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Budget Decentralization In Brazilian Federal Universities: Using The AHP Method To Support Resource Allocation

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Abstract:
The proper use of public resources is a recurring theme in debates about the quality and efficiency of public administration. Thus, with regard to the Federal Institutions of Higher Education (FIHE), this issue has gained importance over time in a context of increasing cuts in the public education budget. In order to optimize the use of a dwindling budget, the managers of these institutions must be able to make decisions about the use of resources, with emphasis on how this amount is allocated internally within each of them. One of the ways to help this process is to use decision support tools. In this sense, the aim of this work is to propose an approach that helps managers find alternatives that contribute to an effective allocation of resources in Brazilian Federal Universities. Based on a theoretical/technical review of institutional documents and scientific production on the allocation of resources in academic units at Brazilian Federal Universities, it was possible to identify criteria and alternatives that can be used by managers to systematize the allocation of budgetary resources. In this way, a survey was carried out with staff and students at the research unit to define the most relevant factors within this context. Once the data had been collected, it was submitted to the multi-criteria Analytic Hierarchy Process (AHP) method, which enabled the analytical treatment and interpretation of this data, so that the criteria and alternatives were quantified through the judgment of the survey respondents. The results showed a prioritization of the criterion related to the costs of the academic units, as well as the use of an indicator that takes into account the various criteria and sub-criteria listed.

Key Word*: Budget decentralization; Public budget; Federal universities; Multi-criteria method*

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I. Introduction

Public Higher Education in Brazil is a topic that cuts across the most diverse areas of scientific knowledge. Whether in the field of Administration, Economic Sciences or History, the strong presence of this topic in research demonstrates the importance of Federal Universities and Institutes in the national context, as well as the multiplicity of possible advances and improvements in the area. Within this theme is the issue of financing Federal Institutions of Higher Education (FIHE), that is, the analysis of the origin of the resources used for them to carry out their activities, as well as the discussion about the best ways to carry it out, based on different techniques, methodologies and theoretical contributions.

When they receive a budget allocation, it is up to the FIHE's management to implement it in order to achieve the precepts of efficiency, efficacy and effectiveness, as well as the institutional objectives outlined in their planning documents. To this end, many institutions take steps to decentralize resources to their academic units.

The decentralization of budgetary resources to academic units cannot be done on the basis of political and informal criteria (UFV 1994, 1998; Ferreira, 2019). As demonstrated by Reis (2011) and Cavalcante et al. (2019), this has come to be known as "counter policy", where the managers of each academic unit convince the authorizing officer of the release of a resource, intensifying the role of political and personal factors to the detriment of technical factors.

Based on this premise, some federal universities have developed methodologies based on technical and objective criteria to parameterize the distribution of the budget among the academic units. Nevertheless, several authors point to the need to improve these methodologies. Alves (2016) points out, for example, the lack of adequate sizing of needs for the full operation of university units, as well as the lack of cost differentiation between courses. In some cases, there is also a lack of performance indicators and parameters to support the allocation of resources (Silva et al., 2012; Alves, 2016). Gama Júnior and Bouzada (2015) and Ferreira (2019) point to the lack

of review of the models used. This is problematic in a dynamic context of successive changes, as in the case of university management.

Given the diversity of technical criteria and indicators in the literature capable of guiding management, there is a need for an approach that systematizes these attributes into criteria, sub-criteria and alternatives, so that university managers can rationalize choices within their own context.

The aim of this study was to propose a multi-criteria approach to help managers find alternatives that contribute to the effective allocation of resources in academic units within Brazilian Federal Universities. In order to accomplish this task, a survey was carried out with stakeholders at the Federal University of Espírito Santo (FUES), making it possible to identify and prioritize the criteria, sub-criteria and alternatives with the highest priority in terms of resource distribution methodology.

II. Budget decentralization in universities

Authors such as Silveira et al. (2017) and Garozzi and Raupp (2020) see the budget not just as an amount of resources needed to keep the "machine" running, i.e. to meet the needs of the institution's middle area, but as an amount intended to channel institutional progress and improve core activities, always in line with what was planned.

Federal universities act in line with this idea, using budget resources in order to pursue what was designed in their strategic planning, seeking to achieve the established goals, fulfill their institutional mission and achieve their vision of the future. Ultimately, good budget management practices contribute to meeting the aspirations of society, the main stakeholder.

One of the main decision-making factors for managers when it comes to budget management is the way in which the institution's central administration decentralizes resources. The academic and administrative areas of universities need resources to maintain and develop their activities, and the transfer of budgets to these units must guarantee the effectiveness of this process. Technical criteria are needed to parameterize this transfer (Carvalho, 2017), strengthening impersonality and rationalization in the use of public resources.

Methodologies for allocating resources to academic units can generally be found in two different formats: institutional documents and regulations and scientific production on the subject. The differences between these formats are both in the methodology used and in the purpose of each document.

Starting with the first format, we have those documents that are produced by the university itself, establishing the methodology, criteria, indicators, among other attributes concerning the way each of these institutions distributes resources internally. This document can be in the form of regulations, such as Resolutions of the Higher Bodies, exemplified in the cases of the Federal Technological University of Paraná (UTFPR, 2012) and the Federal University of Uberlândia (UFU, 2018). Because they are deliberated on by the university's higher councils, the Resolutions incorporate a greater degree of normative substance to the decisions made by them - to a greater or lesser degree according to the statutes of each institution - and therefore end up institutionalizing decisions at the level of governance and management. In this regard, Lobato (2019) highlights the importance of institutionalized methodologies through governance structures, in order to guarantee the continuity of the process in contexts of political influences caused by changes in management components.

Still in the first format, we also have technical documents produced by university managers themselves. Most of the time, they have the character of a guide, seeking to inform and publicize the ways in which those responsible for the budgetary and financial management of the institutions decentralize the budget internally.

The second format is based on scientific production on the subject, consisting of scientific articles, dissertations and theses. The advantage of these studies, in a way, is that they update the debate based on a more in-depth systematization of the literature. In other words, by starting with a literature review (which includes university budget decentralization methodologies), the authors are able to advance the discussion based on knowledge that not only exists, but is already being practiced in university management.

Despite the diversity of criteria and indicators presented in the literature, it is possible to group them into categories that give substance to the attributes presented, making it possible to group these indicators and identify the broader meaning that guides the institution's methodology. Based on the literature analyzed, it is possible to indicate the existence of three dimensions: costs, performance and fairness.

Costs refer to what the academic units actually need to guarantee the full functioning of their activities. For example, the model by Alves (2016), "seeks to translate the costs associated with the structures of the various courses offered, highlighting the differences between those that require a greater amount of budgetary resources and those that have a lower demand". In turn, Scapinelli (2021) seeks to draw up a matrix that is more in line with the conditions of infrastructure and human resources.

In this context, the most widely used indicator is the Equivalent Student (UFMG, 2010; UFPEL, 2016; UFSC, 1997; UFU, 2018; UFV, 2014; UNIFAL, 2010; Alves, 2016; Mendonça, 2016; Carvalho, 2017), which calculates not only the size of the student body - since it takes into account the number of students entering and graduating - but also the structural differences between courses, by including in the formula variables related to

the area of knowledge of the course, the shift and whether the course is offered off-site, since these three factors lead to higher costs for certain courses, causing a greater need for resources.

The performance criterion, on the other hand, refers to the results achieved by the academic units in their activities, especially within the so-called Academic Tripod, made up of teaching, research and extension. The inclusion of these indicators aims to value "academic production and merit" (Pires et al., 2010), so that academic units make efforts to improve the results of their activities, thus guaranteeing an improvement in the indicators and a greater share of resources.

Performance, within the context analyzed, is evaluated based on efficiency indicators and quality indicators, and encompasses results related to the concept of courses, graduating students, scientific production and extension production (UFMG, 2010; UFPEL, 2016; UFSC, 1997; UFU, 2018; UFV, 2014; UNIFAL, 2010; Alves, 2016; Mendonça, 2016; Carvalho, 2017; Scapinelli, 2021; Ferreira, 2019; Pires et al., 2010).

The fairness criterion is less addressed by the literature surveyed. It demonstrates the concern of institutions to promote the decentralization of resources in a fair manner, mitigating the structural differences of each academic unit, thus preventing the "poor" units from getting poorer and the "rich" units from getting richer. Pires et al. (2010) highlight the innovative nature of the issue, since the adoption of equalization criteria makes it possible to reduce the distance, in terms of budget, between the best-structured units and those with the most precarious structure.

It can be said that academic units with more consolidated structures - i.e., older courses, more structured teaching, research and extension activities and more qualified teaching staff - have a greater potential for better results, which is reflected in their performance indicators. Therefore, the model should adopt variables that are able to mitigate these intra-unit discrepancies.

Based on these dimensions, a summary table was drawn up with the factors and the methodologies that cover them (Frame 1).

Frame 1: Summary of indicators found in the literature

	Dimensions	**Authors**
Costs	Students	UTFPR (2012); UFU (2018); UFSC (1997); UFMG (2010); UFPEL (2016); UFV (2014); UNIFAL (2010); UNIVASF (2015); Alves (2016); Mendonça (2016); Carvalho (2017); Ferreira (2019); Scapinelli (2021); Pires et al. (2010).
	Teachers	UTFPR (2012); UFU (2018); UFSC (1997); UFV (2014); Alves (2016); Carvalho (2017); Ferreira (2019); Scapinelli (2021); Pires et al. (2010).
	Technical-Administrative Staff	UTFPR (2012); UFSC (1997); UFV (2014); Alves (2016); Ferreira (2019); Pires et al. (2010).
	Historical Participation	UFSC (1997); UFV (2014).
	Infrastructure	UTFPR (2012); UFSC (1997); UFV (2014); Alves (2016); Ferreira (2019); Scapinelli (2021).
	Teaching	UTFPR (2012); UFU (2018); UFSC (1997); UFMG (2010); UFPEL (2016); UNIFAL (2010); Alves (2016); Mendonça (2016); Scapinelli (2021); Pires et al. (2010).
	Research	UFSC (1997); UFMG (2010); UFV (2014); Alves (2016); Scapinelli (2021); Pires et al. (2010).
Performance	Extension	UFU (2018); UFSC (1997); UFV (2014); Alves (2016); Scapinelli (2021); Pires et al. (2010).
	Postgraduate Studies	UFU (2018); UFSC (1997); UFMG (2010); UFPEL (2016); Alves (2016); Scapinelli (2021); Pires et al. (2010).
	Teaching Staff	UTFPR (2012); UFU (2018); UFSC (1997); UFMG (2010); UFPEL (2016); UFV (2014); Alves (2016); Carvalho (2017); Ferreira (2019); Scapinelli (2021); Pires et al. (2010).
Fairness		UNIVASF (2015); Pires et al. (2010); Pires (2005); Lobato (2019).

Source: Authors (2023).

III. The Analytic Hierarchy Process (AHP) as a tool to support decision-making

Making decisions is intrinsic to human nature. Saaty (2008) argues that we are decision-makers because everything we do is the result of a decision made previously, even if unconsciously. According to the author, decision making involves several factors, such as the problem in question, the criteria that guide the decision, the sub-criteria of each of the criteria, the people who are affected by the decision and what the possible alternatives are in this context. Lehnhart et al. (2020) point to the diversity of points of view related to a decision, highlighting that it is more difficult to find suitable answers and alternatives in complex problems, with the presence of several criteria.

As we have seen, the diversity of indicators used by universities and indicated by the authors who deal with the subject of this work imposes a complex decision on the managers of these institutions, who must choose, within this set of alternatives, which indicators are the most appropriate for the context in which the university is inserted and the objective of their use, which is to ensure greater efficiency in the allocation of resources between

academic units. It is therefore crucial in this process to take into account the opinions and views of the civil servants who work directly on the subject.

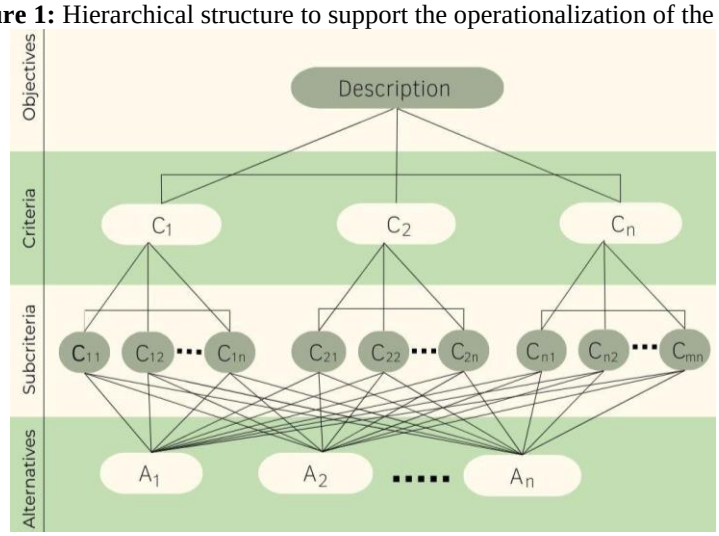
With this in mind, the method used in this study will be the Analytic Hierarchy Process (AHP), due to its ability to synthesize "stakeholder preference judgments" (Gonçalves, 2016), from "a finite number of alternatives based on a set of selected criteria" (Morimoto; Oliveira, 2019). This will enable the research population to establish relative judgments regarding the use of indicators for budget decentralization.

The AHP method was developed by mathematician Thomas Lorie Saaty in the 1970s to serve as a tool to support decision-making in contexts where the problems to be solved involve several criteria. The problem in question is then broken down into criteria and sub-criteria, until it reaches the level of alternatives that decision-makers must take in order to tackle it (Saaty, 2008). The author argues that multiple criteria facilitate decision-making, since the trade-offs involved (gains and losses that are obtained when exchanging one option for another) explain the advantages and disadvantages of choices in circumstances of uncertainty (Saaty, 1994).

The participation of the actors involved in the problem is of the utmost importance in the process, since the individual knowledge of each actor is not enough to make a decision and the participation and debate of the whole group is necessary (Saaty, 1994). Jannuzzi, Miranda and Silva (2009) state that multi-criteria analysis does not seek to find optimal solutions, but compromise and consensus solutions, thus highlighting the collective nature of the decisions discussed.

In decision-making, Saaty (2008) divides the process into four stages: first, the problem is defined and the type of knowledge required. Next, the decision hierarchy is built, in which the main objective is configured at the top, which in turn is detailed in a set of criteria and sub-criteria (intermediate levels), until they reach the level of alternatives. In the third stage, a matrix of pairwise judgments is constructed, where the criteria, sub-criteria and alternatives are evaluated in pairs. Finally, the priorities of each of the factors obtained through the pairwise judgment matrix are calculated (Figure 1).

Figure 1: Hierarchical structure to support the operationalization of the AHP



Source: Saaty (2008).

Saaty (2008) states that, in order to make it possible to compare criteria, sub-criteria and alternatives, a numerical scale is needed to reflect the relative importance of each attribute (Table 1). This thought is corroborated by Gonçalves (2016), who highlights the importance of a scale that helps consolidate the opinions of different stakeholders in the operationalization of multi-criteria methods.

Table 1: Numerical scale of preferences

Numerical scale	Verbal scale
1	Elements of equal importance
3	Element with moderate importance over the other
5	Strong importance of one element
7	Very strong importance of one element
9	Extreme importance of an element
2, 4, 6 and 8	Adjacent values

Source: Saaty (2008).

In this way, the parity evaluation is consolidated, since each attribute will have an evaluation (according to the numerical scale) relative to another attribute (Gonçalves, 2016). According to Saaty (2008), this set of scores

(evaluations) makes it possible to construct a generic judgment matrix. Thus, to prepare this matrix, Equation 1 must be taken into account:

$$n(n-1)/2 \quad (1)$$

The generic matrix (2) is obtained from (1):

$$A = \begin{bmatrix} 1 & a_{12} & \dots & a_{1n} \\ 1/a_{21} & 1 & \dots & a_{2n} \\ \vdots & \vdots & \dots & \vdots \\ 1/a_{n1} & 1/a_{n2} & \dots & 1 \end{bmatrix} \quad (2)$$

In which:

$a_{ij} > 0 \rightarrow$ *positive*;

$a_{ij} = 1 \therefore a_{ji} = 1$;

$a_{ij} = 1/a_{ji} \rightarrow$ *reciprocal*;

$a_{ik} = a_{ij} \square a_{jk} \rightarrow$ *consistency*.

The generic matrices must then generate normalized tables, which allow the calculation of global priorities and a global priority vector (Zatta et al., 2019). In order to verify the consistency of the judgments, the Consistency Ratio (*CR*) is used (Equation 3), according to Saaty (1977):

$$RC = IC/IR \quad (3)$$

In wich: "*IR* is the Random Consistency Index for a reciprocal matrix of order n, randomly elaborated with non-negative elements" (Zatta et al., 2019). The *RC* value must be equal to or less than 0.10, otherwise the judgments must be recalculated (Saaty, 1977). In addition, in order to measure the consistency of the judgment matrix, the Consistency Index (*CI*) should be used (Equation 4). Where: $\lambda_{máx.}$ represents the "highest eigenvalue of the judgment matrix" (Zatta et al., 2019):

$$CI = (\lambda_{máx.} - n)/(n-1) \quad (4)$$

IV. Methodological Procedures

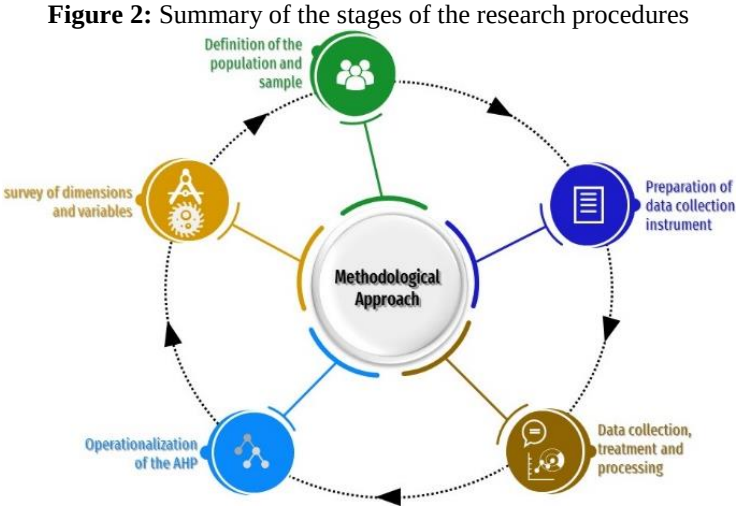
In order to build a decision support approach for decentralizing budget resources to academic units within universities, five stages were carried out, as shown in Figure 2. The research unit was the Federal University of Espírito Santo (FUES), a Federal Higher Education Institution located in Espírito Santo.

The first stage of the research consisted of defining dimensions and variables related to budget decentralization to academic units. Based on the analysis of institutional documents produced by the universities themselves and scientific production - articles, dissertations and theses - on the subject, it was possible to find a set of constructs, dimensions and indicators used by the institutions surveyed and proposed by the authors who have addressed the discussion. Among these findings, it was possible to define the set of criteria and sub-criteria needed for the subsequent application of the survey and the AHP method, thus guiding the data collection and processing phase.

In the second stage, the research population and sample were defined, with the aim of defining, within FUES, who would be those civil servants and students capable of evaluating the appropriate criteria and indicators for budget decentralization to academic units. The confidence level of the survey was determined, as well as the margin of error and the size of the sample through sample calculation (Santos, 2013).

Then, in order to operationalize the AHP, the data collection instrument was developed in the third stage, which consisted of a survey in the form of an online questionnaire sent to the defined population. In order to validate the data collection instrument, i.e., ensure its adherence to the objectives of the work (Rocha, 2020), a pre-test and a test were carried out before applying the questionnaire to the population. The purpose of the pre-test is to adapt the language and improve the questions (Heinrich et al., 2021), check that the dimensions listed are appropriate to the research objectives and the unit studied (Rocha, 2020) and adapt the data collection instrument to the reality of the interviewees (Gonçalves, 2016). The pre-test was sent to five experts in the field.

Figure 2: Summary of the stages of the research procedures



Source: Authors (2023).

The test phase was applied to a portion of the sample. This provided an opportunity to make adjustments to the questionnaire, checking that it was understood by the respondents, by applying it to 5% of the sample, as indicated by Gonçalves (2016).

After drafting the instrument, with the contributions of the pre-test and test, in the fourth stage the data was collected by means of a survey in the form of a questionnaire, sent to the civil servants defined as the population within the scope of this research. After collection, in accordance with the procedures adopted by Gonçalves (2016) and Rocha (2020), the data was processed using statistical software in order to identify missing values and outliers which, if left untreated, could cause distortions in the data analysis.

Finally, with the data collected and processed, the fifth stage consisted of operationalizing and applying the AHP method (Gonçalves, 2016). The hierarchical structure was drawn up as a reflection of the structure defined by the data collection instrument, with the appropriate organization of the objective, criteria, sub-criteria and alternatives. The data was entered into the Expert Choice Trial software in order to generate the matrix of judgments and the relative weight of the dimensions, thus making it possible to prioritize and effectively analyze the judgments made by the respondents (Zatta et al., 2019).

V. Results

The population defined to take part in the survey was made up of FUES teachers, administrative staff and students from two different areas. Teachers, technicians and students who are members (main and alternate) of the Teaching Centers (academic units) were defined, since they participate in discussions and decision-making regarding matters relating to the administration and management of these units. In addition to these actors, the population included teachers and technicians working in predetermined units in the Dean of Planning and Institutional Development and the Dean of Administration, who carry out activities related to planning, institutional information management, governance and budget planning/execution.

In this context, the population comprised 436 individuals (teaching staff, technical-administrative staff and students), and the sample was chosen at random, sized by sample calculation, according to Santos (2013). A 90% confidence interval was considered, with a 10% margin of error, a critical value of 1.64 for normal distribution and an estimated minimum value for the sample of 90%.

The application of the pre-test and test made it possible to refine the findings of the literature, resulting in the definition of the three criteria: "Need", "Performance" and "Equanimity". "Need" refers to what the academic units need in order to fully operate their activities, according to the specific characteristics of each unit. It is divided into the sub-criteria of "Academic Structure" - specific characteristics of the academic unit (number of staff) and the unit's courses, such as number of students, shift, area of knowledge, etc. - and "Infrastructure", i.e., the physical structure of the academic unit (classrooms, laboratories, open space, etc.).

The "Performance" criterion deals with the efforts made by the academic units to improve their performance in the activities they carry out. The related sub-criteria are "Quality", which refers to the quality of the academic unit's undergraduate and postgraduate courses, and "Efficiency", which refers to achieving results using fewer resources.

Finally, the "Fairness" criterion refers to the fairness of the distribution of resources, where characteristics inherent to the units that hinder their performance are taken into account in the allocation model. It is made up of the "Equalization" sub-criterion, which relates to the adoption of variables that reflect the structural differences (infrastructure, teaching/technical staff, etc.) of each unit, benefiting units with any structural deficiencies.

The alternatives are made up of indicators that can be used in the budget distribution model. Indicators are metrics used to measure performance, quality, efficiency, among other attributes that one wishes to quantify and, according to Frainer et al. (2017), "they are crucial for guiding decision-makers in a variety of ways to conduct public policy, as the information they generate facilitates the decision-making process". It is precisely this sense that justifies the choice of indicators as alternatives: the possibility for managers to define objective metrics to guide decision-making, which in this case is related to distributing the budget more effectively among the academic units. To this end, four indicators were chosen: Maintenance Index (Iman), Budget Execution Difference (BED), Weighted Equivalent Student (WES) and Course Quality Dimension (CQD).

Although indicators related to infrastructure are present in various works (UFSC, 1997; UTFPR, 2012; UFV, 2014; Alves, 2016; Ferreira, 2019; Scapinelli, 2021), the Maintenance Index (Iman) was defined based on the formulas proposed by Alves (2016) and UFSC (1997), as they consider different types of physical areas and weights for each one (Equation 5):

$$IMan_j = w1 \cdot Alab + w2 \cdot Acon + w3 \cdot Afr \quad (5)$$

Where:
j → Academic Unit.
$Alab$ → Total area of laboratories
$Acon$ → Total built-up area
Afr → Total area not built
$w1$, $w2$, $w3$ → variable weights, where $w1+w2+w3=1$

The Budget Execution Difference (BED) indicator has a formula adapted from the indicator proposed by Pires (2005) and Pires et al. (2010), Equation 6:

$$BED = \left(POmax_{n-1} - Pm_j \right) \cdot Ti \quad (6)$$

Where:
$POmax_{n-1}$ → highest percentage share of an academic unit in the amount of resources distributed in the previous financial year.
Pm → average between the percentage share of academic unit j in the distribution of resources in the previous financial year and the share of the same unit calculated for the current financial year.
Ti → variable participation rate.

The Weighted Equivalent Student (WES) indicator (Equation 7), on the other hand, is the result of applying weights to the equivalent student indicator of the National Association of Directors of Federal Higher Education Institutions (ANDIFES), according to the practices of UNIFAL (2010), UFU (2018) and UFES (2022):

$$WES_{i,j} = \sum_{i=1} \left(ESQ_i \cdot W \right) \quad (7)$$

i → Course;
j → Academic Unit;
ESQ_i → Equivalent Students of course *I*;
W → Percentage of course load *i* given by Academic Unit *j*.

Finally, the Course Quality Dimension (CQD) indicator was based on MEC (2013), and seeks to measure the quality of undergraduate courses (based on the SINAES concept) and master's and doctoral courses (based on the CAPES concept) at academic units (Equation 8):

$$CQD = QDU_j + QDM_j + QDD_j \quad (8)$$

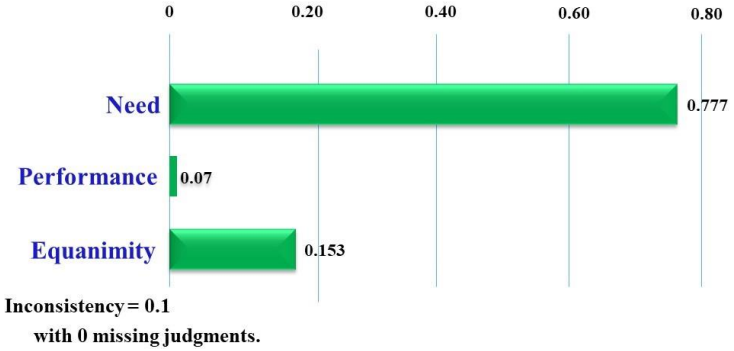
QDU → Quality dimension of the academic unit's degree courses *j*;
QDM → Quality dimension of master's degree courses in academic unit *j*;
QDD → Quality dimension of doctoral courses in academic unit *j*.

This structure supported the construction of the second block of the questionnaire, which contained 35 objective questions of pairwise comparisons between criteria, sub-criteria and alternatives, according to Saaty (1977), with response options based on the Likert scale. Each option represented a level of preference for one item over another. The results presented will be compared to the evidence found in the literature on the subject, making it possible to interpret the results obtained through the survey. Cronbach's alpha was used to calculate the internal consistency of the data collection instrument, based on the work of Zatta et al. (2019). The coefficient was 0.974, an acceptable result for analyzing the data collected.

According to the sample calculation based on Santos (2013), a calculated sample of 59 individuals was obtained, while 78 responded to the data collection instrument. Using SPSS statistical software, 5 outliers were identified which, when discarded from the sample, resulted in a valid sample of 73 individuals. On the other hand, no missing values were identified, so there was no need to disregard records.

After processing the data (Figure 3), the result showed that the criterion Need (77.7%) is the one seen as most important by the respondents when it comes to the effective distribution of the budget to the academic units. It is interesting to note that, in the literature surveyed, this is the criterion most often addressed (UFSC, 1997; Pires et al., 2010; UFMG, 2010; UNIFAL, 2010; UTFPR, 2012; UFV, 2014; UNIVASF, 2015; UFPEL, 2016; Alves, 2016; Mendonça, 2016; Carvalho, 2017; UFU, 2018; Ferreira, 2019; Scapinelli, 2021), suggesting that the issue of costs, in the university context, is a recurring theme when it comes to budget management, highlighting the importance of budgetary resources for maintaining the activities and development of institutions.

Figure 3: Summary of the stages of the research procedures



Source: Software Expert Choice Trial (2023).

These findings point to the existence of a possible alignment of expectations between the "Need" criterion and the management activities of the universities surveyed. Corroborating these findings, Scapinelli (2021) highlights the importance of taking into account the costs of each academic unit, including to make the execution of their planning pieces viable. Alves (2016) considers it essential to have the estimated costs of the academic units "so that the need for the requested resources can be substantiated". The author also considers the criterion to be important insofar as the model that takes it into account highlights the units that need a greater amount of resources, contributing to planning. It can be seen from this that the authors link the issue of the need for resources to a process of alignment with the unit's objectives, demonstrating that the identification of costs and their consequent incorporation into the distribution model is a fundamental condition for the planning of academic units, as Ferreira (2019) states, when he says that the variables in the distribution matrix must be "distributed according to the unit's real need to achieve its objectives".

Within the "Need" criterion, the "Infrastructure" sub-criterion (88.9%) was prioritized more than the "Academic Structure" sub-criterion (11.1%), probably due to the relationship between laboratory infrastructure and the development of academic activities (Scapinelli, 2021) and the fact that infrastructure is an institutional evaluation item, according to Law No. 10.861/2004, which established the National System for Higher Education Evaluation (SINAES).

The second most important criterion for respondents was Equanimity (15.3%), demonstrating the sample's concern with issues related to fairness and equality in the distribution of resources between academic units. Pires et al. (2010) highlight the innovative nature of the issue, since the adoption of equalization criteria makes it possible to reduce the distance, in terms of budget, between the best-structured units and those with a more precarious structure. The findings therefore corroborate the perception that the distribution model must take into account certain specificities of the academic units, such as teaching qualifications, course characteristics, laboratory infrastructure, among other items that make some academic units more structured than others (Pires et al., 2010).

Last in the order of prioritization (7%) was the Performance criterion, related to the adoption of distribution parameters that give preference to the academic units with the best performance. The low level of prioritization of this criterion can perhaps be explained by the problematization surrounding the idea of meritocracy, which is questioned in terms of its materialization in public educational institutions, due to the context of social inequality in which Brazil is inserted (Marques et al., 2022).

In addition, it is important to note that, in a way, the "Performance" criterion is opposed to the "Equanimity" criterion, because while the former seeks to value merit and favor those academic units that present more satisfactory quantitative and qualitative results in relation to final activities, the other assumes that this

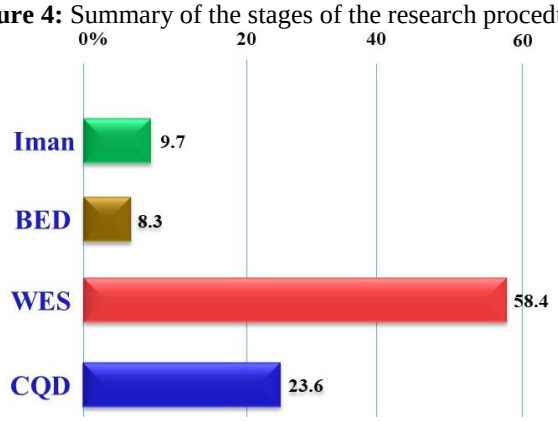
difference between the performance of the units may have its roots in the very structural differences between them (Pires et al., 2010).

As for the sub-criteria linked to the "Performance" criterion, it was observed that "Quality" (88.9%) was considered more important than the "Efficiency" sub-criterion (11.1%). The issue of efficiency, however, is often problematized in terms of its applicability in public administration (Oliveira; Paula, 2014; Burgos; Bellato, 2019). The main criticism lies in the fact that, unlike monetary decisions, where comparability between different actions can be made by measuring the results and, therefore, the efficiency of the action, when it comes to public management, the results are often linked to the realization of objectives and the achievement of intangible results. In this way, it becomes difficult to think of public policies with a focus solely on efficiency.

For Oliveira and Paula (2014), what is essential "should be related to the democratic definition of the values to be pursued", while the concern with efficiency is centred on "its definition of the adequacy of means and ends, rather than prioritizing the definition of these ends and selecting the criteria". In this way, the prioritization of the "Quality" sub-criterion seems to demonstrate concern with the ends and results towards which performance is oriented, rather than emphasizing the question of the use of resources to achieve these ends.

As for the alternatives (Figure 4), which in the structure are defined as indicators to be used to parameterize budget distribution to academic units, the results showed that the most prioritized indicator was WES (58.4%). This was followed by the *CQD* indicator (23.6%), *Iman* (9.7%) and *BED* (8.3%).

Figure 4: Summary of the stages of the research procedures



Source: Software Expert Choice Trial (2023).

The large-scale prioritization of the WES indicator is consistent with the findings in the literature, since the basis of the indicator is the Equivalent Student equation (MEC, 2013) which, in turn, is present in most technical documents and scientific production (UFMG, 2010; UFPEL, 2016; UFSC, 1997; UFU, 2018; UFV, 2014; UNIFAL, 2010; Alves, 2016; Mendonça, 2016; Carvalho, 2017). As mentioned, the difference with the WES indicator is that it is the result of incorporating weights into the ANDIFES Equivalent Student indicator, in line with the practices of UNIFAL (2010), UFU (2018) and UFES (2022).

In addition, the prioritization of this indicator is also consistent with the prioritization of the survey's criteria and sub-criteria. Basically, the indicator seeks to translate the costs of academic units through the student body and the structural characteristics of the courses that make up the unit. The indicator also adopts fairness criteria, since the Equivalent Student equation changes when it relates to new, evening and off-site courses, for example, translating structural issues into the formula that must be taken into account for a fairer distribution.

VI. Conclusion

This paper proposes a methodological approach based on finding alternatives that contribute to the effective allocation of resources in academic units within Brazilian Federal Universities. The research was carried out with FUES teachers, technicians and students, but with potential for replication in other Universities, safeguarding the specificities of each one in the development of the method.

Within this context, it was possible to observe from the results that the respondents prioritized mainly the criterion of "Necessity", expressing the respondent's emphasis on the issue of the costs necessary for the functioning of the academic units. In addition, the criterion of "Equanimity", in the order of prioritization, was in second place, shedding light on a topic that has not yet been discussed in the literature, which is the adoption of criteria and indicators in budget apportionment methodologies, with a view to distributive justice, allocating budget to units that, due to structural deficits, have performance problems.

As suggestions for future work, as a complement to the method used in this research, other decision support tools could be used, especially the linear programming method, aimed at optimizing the decision. The use

of AHP in conjunction with linear programming can give more substance to the decision-making process, so that the results can be compared.

Finally, leadership and its role in the effective management of resource allocation has been commonly debated in the literature. Research can therefore help by evaluating the relationship between the decentralization of spending and the profile of leaders in planning, conducting and managing activities related to resource allocation.

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