potential differences between such policies should be enlightening (Chang, 2015).

While this sample of two countries is far from being balanced and surely does not cover all the possible academic dismissal policies worldwide, it provides a short overview of the variation found across countries, which is considered sufficient for the paper at hand. Furthermore, the dismissal policies of Taiwanese universities have already been summarized in the previous section. Thus, we only introduce the policies of the US and the Netherlands in this section. Then, we compare the policies of the US, the Netherlands, and Taiwan. We shall focus on these factors: whether the dismissal criteria are rigid or flexible, whether the dismissal is temporary or permanent, and whether a review by a panel is required prior to dismissal.

The academic dismissal policies of most American universities allow some flexibility and the law requires the due process of notice and hearing before depriving a student's rights in education (Grindle, 2009). For example, the policy of Harvard University has the Administrative Board review a student's unsatisfactory record at the end of every term. The Resident Dean should provide a description of the student's situation, which is analyzed based on conversations with the student, the feedback of the course instructors, and the student's adviser.[2] The Resident Deans make up the majority of the board members, which also include teachers and senior administrators. A student with an unsatisfactory record may be issued a warning, placed on probation, or required to withdraw. A student on probation is relieved of probation at the end of the following term if satisfactory records are provided. However, a student placed on probation for the second time or failing to meet the minimum requirements may be required to withdraw for two terms.[3] A student required to withdraw for the second time is in effect dismissed, as re-admission is usually no longer permitted.

What is known as 'withdraw' at Harvard is called being 'dismissed' in the University of California at Berkeley. A student with a) a S-GPA below 1.5 or b) a C-GPA below 2.0 or c) no letter grades in a semester, is placed on probation at the end of the semester.[4] A student on probation must earn at least a 2.0 S-GPA and a 2.0 C-GPA from UC in the next semester to clear probation. A student failing to clear probation will be examined by the Dismissal Review Committee and receive one of these three decisions: dismissed, on probation for another semester, or less commonly, decision pended. During the decision process, the following factors are taken into consideration: the student's academic history, notes from the advisers, trends toward improvement, struggles in particular subjects or directions, and the likelihood to graduate in the next semester. Also, it is stressed that 'dismissal' does not mean being 'kicked out' permanently, as readmission is granted if specific criteria are met, including meeting with a college adviser and attending another institution full-time for at least two semesters or three quarters and earning B grades or better.

The last American university whose academic dismissal policy we shall review is Stanford University.[5] The closest concept to dismissal at Stanford is 'suspension'. However, there are two prior stages leading up to suspension: probation and provisional registration. A student is placed on probation if s/he fails one of the three minimal requirements: a) earn at least 9 credits in a single quarter, b) earn at least 36 credits over three consecutive quarters, and c) maintain a C-GPA of 2.0 or above. Students are removed from probation

[2] See https://handbook.fas.harvard.edu/book/administrative-board-harvard-college, Harvard College Handbook for Students 2020-2021.

[3] The minimum requirements are listed as follows. First the student needs to pass at least two courses, one of which must be towards a degree and with a letter grade. Moreover, the student should not have failed more than one course.

[4] See https://lsadvising.berkeley.edu/academic-difficulty/academic-probation, UC Berkeley, College of Letters and Science.

[5] See https://undergrad.stanford.edu/planning/academic-policies/academic-progress, Academic Progress, Stanford Undergrad.

by earning a minimum of 12 credits of new course work and maintaining a C-GPA of 2.0 or better for three consecutive quarters. A student failing to clear probation is placed on provisional registration. Students are removed from provisional registration by earning at least 12 credits of new course work and maintaining a C-GPA of 2.0 or better for three consecutive quarters. A student failing to clear provisional registration is suspended. Suspension is typically for one year the first time, but subsequent suspensions may be for up to three years. However, a student with a prior probation record may also be placed directly on provisional registration or suspended; a student on probation may also be suspended directly. Importantly, a student who wishes reconsideration of a decision or wishes to submit a grievance relating to a matter of academic policy can discuss the situation with an Academic Advisor to initiate the due process.

With regard to the Netherlands, most universities have explicit academic dismissal policies at the end of the student's freshman year, which are enforced via the common means authorized by law known as the 'binding study advice' (BSA). A negative BSA is issued to students who are unable to meet the threshold of academic performance at the end of their freshman year. Such students are then required to leave the program, but not necessarily the university, as they may be admitted to a different program of the same university (Arnold, 2015). The threshold is usually to pass three quarters of the taken courses, which are generally between 42 and 48 credits. Thus, the threshold is largely based on C-CPR. However, the actual BSA-norm varies among universities, ranging from 15 credits to the maximum of 60 credits.[6] A negative BSA is accompanied with student counseling and frequent information provision to students at an early stage. If the program's threshold is relatively high, the students are often allowed an extra reset or the use of the good mark of a course to compensate for an unsatisfactory result.[7] During the decision process of the BSA, the institution's executive board is required to take the student's personal situation, either private or at the institution itself, into consideration.[8] Note also that students enrolled in more than one program receive a separate BSA for each respective program.[9]

The Dutch BSA system, like the Taiwanese dismissal policies, has been under scrutiny in recent years, and studies on both systems likewise indicate mixed effects due to the enforcement of such policies. On the one hand, the introduction of the BSA can improve the performance of learning activities; however, it does not result in more self-study time of the students (de Koning, Loyens, Rikers, Smeets, & van der Molen, 2014). Similarly, in Taiwan, study time and in-class attendance rates can increase significantly after a stricter dismissal policy is implemented (Keng, 2016). A study by Vooijs, Van de Ven,

[6] See https://www.lde-studentsuccess.com/research-findings/educational-policy/binding-study-advice

[7] See https://vsnu.nl/en_GB/bsa, the Association of Universities in the Netherlands.

[8] See https://dutchstudentunion.nl/info/education/binding-study-advice/, Dutch Student Union.

[9] See https://www.eur.nl/en/eshcc/examination-board/binding-study-advice, Erasmus School of History, Culture and Communication.

and Buitendijk (2015) also suggests that students seem to adopt their study behavior to the BSA-norm. Under a stricter norm, more credit points are earned by the students, but the drop-out rates remain the same. However, the positive change in study behavior due to the dismissal policy can be attributed to an external motivation to avoid dismissal, but external motivations are known to have a crowding effect on internal motivations and may be harmful in the long term (Atiq, 2014; Wrzesniewski et al., 2014). Arnold (2015) also demonstrated that the BSA policy, as expected, significantly increased both the first-year dropout rates and the completion rates of first-year survivors, but did not solve the problem of student dropout as the overall completion rates remained the same. Moreover, while the BSA-policies force students to exit the program, most remain in the same academic domain or re-enroll in the same program elsewhere (Cornelisz, van der Velden, de Wolf, & van Klaveren, 2019). Moreover, the BSA generally results in an increase of graduation rate and student satisfaction regarding program feasibility, but a decrease of student satisfaction overall (Sneyers & De Witte, 2017). Likewise, in Taiwan, student dropouts have shown an alarming upward trend in the past decades (Jian, 2021), regardless of the implementation of dismissal policies. As a summary, no clear benefits of the BSA policy or the Taiwanese dismissal policies are found. This begs the following question: should a dismissal policy with no clear benefits continue to exist?

Furthermore, in comparison to the practice in the US and the Netherlands, several traits in Taiwan's practice stand out, which further motivate our close examination of Taiwan universities' academic dismissal policies. First, S-CFR-based policies in Taiwan universities are extremely rigid. Once a student crosses the stipulated red line, dismissal is automatic. Second, a dismissed student must leave both the program and the university permanently. Third, there is no academic probation prior to dismissal in Taiwanese universities, which is also surprising given its common practice in most universities in the US, and also in South Korea, a neighboring country (Yang, Yon, & Kim, 2013).

Fourth, this is even more surprising given the fact that in cases of disciplinary actions resulting in a major demerit, a dismissal, or an expulsion, a hearing by a committee is not only allowed, but in fact mandatory, prior to the disciplinary action. In the case of academic dismissals, even when an appeal is filed after the dismissal, a hearing is not required by law, and the university's Student Appeals Review Committee can simply reject the appeal without a hearing. Decisions of reversal are thus extremely rare. Taking NCCU as an example, only 6 cases over 75 appeals heard in the last fifty years resulted in a decision to overturn the dismissal.[10] In all these cases, the reason for the overturn was that the student in question became legally disabled in the course of study, and, by law, i.e., the University Act, the legally disabled are exempt from academic dismissal.

[10]This de-identified information was provided to the first author by NCCU's Office of Student Affairs in January 2020.

Last but not least, the policies of individual universities in Taiwan have not been stable at all in the past three decades. Due to the serious stigma of academic dismissals and also the impact of NTNU's abolishment of its academic dismissal policy, most universities, except the military and police academies, arguably the most conservative higher education institutions, decided to relax their dismissal standards. NTU, for example, did so twice, and NCCU did so twice as well before abolishing its dismissal policy in 2019. Such changes must by law be decided by the university council meeting. However, justification and reasoning for either the old policy or the more lenient new ones are hardly ever openly explained to the student body. Likewise, in academic journals, no articles known to the authors explicitly argue for the academic dismissal policies from an educational perspective. Thus, one can only derive the conclusion that the various dismissal standards are simply arbitrary. Such a gap in research is utterly astonishing, given the severity of the punishment and the long history of these dismissal practices.

Before developing the quantitative analysis, we also use rational argumentation to demonstrate that the past and current academic dismissal policies in Taiwanese universities based on the concept of S-CFR are highly questionable and inevitably unfair. First of all, the core design of such policies totally disregards a student's overall and cumulative academic performance in terms of the well-established standards of grade point average (GPA), whether being cumulative (C-GPA) or by semester (S-GPA), as well as the cumulative credit pass rate (C-CPR). As a consequence, the student's current standing in the progress towards the degree is completely ignored (Her & Lin, 2017). For instance, in 2014, NCCU had a cumulative *two-one* and *three-one* dismissal policy. That is to say, a student is dismissed if s/he fails more than half of the credits taken in a semester and then fails again one third of the credits taken in any subsequent semester. In June 2014, as the school year came to an end, an NCCU senior law student committed suicide for fearing dismissal, as he had a *two-one* S-CFR record from his freshman year and was threatened by a *three-one* S-CFR in the second semester of his fourth year. This student, had he been given another semester or two, could have easily completed his degree, as, after all, a student is allowed by law to have up to six years towards a bachelor's degree. Recall the dismissal policy of UC Berkeley, which specifically considers the likelihood for the student to graduate in the next semester. Had this student been with UC Berkeley, most likely he would have graduated with a law degree. Imagine also the constant fear of dismissal this NCCU student had to live with after his *two-one* record in the first year of his university life. After this tragic event, the administrative heads of the College of Law urged the university council to abolish, or at least to re-examine, the dismissal policy. After long and intense deliberations, the council's decision was not to abolish but to again revise and relax the policy to be two consecutive two-one or three cumulative three two-one. Again no justification for this new policy was given. The only consensus was that fewer dismissals would occur under this new policy. The fairness issue never came up.

Note that the concept of credit fail rate (CFR) or the reverse concept of credit pass rate (CPR) is of course a useful one in university education. After all, a university degree is awarded to a student based on the total number of credits s/he has successfully earned. In Taiwan, that number is most commonly 128. Thus, a student with a higher CPR in general, hence a lower CFR, is making better progress and is thus more likely to get a diploma in due course. However, it is crucial to distinguish between the semester CPR (S-CPR) and the cumulative CPR (C-CPR), as the C-CPR is undoubtedly a much more meaningful tool in predicting the student's likelihood of reaching the threshold of 128 credits. The complete line-up of individual S-CPRs in the student's study history is useful in showing the overall trend of the student's performance, but the failing S-CPR, or S-CFR, be it *two-one*, *three-one*, or *three-two*, of one or two semesters considered in total isolation, i.e., completely oblivious of the successful performance in all other semesters, is a rather poor indicator of either the overall performance or the trend of performance.

A dismissal policy can only be justified constitutionally as a reasonable and necessary mechanism of academic quality control (Her et al., 2019), and as such its standard can in theory involve one or more measures. Given its grave consequence of depriving certain students' right to education, the standard set by a dismissal policy must also be in line with the spirit and goal of a university education. The traditional dismissal policy imposed by the MOE, where a single measure of a single occurrence of a *two-one* S-CFR triggers dismissal, is by now generally viewed as simple-minded and harsh and has thus been abandoned by nearly all universities except institutions such as the military and police academies. Most universities have switched to a more sophisticated strategy. It is well recognized that the three kinds of assessment strategies, i.e., disjunctive, conjunctive, and compensatory, all have their advantages and disadvantages (Haladyna & Hess, 1999). A conjunctive strategy of dismissal policies is the most common by now, where two or three conditions must be met for dismissal. For example, NTU's current dismissal policy involves three conditions: 1) a *two-one* S-CFR, 2) a *three-one* S-CFR, and 3) the *three-one* semester immediately following the two-one semester. All three are necessary conditions and conjunctively form the standard of dismissal. Some universities have a mixed strategy of conjunctive and disjunctive measures, e.g., two consecutive *two-one* S-CFRs or three cumulative *two-one* S-CFRs, which was NCCU's dismissal policy before abolishment. While the two sets of measures are both conjunctive, each set serves disjunctively as a sufficient condition for dismissal. Oddly, no universities in Taiwan care enough about the students' overall academic performance to employ a compensatory strategy that focuses on total performance summing the scores of GPA (both S-GPA and C-GPA) and C-CPR. Yet, when universities rank students' academic performance, without exception it is the total performance revealed by the C-GPA. The disregard of a student's overall performance and his/her individual circumstances is thus not only a clearly identifiable characteristic in the core design of the dismissal policies.

A serious consequence of dismissal policies based on such a narrow criterion of the S-CFR of one or two semesters is the predictable unfairness inherent in such policies. We shall first offer a few hypothetical but realistic cases. We have purposely chosen NTU and Aletheia University, two Taiwanese universities that have drastically different dismissal policies. NTU's current policy is two consecutive semesters with *two-one* and *three-one* S-CFRs. For example, assuming that student A and student B of NTU have exactly the same performance in all regards, except that A has a record of *two-one* and *three-one* S-CFRs, but B has the same record with the opposite order, thus *three-one* first followed by *two-one*. Arguably, A's *two-one three-one* order suggests an upward trend, while B's *three-one two-one* order indicates a downward trend. Yet, A is dismissed, not B. It seems rather unfair to dismiss a student with an upward trend of performance while keeping a student with a downward trend of performance.

Now consider Aletheia University's dismissal policy: a student is dismissed if s/he fails all courses in a semester by receiving a zero grade in every course. No doubt one must think that such a standard is rather loose. Yet, ironically, a student dismissed under Aletheia's policy would not be dismissed in NTU. Why? Because under NTU's consecutive *two-one three-one* policy, a semester of all courses with a zero grade is simply seen as a *two-one* (failing half or more of the credits taken). As long as the student does not have a *three-one* S-CFR in the following semester, the previous *two-one* record (including the record of all courses all zero points) is wiped clean. In fact, the NTU policy allows a student to fail all courses in a semester up to six times within the six years allowed by law, as long as none of these semesters is immediately followed by a *three-one* semester. The NTU's policy is thus in some ways much more loose than that of Aletheia's. Moreover, consider two Aletheia students, A and B. A took only one course in the semester and received a final grade of zero; B, however, took five courses in the semester and at the end received 1 point from one course and zero from all other four courses. A is dismissed, B is not. This, again, is utterly biased, as a student failing one course is kicked out but another student failing five courses are allowed to continue.

Numerous such hypothetical but realistic examples of unfairness can be conjured up, and the potential unfairness inevitably arises from the blind spots inherent in a dismissal policy only concerned with the S-CFR of one or two or three semesters, whether in a row or cumulatively. Consider this scenario. A third-year student in a Taiwanese university is the only student in a class of 80 students to be dismissed due to a "two-one" policy. Do the 79 continuing student all have better C-GPA than the dismissed student? Do they all have better C-CPR and have earned more credits than the dismissed? Surprisingly, no universities have ever considered such important questions and nor have any researchers. If there are indeed students among the 79 continuing classmates with worse overall academic performance than the dismissed student, is it fair to have dismissed the one student who was simply unlucky? In the following

sections, we will demonstrate with a quantitative analysis of actual data that unfair dismissals are indeed the harsh reality.

To date, Her et al. (2021) remains the only study in the literature that has addressed this fairness issue empirically using basic descriptive statistics of GPA and CPR. It has shown that unfair cases can and do happen, as some best-performing dismissed students have better GPA and/or CPR than some worst-performing not-dismissed students. In the next section, we further examine the fairness issue based on academic performance of students in the same set of data by using quantitative methods (i.e., PCA and k-means clustering). The performance of students is used to classify the dismissed and not-dismissed students more precisely and to reveal a more global picture of the unfairness inherent in such "two-one" dismissal policies.

3 A quantitative case study of dismissal policies in Taiwan

We used data from NCCU, which currently has 10 colleges, 34 departments, 48 graduate institutes, with around 9,700 undergraduate students and 6,500 graduate students. In the past 75 years, the original single two-one policy was relaxed twice before the university abolished academic dismissals entirely in 2019. This four different stages in terms of dismissal policies are summarized below.

- Stage 1 (S1): From fall 1956 to spring 2010, the original 'single two-one' policy was enforced, i.e., a student failing one half of the course credits in a semester is dismissed.
- Stage 2 (S2): From fall 2010 to fall 2015, a policy of 'cumulative two-one three-one' was in place, i.e., a student who fails more than half of the credits in a semester and later fails more than one third of the credits in a semester is dismissed.
- Stage 3 (S3): From spring 2016 to fall 2018, the dismissal policy was further relaxed to 'two consecutive two-one' or 'three cumulative two-one', i.e., a student who fails more than half of the credits within two consecutive semesters is dismissed. Likewise, a student who fails more than half of the credits within any three semesters is dismissed.
- Stage 4 (S4): In the spring semester of 2019, academic dismissals were abolished and have remained so ever since.

In total, the data covered 22703 regular undergraduate students who entered the university in the 11 academic years between fall 2007 and spring 2018, thus 22 semesters in total from the fall semester in 2007 to the spring semester in 2018. The data was provided by NCCU's Office of Institutional Research and had been anonymized prior to delivery. The research was IRB approved by NCCU's Office of Academic Ethics and Research Integrity (NCCU-REC-201901-I008). The data of the students' academic performance

includes credit grades and pass/fail results during the 11-year period between fall 2007 and spring 2018, thus covering the three different dismissal policies from S1 to S3. Note that the data covered regular students only and thus excluded students with a certified handicap, to whom academic dismissals do not apply, and other students with a special status, e.g., indigenous students, overseas students, students on athletic scholarships, etc., who are subject to a different evaluation system. Also note that due to data privacy rules, we were not able to access the full detailed information of each student at the individual level, which also limits the scope and the depth of the quantitative analysis. The makeup of the regular students in the data in terms of the time of entry to the university is shown in Table 1.

Table 1 Number of students covered in the data from NCCU.

Year	Students	**Year**	Students
2007	1948	2013	2042
2008	2196	2014	2005
2009	2218	2015	2027
2010	2145	2016	2021
2011	2061	2017	1987
2012	2053	Total	22703

An overview of the number of dismissed students per semester in the 11 academic years is shown in Figure 1, where the three different colors on the x-axis represent the three stages of dismissal policies. Most notably, the figure clearly shows a declining trend of the ratio of students dismissed, which matches the intended purpose in loosening the dismissal criteria.

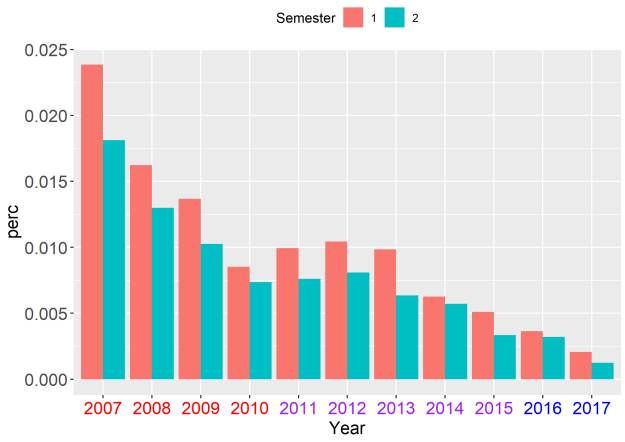

Fig. 1 An overview of dismissed students per semester and year. The y axis indicates the ratio of dismissed students per semester.

In the following quantitative analyses, we take two assumptions for granted and use them as the yardstick to measure the (un)fairness of the dismissal policies. First, we assume that the intended purpose of all "two-one" policies is to fairly identify students with the worst academic performance and then dismiss them. Second, we assume that any fair assessment of academic performance must consider the student's grade means, total credits earned, and total credits failed. In other words, if students with better performance in the latter sense are dismissed, while those with similar or worse performance are spared, such a policy is deemed unfair. Figure 2 shows the amount of credits taken and the mean grade of each semester during the three stages of academic dismissal policies. The facets refer to the three stages. The abbreviations are interpreted as follows: dis = dismissed, not-dis = non-dismissed, S1 = stage 1, S2 = stage 2, S3 = stage 3. Each data point indicates a student's performance during an individual semester.

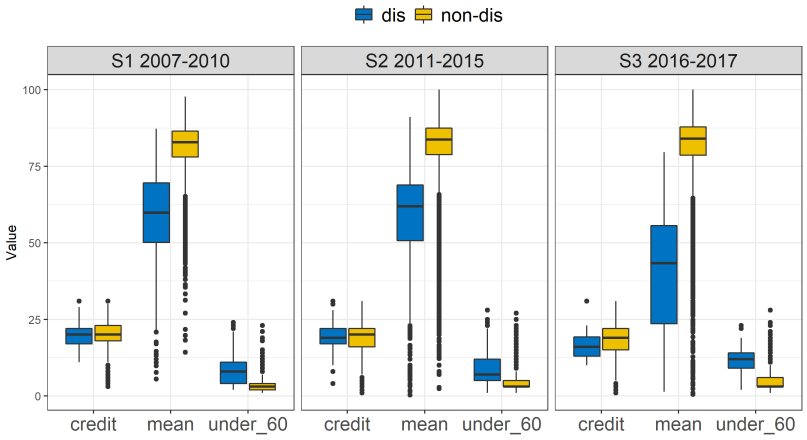

Fig. 2 An overview of student performance per stage pf dismissal policies at NCCU.

In terms of the changes observed across policies, first, there is a drop of the mean grades of dismissed students from S1 to S3, indicating that the change of policies tends to isolate students with a lower performance in terms of grades. Second, a similar, but weaker, tendency is found for credits, indicating that students with a lower amount of credits taken per semester were filtered out. Third, the opposite tendency is found for failed credits (i.e., credits with a grade lower than 60, the grade points required for passing in a percentile system). This shows that the change of dismissal policies has the effect of identifying the students having failed the majority of the credits taken. However, in comparing the dismissed and non-dismissed students, we observe that a large number of non-dismissed students actually have much lower means than dismissed students. Also, there are non-dismissed students with many more

failed credits than the dismissed students. During S1, 266 non-dismissed students had a mean lower than the mean of dismissed students. During S2, 904 non-dismissed students had a mean lower than the mean of dismissed students. During S3, 144 non-dismissed students had a mean lower than the mean of dismissed students. These numbers show that across all stages of the dismissal policy, within students who had a similarly low performance in terms of grades, some were dismissed but others were not. This infers that the dismissal policies are not fair as students in similar situations were not treated in the same way.

After these preliminary observations on the data, we conduct the quantitative analysis. The following R packages are used to conduct the analysis: cluster (Maechler, Rousseuw, Struyf, Hubert, & Hornik, 2019), factoextra (Kassambara & Mundt, 2020), ggfortify (Y. Tang & Horikoshi, 2016), ggsci (Xiao, 2018), readxl (Wickham & Bryan, 2019), tidyverse (Wickham, 2017). As a first step, we reduce the data on grade means, amount of total credits, and amount of failed credits with principal component analysis (PCA), a method used for unsupervised dimension reduction (Jolliffe, 2002). Multidimensional data often include variables that are correlated; it is thus preferable to reduce it first before feeding it to other downstream tasks. PCA fulfils this aim by using a mathematical procedure to transform a number of correlated variables into uncorrelated variables, which are called 'principal components'. The first component accounts for as much of the variance in the data as possible. The embedded variance then decreases gradually in each of the following components. If only two components can explain most of the variance, the data size is substantially reduced, which is then very helpful for further processing.

The output of PCA on the NCCU data is displayed in Figure 3. Each point represents the performance of a student at a specific semester during the 11-year period. Again, S1 = stage 1, S2 = stage 2, S3 = stage 3, dis = dismissed, not-dis = non-dismissed. The closer two points in the space, the more similar the performance of the students at a specific semester. The x and y axis represent the first two principal components captured by the PCA.

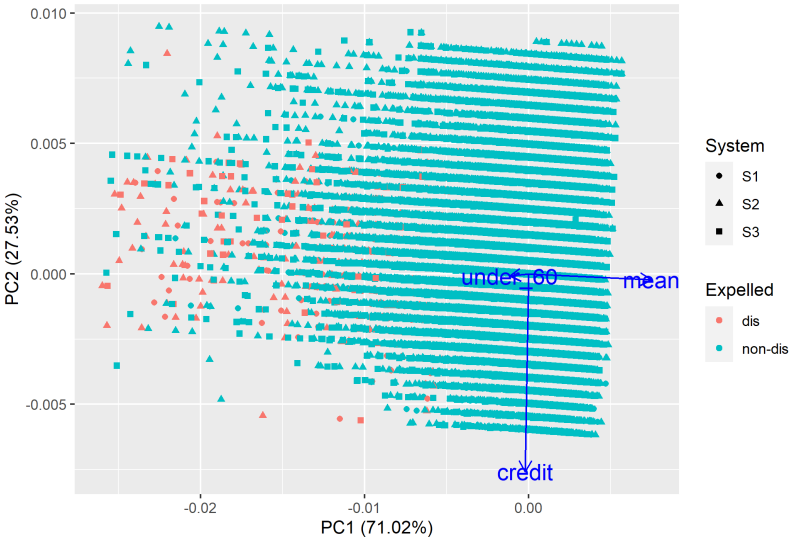

Fig. 3 The output of principal component analysis on the NCCU data. Each point indicates if a student was expelled or not at a given semester. The 'System' label refers to the stages of dismissal policies at NCCU.

The main observations are highlighted as follows. First, the first two components capture 71.02 + 27.53 = 98.57% of the variance in the data. This indicates that the two-dimensional representation of the data faithfully captures the information encoded in the raw data. Second, the length of the arrows relate to the magnitude of information encoded in the raw variables (i.e., means, amount of total credits, and amount of failed credits). We can see that the means and the amounts of total credits are the main variables that capture the variance of the data, while the information of the amounts of failed credits is not very relevant. Third, the locations of the points with relation to the direction of the arrows indicate their trend in each variable. For instance, the points located at the left of the plot have higher means than the points located at the right of the plot. The visualization shows that dismissed students tend to have a lower mean, which is expected. We see that quite a large amount of non-dismissed students (in blue) are located close to the dismissed students (in red) within the space, which once again infers that the dismissal policies did not treat students with similar performance in the same way.

The extracted components can then be used to cluster the data points, i.e., to identify how many main groups can be found in the data. One of the most common clustering methods is k-means clustering (Forgy, 1965; Hartigan & Wong, 1979; Lloyd, 1982), which is generally used on the output of PCA (Ding & He, 2004; Zha, Ding, Gu, He, & Simon, 2002). The grouping is done by minimizing the sum of squared distances (Euclidean distances) between items and the corresponding centroid (the center of the cluster). The clustering process is as follows: First, a k number of seed points are generated randomly

within the investigated space. Second, each data point within the space is assigned to the nearest seed centroid, which represents a cluster. Third, new seed points are generated as the centroids of the current k clusters. Finally, the second to third step is repeated until the centroids do not change any more, i.e., when the optimal centroids are found for each cluster. An example of the application of this method in research is the identification of language-impaired children, i.e., based on the performance of children in language-related tasks, clinicians can cluster children into several groups and identify which specific groups may require support with regard to language learning (Hamann & Abed Ibrahim, 2017).

During the clustering process, we ask the model to identify two clusters, since we are interested in comparing the output of clusters with the binary classification of dismissed versus non-dismissed made by the dismissal policies. The output of binary k-means clustering on the NCCU data is shown in Figure 4. The colors represent the two clusters found by the k-mean algorithm. The shapes of the points refer to the decisions of dismissal policies. The abbreviations are interpreted as follows: dis = dismissed, not-dis = non-dismissed. As expected, we see that automatic clustering identifies a cluster of students with lower mean grades, which is the cluster in red found on the left on the plot. However, crucially, this cluster also includes quite a large number of students that were not actually dismissed by the dismissal policy in place. For example, quite a few non-dismissed students (represented by the cross signs) have been clustered with the dismissed students (represented by the circles).

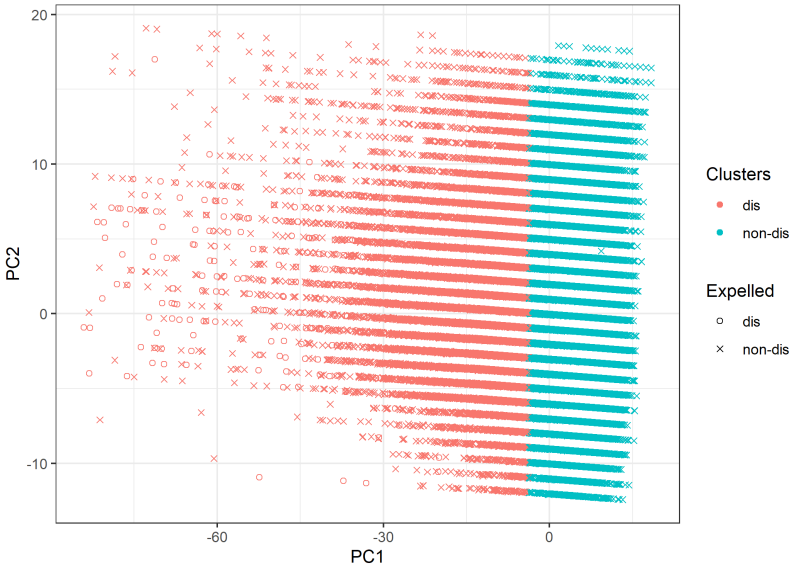

Fig. 4 The output of k-means clustering on the NCCU data. Each point indicates if a student was expelled or not at a given semester. The colors refer to the automatic clusters and the shape indicate if a student was actually expelled or not.

We then need to assess how similar are the clusters generated by k-means and the original decisions of dismissal policies. To do so, we use the Rand index, which is used to compare the similarities between clusters. The Rand index is defined as the number of pairs of objects that are either in the same group or in different groups in both partitions divided by the total number of pairs of objects. The Rand index lies between 0 and 1. When two partitions agree perfectly, the Rand index achieves the maximum value 1. A potential problem with the Rand index is that the expected value of the Rand index between two random partitions is not a constant. This problem is corrected by the adjusted Rand index that assumes the generalized hyper-geometric distribution as the model of randomness. The adjusted Rand index has the maximum value 1, and its expected value is 0 in the case of random clusters. In our case, the adjusted rand index is 0.02, which indicates that the distribution of data within the binary clusters is quite different when comparing the output of k-means with the decisions of dismissal policies. To get a more precise idea of how the clustering matches with the original classification, we can use the measures of accuracy, baseline, precision, and recall, which are commonly used in machine learning tasks.

First, we can calculate the accuracy of k-means clustering with regard to the decisions made under the dismissal policy. To do so, we use the confusion matrix shown in Table 2 below. The rows represent the predictions, while the columns refer to the decisions of the dismissal policy. The diagonal indicates the correct predictions based on k-means clustering, which means that the students that are predicted as dismissed or non-dismissed by k-means are also dismissed or non-dismissed in the NCCU data. Each tokens represent the dismissed/not-dismissed status of a student at a specific semester during the 11-year period.

Table 2 The confusion matrix for the output of k-means clustering.

	Actual-dismissed	Actual-not-dismissed
Cluster-dismissed	808	36737
Cluster-not-dismissed	65	119574

The overall accuracy of the predictions is equal to the total amount of correct predictions by the total amount of tokens, which is (808 + 119574) / (808 + 119574 + 65 + 36737) = 0.7659. This shows that the k-means clusters can predict correctly 76% of the data. To assess the accuracy, we compare it with the majority baseline, which refers to what the model would get by guessing that everything is the biggest category. In our case, the model could get an accuracy of (36737 + 119574) / (808 + 119574 + 65 + 36737) = 0.9944 just by guessing that most students are non-dismissed. The fact that the accuracy of the k-means predictions (0.7659) is much lower than this baseline shows again that the k-means clusters do not match with the decisions of the dismissal policy.

To have a further understanding of how the predictions do not match the decisions of the dismissal policies, we evaluate the precision and recall on each category. Precision measures how many cases are correctly classified within all the predictions on a category, while recall evaluates how many cases are correctly retrieved among all the expected correct output. These measures are used in a similar way as the measures of suppliance in obligatory context and target-like use in language acquisition (Pica, 1983; M. Tang, 2017). These two measures can also be merged as the f-score, which is equal to the harmonic mean of the precision and recall, i.e. 2(recall × precision)/(recall + precision) (Ting, 2010). In other words, the f-score is used as an average representation of precision and recall. The precision and recall on dismissed and non-dismissed student categories are shown in Table 3. Note again S1 = stage 1, S2 = stage 2, S3 = stage 3.

Table 3 The precision and recall of k-means clustering on the NCCU data.

	All		Stage 1		Stage 2		Stage 3	
Cluster	dis	not-dis	dis	not-dis	dis	not-dis	dis	not-dis
Precision	0.021	0.999	0.035	0.999	0.023	0.999	0.011	0.999
Recall	0.925	0.765	0.935	0.721	0.920	0.762	0.937	0.799
F-score	0.041	0.866	0.067	0.838	0.045	0.865	0.022	0.888

Under the column of 'All', we can see that the model in general has a high recall on dismissed students, which means that the model does find the dismissed students. However, the precision is low, which means that the identified clusters include a large number of students that are not labelled as dismissed in the data. On the other hand, the model has a low recall and high precision for non-dismissed students, which means that students identified as non-dismissed are generally non-dismissed in the original data; nevertheless, not all non-dismissed students are identified correctly by the k-means clusters.

The same method is reduplicated on the data from the three stages of dismissal policies at NCCU; see the columns under 'S1', 'S2', and 'S3'. Two important observations are made. First, the precision of dismissed students clearly decreases from stage 1 to stage 2, and from stage 2 to stage 3. This indicates that the data of dismissed students matches less with the automatically detected clusters along with the change of dismissal policies. Second, the recall of not-dismissed students increases from stage 1 to stage 2, then to stage 3. This shows that the automatic cluster of not-dismissed students matches better with actual not-dismissed students along with the change of dismissal policies. Similar observations are found when considering the f-score. To summarize, the change of policies result in less students being identified as dismissed as there should be according to automatic clustering. This observation matches with the general expectation behind the relaxing of dismissal standards and also the annual data released by the Ministry of Education.

4 Discussion

Note crucially that though the quantitative analyses reported in section 4 employed specific data from only one university, i.e., NCCU, the reality that its four different "two-one" policies have created a scenario of unjustifiable unfairness in dismissals can be said to apply not only to the four policies in question but also across the board to all such "two-one" policies, for two reasons.

First, even though the actual data are from one university, the data cover four distinct dismissal policies in a period of 11 years, i.e., 'single two-one', 'cumulative two-one three-one', 'two consecutive two-one', and 'three cumulative two-one'. While the four policies are surely not exhaustive of the various "two-one" policies currently in place among the universities that still have academic dismissals, they are fairly typical policies and can thus be argued to be fairly representative of the status quo. In fact, many universities, especially the top universities, nowadays have an office of institutional research. Given this capacity, the burden of proof rests heavily, if not solely, on the university, which bears the responsibility to demonstrate the pros and cons of a particular dismissal policy, if not before, at least after it deprives students of their constitutionally protected right to education. The current study demonstrates precisely how this can be easily done after such a policy has been implemented for a period of time. And the result is clear: such policies are quite unfair.

More importantly, the rational analysis in section 2, as well as arguments offered elsewhere in the literature cited, apply to all such dismissal policies based on the CFRs of one or two or three semesters only. In other words, students' overall performance in terms of GPA and CPR are entirely ignored, and the GPA is the most important indicator that nearly all universities use to gauge academic performance (Yang et al., 2013). Thus, all "two-one" policies suffer an inherent bias due to this failure to consider the GPA and the overall CPR. Such a failure will inevitably lead to unfairness across the board in every university with such a dismissal policy. What the quantitative analyses have revealed is therefore not specific to the four policies the data cover but rather the unfairness that is in the shared core design of all such "two-one" policies.

Finally, the most meaningful contribution of this study is its findings clearly indicates that the direction of changes in academic dismissal policies that universities have been taking needs serious reconsideration and a more constructive approach to student quality control should be the urgent topic of current educational discourse. Ever since the MOE removed the mandate of the dismissal from university based on a single two-one S-CFR in the late 1990's, a clear trend of university dismissal policies in the past two decades has emerged, i.e., a gradual but continual relaxation of such policies, the case of NCCU examined in this study as a typical example, with the sole purpose to reduce the sheer number of dismissals. A consequence of this avoidance strategy is the lack of empirical studies of the inadequacies of such "two-one" policies based on S-CFR, and hence also the absence of proposals of alternative

approaches to academic dismissals and, more importantly, the necessity of dismissal policies at all. Existing studies (Her & Lin, 2017; Her et al., 2019, 2021) and the current study demonstrate compellingly that academic dismissals are reactive, ineffective, and unfair measures of student quality control, which also on occasion result in unfortunate tragedies due to the stigmatization of university dismissals, and should be replaced with more proactive, constructive, and cooperative means of academic consultation.

5 Conclusion

In this study we examined the issue of fairness in the so-called *two-one* academic dismissal policies in Taiwan's universities, motivated by the fact that in the literature such dismissal policies were hardly ever supported by theoretical argumentation or empirical evidence. Most of the studies on academic dismissal policies were conducted by individual scholars and researchers after the policies were already in place and simply assumed that such policies were fair.

We first cited academic dismissal policies in universities in the Netherlands and the US and provided a comparison with the *two-one* policies, where the most important drawback is the inflexibility and lack of a review process prior to dismissal. The student as a person and his/her personal circumstances are not taken into consideration. The only recourse the student has is to file an appeal and/or a lawsuit after the dismissal. We then offered a rational argumentation to demonstrate that such policies are bound to produce undesirable results in terms of fairness and appropriateness due to the disregard of students' overall performance in terms of C-GPA (cumulative GPA), S-GPA (semester GPA), and C-CPR (cumulative credit pass rate).

The rational account was then supported by a quantitative analysis, based on large-scale (N = 22,703) longitudinal data (11 years) from NCCU (National Chengchi University), a top university in Taiwan. We have shown that the disregard of cumulative and semester GPAs of current policies has led to unfair dismissals of students with relatively, but clearly, better academic performance. Though the results confirmed the intended purpose of the more lenient policies to expel fewer students, they clearly showed that the overall matching between the automatic clusters and the actual data of dismissals decreases as the policies become more lenient. This means that, while different dismissal policies all suffer in terms of fairness, the more lenient policies, contrary to common misconception, perform even worse and are even more unfair.

It must be stressed again that, legally, a dismissal policy has the grave consequence of depriving a student's constitutionally protected right to education; thus, the standards set by such policies must be fair, justifiable, and in harmony with the spirit and goal of a university education. Yet, throughout history, such policies in Taiwan's higher education have consistently ignored to consider the university's own responsibilities, the students' individual circumstances, and their overall academic performances. Given the fallacies of

such dismissal policies and their resulting unfairness, we strongly suggest that universities and the central authority of education reconsider the core design of the current policies. Indeed, if a university insists to continue its current policy, it is irresponsible and unconscionable not to dispute the existing arguments and evidence that such policies are unfair and unjustifiable. Ultimately, the experiences gained from the American and Dutch systems, the qualitative argumentation of the unfairness of the Taiwanese "two-one" policies, and the empirical quantitative evidence offered in this study consistently and convincingly demonstrate the following. The trend of relaxing the dismissal standards under the "two-one" design is futile in addressing the fairness issue and the "two-one" design needs to be abolished entirely. We therefore urge universities to consider following the example of NCCU, NTNU, Tunghai University, and two dozen or so other universities to replace academic dismissal policies with more proactive, constructive, and conducive mechanisms of advising and consultation.

Acknowledgments

The authors would like to thank the anonymous reviewers and the editors of JERD for their constructive comments and suggestions, which helped improve the paper significantly. However, any errors that remain are our sole responsibility. O.-S. Her, the corresponding author, is grateful to NCCU for granting him a university development research project in 2019 titled 'An Empirical Study of the Legality of NCCU's Academic Dismissal Policies', where the data used in the current study was obtained. The third author, M. Allassonnière-Tang, is thankful for the support of the ANR-20-CE27-0021 grant from the French National Research Agency.

Competing interests

The authors have no conflict of interest to declare.

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