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RIPEM

Exploring the interfaces between Statistics and Financial Education: Brazilian High School students' perception of the Sustainable Development Goals

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Abstract: Brazil is experiencing broad curricular reform, after the publication of the National Common Curricular Base — BNCC, especially with the advent of New Secondary Education, such as the introduction of Financial Education, the expansion and deepening of Statistical Education, guidance for the approach through projects and the appreciation of contemporary transversal themes concerned with the environment (such as the Sustainable Development Goals — SDG, proposed by the UN in the 2030 Agenda). In this context, we conducted qualitative research, of an exploratory nature, involving 99 high school students, seeking to understand their perception regarding such changes, involving Statistics, Financial Education and SDG. The results indicate a lack of confidence in the school's ability to adequately guide them regarding their Financial Education, recognition of the need to improve knowledge in Probability and Statistics, to understand the new challenges of the 21st century, exposed in the 2030 Agenda, as well as to promote changes socioeconomic conditions to meet such demands.

Keywords: Statistical Education. Financial Education. Transdisciplinarity. Sustainability. SDG.

Explorando las interfaces entre Estadística y Educación Financiera: la percepción de los estudiantes brasileños de secundaria sobre los Objetivos de Desarrollo Sostenible

Resumen: Brasil está experimentando una amplia reforma curricular, después de la publicación de la Base Curricular Común Nacional — BNCC, especialmente con la llegada de la Nueva Educación Secundaria, como la introducción de la Educación Financiera, la expansión y profundización de la Educación Estadística, orientación para el abordaje a través de proyectos y la valorización de temas transversales contemporáneos relacionados con el medio ambiente (como los Objetivos de Desarrollo Sostenible — ODS, propuestos por la ONU en la Agenda 2030). En este contexto, realizamos una investigación cualitativa, de carácter exploratorio, que involucró a 99 estudiantes de secundaria, buscando comprender su percepción sobre dichos cambios, involucrando Estadísticas, Educación Financiera y ODS. Los resultados indican una falta de confianza en la capacidad de los escolares para orientarlos adecuadamente en cuanto a su Educación Financiera, el reconocimiento de la necesidad de mejorar los conocimientos en

Probabilidad y Estadística, para comprender los nuevos desafíos del siglo XXI, expuestos en la Agenda 2030, así como promover cambios en las condiciones socioeconómicas para satisfacer tales demandas.

Palabras clave: Educación Estadística. Educación Financiera. Transdisciplinariedad. Sostenibilidad. ODS.

Explorando as interfaces entre a Estatística e a Educação Financeira: percepção de estudantes do Ensino Médio brasileiro acerca dos Objetivos de Desenvolvimento Sustentável

Resumo: O Brasil vive ampla reforma curricular, após a publicação da Base Nacional Comum Curricular — BNCC, sobretudo com o advento do Novo Ensino Médio, como a introdução da Educação Financeira, a expansão e aprofundamento da Educação Estatística, a orientação para a abordagem por meio de projetos e a valorização de temas contemporâneos transversais preocupados com o meio ambiente (como os Objetivos de Desenvolvimento Sustentável — ODS, propostos pela ONU na Agenda 2030). Nesse contexto, conduzimos uma pesquisa qualitativa, de natureza exploratória, envolvendo 99 estudantes do Ensino Médio, buscando compreender sua percepção a respeito de tais mudanças, envolvendo Estatística, Educação Financeira e ODS. Os resultados apontam falta de confiança na capacidade da escola orientá-los adequadamente quanto à sua Educação Financeira, reconhecimento da necessidade de aprimorar conhecimentos em Probabilidade e Estatística, para compreender os novos desafios do século XXI, expostos na Agenda 2030, bem como de promover mudanças socioeconômicas para atender a tais demandas.

Palavras-chave: Educação Estatística. Educação Financeira. Transdisciplinaridade. Sustentabilidade. ODS.

1 Introduction

The implementation of the curriculum guidelines of the National Common Curriculum Base — BNCC (Brazil, 2018) has reinforced the need to explore interdisciplinarity (Fazenda, 2002; 2011), as well as transdisciplinarity in the approach to Contemporary Cross-Cutting Themes — TCT (Brazil, 2019b), such as Financial Education, Tax Education and Labor, which make up the Economy macro-area, as well as Education for Consumption, which makes up the Environment macro-area.

At the same time, the guidelines for the development of statistical research, in the Probability and Statistics thematic unit, in the Mathematics curriculum component, covering the investigative cycle (Cazorla & Giordano, 2021), offered teachers ample possibilities for contextualizing the teaching of Statistics, placing the student in the role of protagonist in the learning process, often experiencing the role of researcher for the first time in their lives. From this perspective, choosing a topic that motivates the student and encourages them to engage in authorial research is fundamental (Pereira et al., 2022). Among the themes that have aroused growing interest among Brazilian students, we highlight sustainability, socio-economic development and social justice.

There are many crises facing humanity in our time. Wars, such as the invasion of Ukraine or the conflict between Israel and Hamas, poverty, hunger, global warming, environmental destruction, pandemics such as Covid-19, religious conflicts, racism, femicide, homophobia, socio-economic inequalities and social injustice. These, among other serious global problems, are the starting points of the 2030 Agenda (UN, 2015).

Approved in 2015 by the United Nations General Assembly and signed by 193 countries, the 2030 Agenda calls for common sense, solidarity and cooperation between peoples in order to establish a global commitment that can ensure a sustainable future, given that the very preservation of our species, among many others, is under threat. In addition, targets and actions are proposed, so that the document is not limited to a letter of intent, but becomes a practical instrument for environmental and socio-economic transformation.

In this document, 17 Sustainable Development Goals — SDG are proposed, namely: poverty eradication; zero hunger and sustainable agriculture; health and well-being; quality education; gender equality; clean water and sanitation; clean and affordable energy; decent work and economic growth; infrastructure innovation; reducing inequalities; sustainable cities and communities; responsible consumption and production; action against global climate change; life on water; life on land; peace, justice and effective institutions; partnerships and means of implementation.

This theme, which is present in Brazilian textbooks and meets the demands of the BNCC (Brasil, 2018), motivated our investigation into the perception of Brazilian high school students about the role of Statistics and Financial Education in tackling the global challenges associated with the SDG. Their responses reflect the fragility of curricular changes on the one hand, but also the possibility of reframing the teaching of Statistics and Financial Education.

The next section presents the methodological procedures adopted in our investigation.

2 Methodological procedures

The subjects of our research, which was qualitative and exploratory in nature (Creswell & Creswell, 2021), were 99 2nd and 3rd year high school students from a Brazilian public school in the greater São Paulo area, aged between 16 and 18. They voluntarily answered a questionnaire consisting of twenty objective questions, using the digital tool Google Form, during the month of March 2024, at a time when the São Paulo state school system was undergoing a wide-ranging curriculum reform (Lima et al., 2022), from the perspective of the New High School (Kistemann Jr; Giordano; Damasceno, 2022). The content of the questions involved these students' perceptions of the curriculum changes and the role of Statistics and Financial Education in understanding the global problems associated with the SDG.

These answers were collected at the end of a didactic sequence that combined elements of Probability and Statistics, one of the five thematic units of Mathematics proposed in the BNCC (Brasil, 2018) and the TCT Environment, Education for Consumption, Financial Education, Fiscal Education, Work, Health, Food and Nutrition Education, Human Rights Education and Science & Technology. This sequence was developed by the same teacher teaching two Financial Education lessons a week and three Mathematics lessons a week in six high school classes (three 2nd grade and three 3rd grade), over the course of a fortnight.

The aim of this sequence was to sensitize students to the challenges of the 21st century as outlined in the SDG by developing the skills and competences inherent in their statistical and financial literacy. The form they answered is included in Appendix I, presented at the end of this article.

In the next section, we will present elements of our theoretical framework relating to Financial Education.

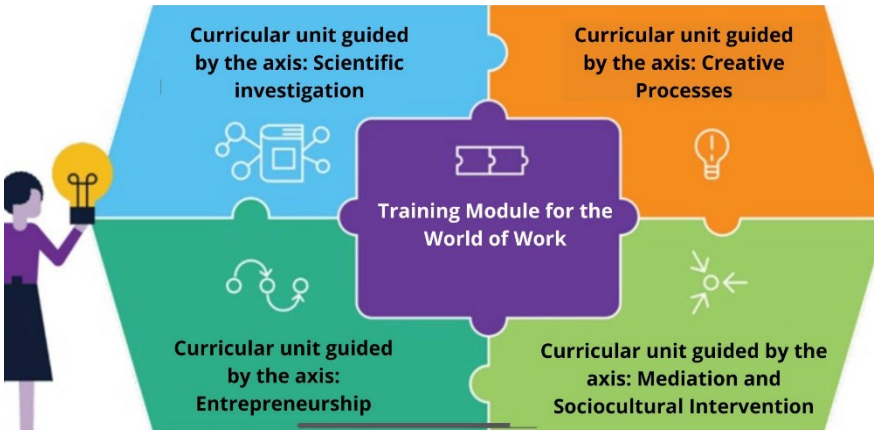
3 Curriculum changes: Financial Education included in Brazilian curricula

All this gave us the idea of organizing a pedagogical activity for high school students

covering three themes and related issues:

Financial Education has gained ground in the context of the New High School (Kistemann Jr; Giordano; Damasceno, 2022). It was first implemented in the São Paulo state network (São Paulo, 2020) as a Formative Itinerary (2019a), in the curricular component Financial Education in Connection, together with Entrepreneurial Connection (São Paulo, 2022). It is worth mentioning that Entrepreneurship is one of the four curricular units of the Formative Itineraries — FI, a set of optional subjects responsible for 40% of the workload of secondary education, as prescribed by the BNCC (Brazil, 2018).

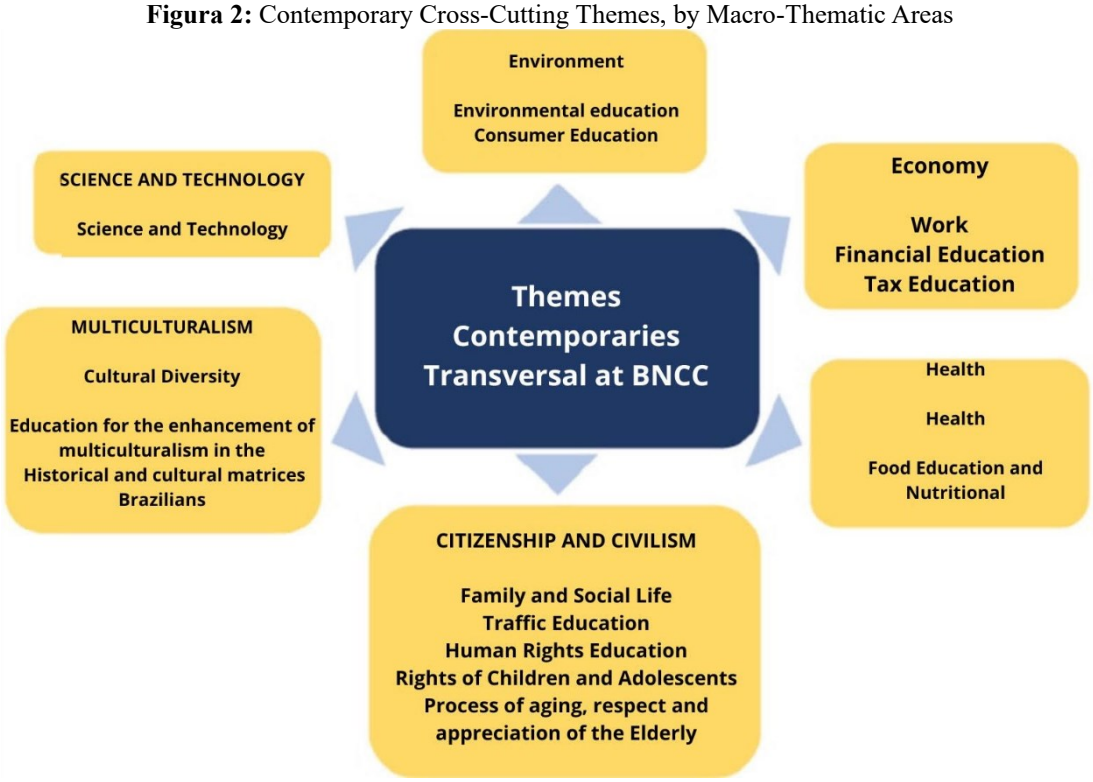
Figure 1: Curricular units guiding the training itineraries



Source: CONSED (2020, p. 8)

As well as being present in the FIs, Financial Education is also directly involved in four of the fifteen TCTs (Brasil, 2019b), which should be covered in both primary and secondary education: Education for Consumption, Work, Tax Education, in addition to Financial Education itself.

Figura 2: Contemporary Cross-Cutting Themes, by Macro-Thematic Areas



Source: Brasil (2019b, p. 13)

In 2024, the São Paulo state school system made a drastic cut in the number of FIs available for students to choose from. Initially, in 2021, 244 new curricular components were offered, but in 2024, this number was reduced by approximately a dozen, divided into three blocks: Mathematics and its Technologies and Natural Sciences and their Technologies, Languages and their Technologies and Applied Human and Social Sciences. Entrepreneurship continued as an IF, linked to Mathematics and its Technologies and Natural Sciences. However, Financial Education has become a regular subject throughout secondary school, regardless of the choice of FI, responsible for two of the five weekly Mathematics lessons in this segment.

In addition, Financial Education is already present in high school textbooks approved by the National Textbook and Teaching Material Program (PNLD), such as the collection adopted by the school of the subjects of our research (Smole & Diniz, 2020), sharing space in a volume with Algebra and Financial Mathematics.

In this same book, along with Financial Education, there is a didactic sequence about the SDG that mobilized students' interest, involving problems whose understanding required statistical literacy skills (Gal, 2019), when measures of position, tables and statistical graphs are presented, requiring careful reading, analysis, interpretation and discussion of statistical information.

In the next section, we will present aspects of the curriculum that deal with the environment and sustainability.

4 Curriculum changes: sustainability on the agenda

Vásquez et al. (2023) recommend that, given its breadth and relevance, the topic of sustainability should be approached from an integrated perspective, despite the weaknesses found in teacher training, which often does not prepare them to deal with such complex and challenging topics.

Present in textbooks and prescribed in the BNCC (Brazil, 2018), sustainability is a mandatory topic in classrooms. In the aforementioned normative document for Brazilian basic education, the word sustainability is mentioned 21 times, as one of the five mathematical competences provided for secondary education:

> Propose or participate in actions to investigate challenges in the contemporary world and make ethical and socially responsible decisions, based on the analysis of social problems, such as those related to health situations, sustainability, the implications of technology in the world of work, among others, mobilizing and articulating concepts, procedures and languages specific to Mathematics (Brazil, 2018, p. 531).

Sustainability can be explored through the SDG approach, as it addresses a wide range of global challenges.

Also present in textbooks approved by the PNLD, as in Smole and Diniz (2020), the SDG objectives emerged from discussions in the subject of Financial Education in six classes of high school students at a São Paulo state public school at the beginning of the 2024 school year. In a short space of time, the students felt the need to support their arguments with reliable scientific data, much of it involving statistical results, which broadened the discussion and highlighted difficulties in reading and interpreting measures of position, statistical tables and graphs, which led us to conduct a survey of these students' perceptions of the role of Statistics and Financial Education in this context.

Figure 3: Sustainable Development Goals

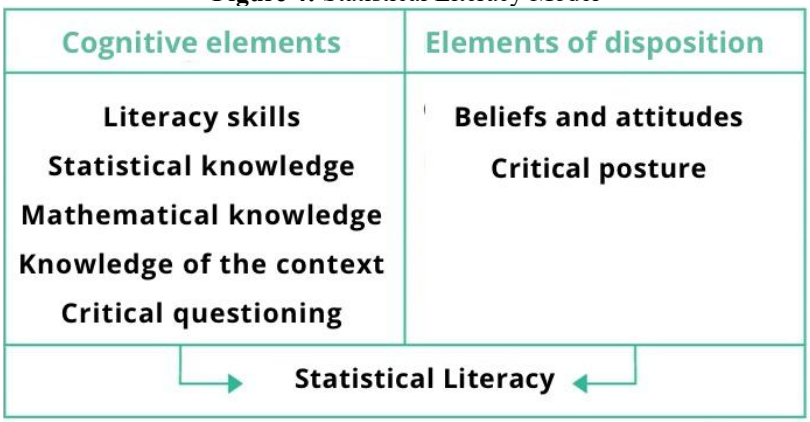
Source: United Nations Organization (UNO-2015)

In the next section, we will present curricular aspects linked to the Probability and Statistics thematic unit.

5 Curriculum changes: the articulating role of Statistics Education

Statistics is the science of numbers in context (Cobb; Moore, 1997). It takes on a new meaning through its applications. Understanding it requires both cognitive and dispositional elements, according to Gal (2019.

Figure 4: Statistical Literacy Model



Source: Adapted from Gal (2019)

Watson (1997) states that:

> The combination of motivated students, well-informed teachers, relevant content and a useful scheme for assessment should ensure that the higher-order thinking required for statistical literacy is achieved for most, if not all, students by the end of secondary school (Watson, 1997, p.15).

Statistical literacy, for Ben-Zvi and Garfield (2004), includes basic skills of great relevance to the interpretation of statistical information, such as the ability to organize data, to construct and present different representations of this data (such as tables and graphs), to master

concepts, words and symbols, understanding probability as the measure of uncertainty.

According to Cazorla and Giordano (2021), Statistics can take on the role of linking different sciences to cross-cutting themes of great social, political, economic, environmental, historical and cultural relevance. It is a science that underpins other sciences, as well as equipping citizens, through the development of statistical skills — literacy, reasoning and statistical thinking — to deal with the large volume of information that comes to us through the most diverse media in our daily lives.

Similarly, Watson (2005) advocates the inclusion and exploration of the study of Probability alongside Statistics in this segment of education,

> in general, secondary school provides fertile ground for the development of statistical ideas [...] In particular, the parallel development of proportional reasoning is an essential ingredient in student success. This should be combined with a wide range of applications to create an appreciation of the usefulness of Probability to the "real world" as well as solving theoretical mathematical problems (Watson, 2005, p. 164-165).

The BNCC (Brazil, 2018) sets out the challenge of developing authorial statistical research for students throughout Basic Education (students aged between 06-17), from the Early Years of Primary School to the end of Secondary School. They must take the lead in their research (Porciúncula, 2022). In addition, they should have freedom of choice regarding the topics investigated (Batanero & Diaz, 2011). The choice of topic investigated can ensure greater student engagement in research and better learning outcomes (Pereira et al., 2022).

So, in March 2024, in Financial Education classes, when the topic of the SDG came up, the students were invited to voluntarily answer a questionnaire with twenty objective questions, using the digital tool Google form, which addressed the didactic-pedagogical articulations that involved Statistics, Financial Education and Sustainability, in particular the SDG objectives. Below we will present some of the main results of our investigation.

6 Results and discussion

Students from six high school classes at a public school in São Paulo were invited to take part in this study on a voluntary basis. Out of 99, 186 agreed to take part, the majority of whom were female (59, as well as 38 males and 02 other genders), with an average age of 16.3 years.

Questioned about the decision to not only maintain, but also expand the space of the Financial Education in the curriculum, 98% agreed (totally: 67%, partially: 31%). Only two students did not consider it justifiable for Financial Education to remain on the curriculum (one partially and one totally). This significant recognition of the importance of Financial Education reflects the need to expand our efforts in exploring this field of knowledge, which is fundamental to the individual and collective well-being of citizens in our society (Kistemann Jr; Giordano; Damasceno, 2022), taking into account the demands prescribed in the BNCC (Giordano; Assis; Coutinho, 2019).

However, when asked about the best source of information about their financial problems, the most popular choice was banking institutions (31%), ahead of parents (27%), followed by other government sources (12%) and influencers' YouTube channels (12%). Only 8% of students considered school to be the best source of financial information, which leads us to question the effectiveness of teaching practices and even the preparation of education

professionals to face these demands (Santo et al., 2022).

Before analyzing the SDG, the students were asked to organize, in descending order, what they valued most in their lives, namely: a. sports (practice); b. sleep; c. family; d. sex; e. religion/spirituality/God; f. book reviews/ballet; g. music; h. friends; i. work/professional career; j. money; k. power; l. games; m. concerts; n. your heart team; o. health; p. books; q. art; r. studies; s. thirst; t. hunger; u. security; v. housing; w. self-esteem; x. social acceptance; y. self-realization; z. cars/motorbikes.

They then carried out a survey of their family expenses, taking into account 8. a. electricity; b. water; c. gas; d. internet/WiFi; e. pay TV/streaming; f. insurance; g. rent/home ownership/iptu; h. clothing; i. supermarket shopping (food); j. pharmacy (medicines, personal hygiene, beauty); k. butcher; l. free market; m. leisure (cinema, theatre, shows); q. delivery (such as i-food), restaurants, bars; r. private health insurance; n. private health insurance; m. leisure (cinema, theatre, concerts, etc.). free market; m. health insurance; n. private pension; o. studies/school supplies; p. leisure (cinema, theater, concerts); q. delivery (such as i-food), restaurants, bars; r. tithing/helping the church/temple/donations; s. bakery; t. pets; u. travel/tourism; v. credit card; w. transport/fuel/IPVA; x. other expenses. Only after cross-referencing their personal values with their spending were the SDG presented. The students were asked to associate their personal values with the SDG.

With regard to the SDG, the majority of students claimed to have already studied them, especially in math classes, followed by biology, history, geography and sociology. Only 35% claimed not to have studied the SDG at school. The SDG considered most important to them, according to their personal values, was the third: health and well-being (13%), followed by the sixteenth: peace, justice and effective institutions (10%). The seventeenth SDG was the least mentioned: partnerships and means of implementation, revealing a possible difficulty in operationalizing their desires to build a better world.

During their lessons, the subjects of this research were invited to visit the World Wide Fund for Nature (WWF) website and calculate their ecological footprint. According to the WWF:

> The ecological footprint of a country, a city, a company or a person corresponds to the size of the productive areas of land and sea needed to generate products, goods and services that we use in our daily lives. In other words, the Ecological Footprint is a way of translating, in global hectares (gha), the extent of territory that a person or an entire society "uses", on average, to sustain itself (WWF, 2024, n.d.).

The ecological footprint surprised 85% of the students, who didn't believe that their consumption pattern could demand so many resources. One student, whose ecological footprint showed that it would take twenty planets to meet his needs, expressed disbelief, claiming that only rich people could require so much, as their consumption patterns would be much higher. Three out of four students claimed that the use of statistical concepts and tools is necessary to determine this indicator (the ecological footprint).

Most of these students also recognized the need to expand their knowledge of Statistics, with reading position measures, tables and graphs, which they considered important to better deal with the global challenges expressed in the SDG (97%, with 57% totally agreeing and 40% partially agreeing), meeting the demands of the BNCC (Giordano, Araújo & Coutinho, 2019).

As for Financial Education, 60% of these students believe that their knowledge of Financial Education will be necessary to reduce the environmental impacts they cause and,

consequently, their ecological footprint. Half of them believe that their knowledge of Statistics and Probability will be necessary to reduce the environmental impacts they cause and, consequently, their ecological footprint, 43% were uncertain about the need to mobilize such knowledge and only 6% said that Statistics and Probability would not be useful in this process.

It's worth noting that all this discussion, as well as the students' voluntary participation in this research, took place at a time when they were back at school, still adapting to the curriculum changes that included Financial Education in the regular curriculum of all classes (until then it had been an elective curricular component, as an IF).

7 Final Remarks

Few educators nowadays question the importance of introducing Financial Education in Basic Education. These students' responses show that they also think this way. However, we are far from reaching a consensus on how to achieve this goal.

Although they recognize the importance of Financial Education in their lives, they do not believe that school is the most appropriate institution to guide them. On the other hand, the students see the importance of mobilizing statistical and probabilistic resources to understand the global challenges represented by the SDG, as well as to seek possible solutions to them.

By discussing the relevance of each of the 17 SDG, and associating them with their personal values, the students were able to reflect on the real role of Financial Education in their education, considered by most to be as important as Probability and Statistics, two fields that have come a long way in Brazilian education in recent years (Giordano, Lima & Silva, 2021).

Financial Education, Statistics and Probability and Sustainability are intrinsically related, both in the basic document of our education, the BNCC (Brazil, 2018), as well as in the Transversal Contemporary Themes (Brazil, 2019b) and in the Formative Itineraries (Brazil, 2019a). It is now up to educators to find ways to explore these interpenetrations in a meaningful and relevant way for today's students, to engage them in the actions needed to promote the socio-economic and environmental transformations that the world so desperately needs.

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