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Transforming lives: high school students' perceptions of scientific initiation at FOP/UNICAMP

Luiza Giachini dos Reis[1]
0009-0008-7000-3297

Caroline Nogueira de Moraes[1]
0009-0005-9942-3779

Stéfany de Lima Gomes[1]
0000-0002-7177-3970

Marcelo de Castro Meneghim[1]
0000-0002-0169-4898

[1]Faculdade de Odontologia de Piracicaba, Universidade Estadual de Campinas (UNICAMP), Piracicaba, São Paulo, Brasil.

Correspondence:
Caroline Nogueira de Moraes
E-mail: c208767@dac.unicamp.br

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Abstract The study aimed to analyze the impact of the Institutional Scholarship Program for Scientific Initiation in Secondary Education (PIBIC-EM) on students who participated in this initiative at Faculdade de Odontologia de Piracicaba, Universidade de Campinas (FOP/UNICAMP). A retrospective cohort study was carried out with 135 former PIBIC-EM students who took part in the program between 2009 and 2021. The instrument used for data collection was a semi-structured questionnaire consisting of thirteen questions divided into four blocks: personal information, aspects of scientific initiation, the impact of the scholarship and the impact of scientific initiation on the trajectory of the participants. The data were stored with identification codes in spreadsheets, tabulated, and descriptive analyses were performed with presentation of absolute and relative frequencies. The results show that 65.2% of the participants said that the program influenced their choice of field or degree, while 98.5% reported a positive impact on their careers. In addition, 91.9% believe that the program encouraged a critical vision and the search for evidence, even outside the academic environment, such as when dealing with contemporary issues like fake news. It can be concluded that scientific initiation in high school promoted critical training and decision-making skills among the participants.
Descriptors: Scientific and Technical Activities. Social Change. Education, Primary and Secondary.

Transformar vidas: percepción de los estudiantes de secundaria sobre la iniciación científica en FOP/UNICAMP
Resumen El estudio tuvo como objetivo analizar el impacto del Programa Institucional de Becas de Iniciación Científica en la Enseñanza Media (PIBIC-EM) en los alumnos que participaron de esta iniciativa en la Faculdade de Odontologia de Piracicaba, Universidade de Campinas (FOP/UNICAMP). Se realizó un estudio de cohorte retrospectivo con 135 egresados del PIBIC-EM que participaron del programa entre 2009 y 2021. El instrumento utilizado para la recogida de datos fue un cuestionario semiestructurado compuesto por trece preguntas divididas en cuatro bloques: información personal, aspectos de la iniciación científica, impacto de la beca e impacto de la iniciación científica en la trayectoria de los participantes Los datos se almacenaron con códigos de identificación en hojas de cálculo electrónicas, se tabularon y se realizaron análisis descriptivos con presentación de frecuencias absolutas y relativas. Los resultados muestran que el 65,2% de los participantes afirmaron que el programa influyó en su elección de campo o titulación, mientras que el 98,5% señalaron un impacto positivo en su carrera. Además, el 91,9% cree que el programa fomentó una visión crítica y la búsqueda de pruebas, incluso fuera del entorno académico, como cuando se tratan temas contemporáneos como las *fake news*. Se puede concluir que el programa de iniciación científica en bachillerato fomentó el pensamiento crítico y la capacidad de toma de decisiones entre los participantes.
Descriptores: Actividades Científicas y tecnológicas. Impacto Social. Educación Primaria y Secundaria.

Transformando vidas: percepções de estudantes do ensino médio sobre a iniciação científica na FOP/UNICAMP
Resumo O estudo teve como objetivo analisar o impacto do Programa Institucional de Bolsas de Iniciação Científica para o Ensino Médio (PIBIC-EM) sobre os estudantes que participaram dessa iniciativa na Faculdade de Odontologia de Piracicaba, Universidade de Campinas (FOP/UNICAMP). Foi realizado um estudo de *coorte* retrospectivo com 135 egressos do PIBIC-EM que participaram do programa entre os anos de 2009 e 2021. O instrumento utilizado para a coleta de dados foi um questionário semiestruturado, composto por treze questões divididas em quatro blocos: informações pessoais, aspectos da iniciação científica, impacto da bolsa de estudos e impacto da iniciação científica na trajetória dos participantes. Os dados foram armazenados com códigos de identificação em planilhas eletrônicas, tabulados e realizadas análises descritivas com apresentação de frequências absolutas e relativas. Os resultados mostram que 65,2% dos participantes afirmaram que o

programa influenciou a escolha de sua área de atuação ou graduação, enquanto 98,5% relataram um impacto positivo em suas trajetórias. Além disso, 91,9% acreditam que o programa incentivou uma visão crítica e a busca por evidências, inclusive fora do ambiente acadêmico, como ao lidar com questões contemporâneas, como as *fake news*. Conclui-se que a iniciação científica no ensino médio promoveu formação crítica e capacidade de decisão entre os participantes.
Descritores: Atividades Científicas e Tecnológicas. Impacto Social. Ensino Médio.

INTRODUCTION

The early inclusion of students in the scientific setting, through research initiation programs aimed at high school, has proven an effective strategy to foster academic training and interest in scientific careers[1,2]. These programs provide significant experiences of contact with the production of knowledge, promoting not only the understanding of research methods and processes, but also the development of skills such as critical sense, autonomy and scientific identity[3,4].

In Brazil, the Institutional Scholarship Program for Scientific Initiation in Secondary Education (PIBIC-EM), promoted by the National Council for Scientific and Technological Development (CNPq), represents one of these initiatives, seeking to bring students closer to the university's basic education, science and research. The main objectives of the program are to awaken scientific vocations, foster critical thinking and promote permanence in school, through participation in research projects supervised by professors associated with higher education institutions (CNPq, 2024)[5].

At the Universidade Estadual de Campinas (UNICAMP), the program was implemented in 2008, and was later adopted by the School of Dentistry of Piracicaba (FOP/UNICAMP) in 2010[6]. Since then, it has been consolidated as an effective bridge between the university and public high school students. Students experience practical research, with professors and graduate students, in projects ranging from literature review to data collection and analysis, which contribute to the development of technical and cognitive skills that are fundamental for their educational trajectory[6].

National studies indicate that PIBIC-EM contributes toward strengthening the academic trajectory of students, with positive repercussions on professional choice, on the inclusion of groups with less representation in science and on the construction of a life project that is more connected to the academic universe[7,8,9]. Moreover, similar programs implemented in other countries exhibit similar impacts, especially among young people from minority groups and with little access to practical experiences in science[2,3].

The MYHealth program in the United States, for example, offered research training for adolescents belonging to racial minorities and reported increased scientific identity and interest in academic careers[2]. Initiatives such as the *CFAR-HIV Research Program* also showed that early immersion in research settings contributes toward raising the academic self-esteem of students from vulnerable populations[3]. Studies such as Rosenbaum *et al.* (2007) [1] reinforce that medical schools can constitute effective settings for training young scientists, even during high school.

Despite such evidence, studies evaluating the effects of PIBIC-EM on academic training, professional choices and personal development of former participants are still scarce, especially in the context of public higher education institutions. Therefore, the present study aims to analyze the perception of former PIBIC-EM participants at FOP/UNICAMP, seeking to understand the effects of participation in the program on their academic, professional and training trajectory.

METHOD

Study design

This is an observational, retrospective cohort study, with a quantitative approach and descriptive character, approved by the Research Ethics Committee of UNICAMP (CAAE No. 66475123.9.0000.5418).

Population and sample

The study population consisted of 408 high school students from public schools who participated in PIBIC-EM at the School of Dentistry of Piracicaba (FOP/UNICAMP), between 2009 and 2021. Participants of legal age, contacted by email, phone or WhatsApp, were included. Those who did not agree to participate or who could not be located were excluded.

Data collection procedures

The former participants were invited to participate in the research through remote contact. After acceptance, participants accessed the Informed Consent Form (ICF), made available virtually. Then, they answered an online questionnaire, prepared based on the instrument of Nogueira (2009)[10], previously adapted and validated in a pilot study with ten participants.

Research Instrument

The semi-structured questionnaire consisted of thirteen questions, organized into four thematic blocks (Figure 1): (1) personal information; (2) aspects of scientific initiation; (3) perception of the scholarship; and (4) impact of the program on the trajectory of the participants.

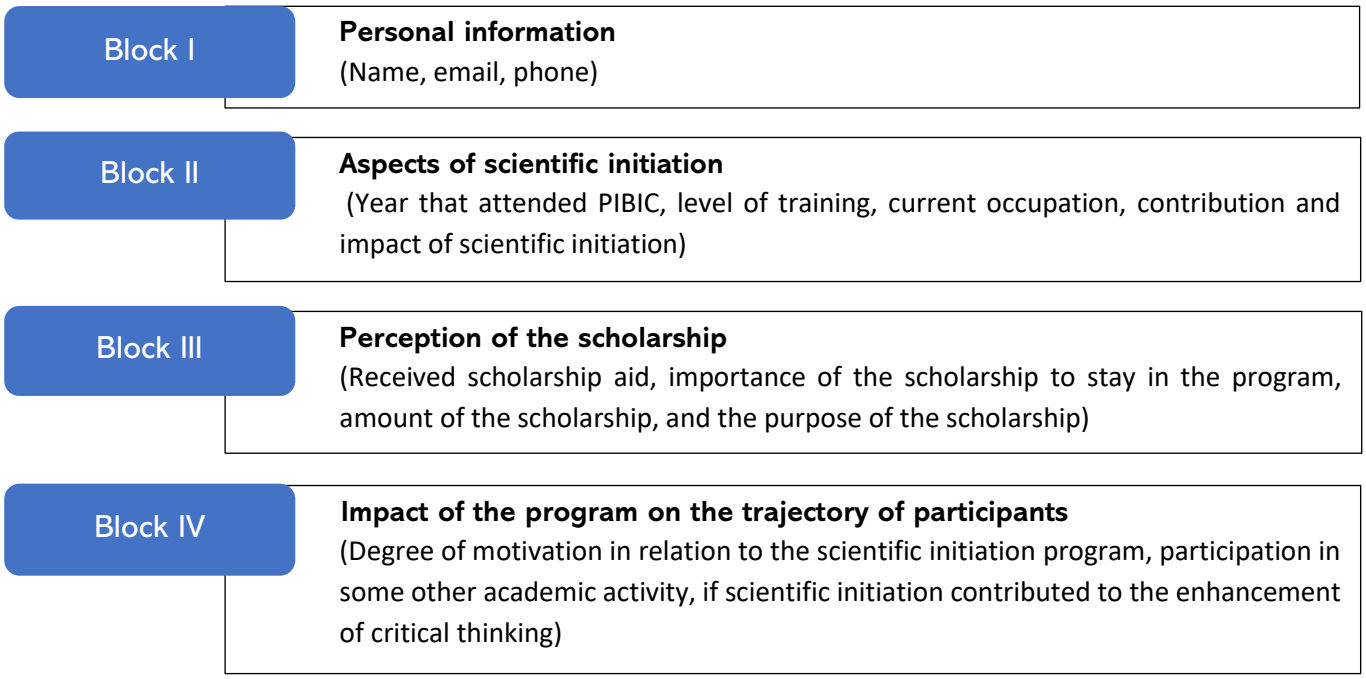

Figure 1. Questionnaire construction by blocks of interest.

Data analysis

The data were stored in electronic spreadsheets with coded identification. The statistical analyses were exclusively descriptive, with the calculation of absolute and relative frequencies. The information was presented through tables and graphs.

RESULTS

The study sample consisted of 135 graduates from the PIBIC-EM program at FOP/UNICAMP, representing a response rate of 33%. There was a predominance of females (71.1%) and a wide diversity of courses and areas of activity among the respondents. Most participants were linked to the program in 2019, corresponding to 21.5% of the total sample.

Regarding the educational trajectory, it was found that 66% of the participants were attending or had completed higher education, 38.5% were in undergoing undergraduate programs, 17.8% had completed undergraduate education, and 9.7% were in graduate programs (specialization, master's or doctoral) (Figure 2). This percentage is higher than the national average for young people aged 18–24 years attending higher education, estimated at 27.1% by the 2022 Demographic Census, which suggests a possible association between the experience in scientific initiation and the continuity of education at a higher level.

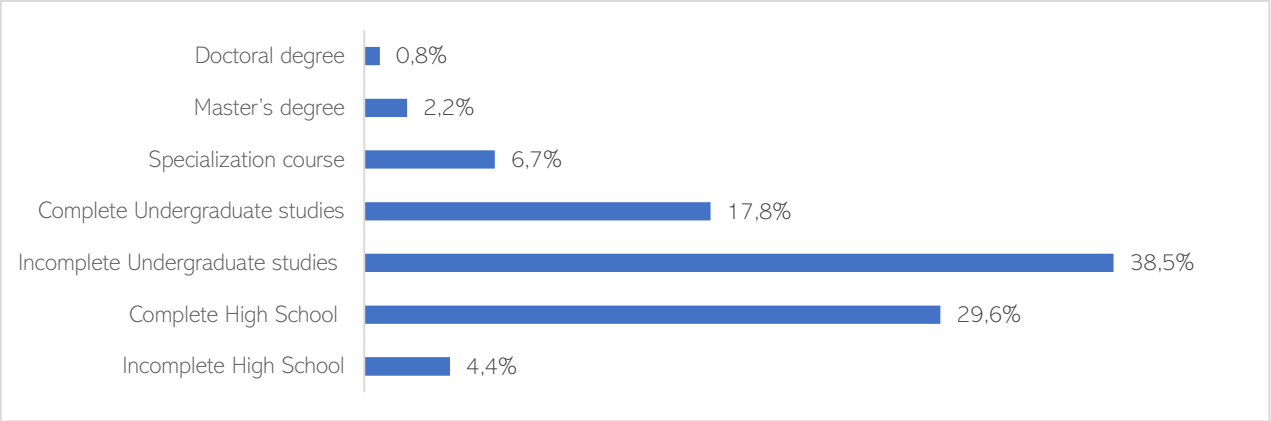

Figure 2. Education level of PIBIC-EM graduates in percentage.

Almost all participants (98.5%) reported a positive perception regarding participation in the program. For 65.2%, this experience directly influenced the choice of the current area of activity. The most frequently mentioned impacts include valued curriculum, personal and professional maturation, development of critical autonomy, and increased interest in entering higher education.

The scholarship was considered essential for staying in the program by 53.3% of the participants, although only 21.5% evaluated its amount as sufficient. These data show the role of the scholarship not only as a financial incentive, but also as a mechanism for permanence and promotion of equity (Table 1).

Table 1. The impact of scholarship during scientific initiation.

Parameter	n (%)
Did you receive a Scientific Initiation scholarship?	
Yes	112 (83.0%)
No	23 (17.0%)
Was it decisive for staying in scientific initiation?	
Yes	71 (52.6%)
No	64 (47.4%)
Regarding the amount of the scientific initiation scholarship, do you consider it:	
Sufficient	28 (20.8%)
Partially Sufficient	54 (40.0%)
Insufficient	33 (24.4%)
I did not receive a scholarship	20 (14.8%)
What was the intended use of the scholarship?	
Transport	80 (59.2%)
Eating	10 (7.4%)
Leisure	09 (6.7%)
Study	04 (3.0%)
Helping the family	10 (7.4%)
Other	22 (16.3%)

Notable motivational factors for participation in the program include the desire to acquire new knowledge (88.2%) and the opportunity to enrich the academic curriculum (72.5%). The desire to continue in the academic area was pointed out by 59.3% of the respondents, while external factors, such as the influence of the family (62.3%) and of the school (43.7%), also had relevance. In contrast, the influence of colleagues and the financial attractiveness of the scholarship had less impact, reinforcing the predominance of intrinsic motivations aimed at academic training (Table 2).

Table 2. Degree of motivation for participation in the scientific initiation program.

Variable	None n (%)	Low n (%)	Average n (%)	High n (%)
Scholarship	25 (18.5 %)	35 (25.9%)	40 (29.7%)	35 (25.9%)
Experience registered in the curriculum	4 (3.0%)	8 (6.0%)	25 (18.5%)	98 (72.5%)
Acquired knowledge	1 (0.7%)	2 (1.5%)	13 (9.6%)	119 (88.2%)
Willingness to continue in the academic area	6 (4.4%)	22 (16.3%)	27 (20%)	80 (59.3%)
Time availability	1 (0.7%)	23 (17.0%)	61 (45.2%)	50 (37.1%)
Peer influence	22 (16.3%)	62 (46.0%)	25 (18.5%)	26 (19.2%)
School incentive	6 (4.4%)	30 (22.3%)	40 (29.6%)	59 (43.7%)
Family incentive	6 (4.4%)	12 (8.8%)	33 (24.4%)	84 (62.3%)

Finally, most participants (91.9%) stated that the program enhanced their critical sense, especially in relation to current issues. Respondents' reports showed the role of discussions promoted during scientific initiation in deconstructing rumors about the university setting, fostering the pursuit of knowledge and the development of the ability to critically interpret information, including in contexts of disinformation.

DISCUSSION

The findings of this study reinforce the potential of PIBIC-EM as a strategy that promotes school permanence, the continuity of the educational trajectory and the fostering of scientific thinking among high school students from the public school system. The high rate of participants who entered or remain in higher education (66%) contrasts strongly with the national landscape. According to data from the 2022 Basic Education Census, among the 22.5 million young Brazilians aged 18 to 24, only 24.2% were enrolled in or had completed higher education; 43.4% had completed high school, but did not enter university; and 21.2% did not complete this level of education[11]. These data suggest that early scientific experience can constitute a positive differential in the educational trajectory of these students, corroborating the results of other national studies[12-14].

Previous studies show that scientific initiation in high school acts not only as a tool for academic training, but also as an instrument for social inclusion and youth protagonism support[15,16]. Complementarily, Almeida, Longhin (2024)[17] emphasize that these practices, when implemented in Brazilian public schools, promote the development of autonomy, critical thinking and transdisciplinary skills, reinforcing the pedagogical potential of scientific initiation in basic education.

The results of the present study show that most participants perceived positive impacts of the experience, especially in the development of autonomy, critical maturation and consolidation of academic identity – aspects also identified by Daminelli (2018)[8] and Bessa, Lima (2017)[18]. In addition, the fact that 65.2% of respondents stated that the program directly influenced their choice of area of professional activity shows the role of PIBIC-EM in the construction of life projects that are more connected to the academic and scientific universe[19,20].

The graduates' perception of the influence of PIBIC-EM on the choice of career and continuity of studies shows the guiding character of scientific initiation, also described in programs such as "My Summer at Fiocruz," geared toward the inclusion of girls from peripheral areas in citizen education and research activities[21]. These initiatives demonstrate that early contact with science contributes toward the education of more critical subjects, engaged and prepared to act in society.

Another relevant aspect refers to the perception of the amount and function of the scholarship. Although only 21.5% consider the amount sufficient, more than half of the participants (53.3%) pointed out that it was essential for their permanence in the program. This finding corroborates what was pointed out by Oliveira, Bianchetti (2018)[22], showing that financial aid, even modest, plays an equity role in enabling the stay of students from contexts of socioeconomic vulnerability. Accordingly, the scientific initiation public policy arises not only as a promoter of academic vocations, but also as an instrument of social justice[16,23].

The role of scholarship as a factor for permanence, cited by more than half of the participants, confirms the relevance of the socioeconomic dimension in the discussion about equity in access to science. The granting of scholarships is pointed out as a necessary strategy to guarantee the participation of low-income students[15,21].

The motivations for participation in the program, such as the desire to acquire new knowledge and to enrich the curriculum, show an engagement profile with a strong intrinsic component, as identified by qualitative studies with scholars from different regions of the country[10,24]. In contrast, extrinsic motivations, such as the amount of the scholarship or the influence of peers, were less mentioned. This pattern reinforces the role of scientific initiation as a space for critical education and the construction of meaning, beyond technical training.

At the international level, programs such as MYHealth and CFAR-HIV, in the United States, reinforce the findings of this study by demonstrating that supervised scientific experiences starting in high school promotes significant gains in scientific identity, academic self-esteem and intention to pursue scientific careers[2,3]. In convergence, Rosenbaum *et al.* (2007)[1] observed that medical schools that receive high school students for scientific experiences produce lasting effects on their academic choices.

Studies in other Brazilian Higher Education Institutions, such as those of Oliveira (2017)[25] and Silva *et al.* (2020)[13], indicate similar results, with emphasis on strengthening academic identity and encouraging the continuity of higher education. These findings reinforce the consistency of the positive effects of PIBIC-EM in different institutional and regional contexts of the country.

It is not possible to generalize the results to all Higher Education Institutions (HEIs), especially those located in regions with lower rates of socioeconomic development. Moreover, the analysis was predominantly descriptive, with no statistical inferences to establish causal relationships between the variables. The loss of contact with former participants and the regional concentration of the sample are also methodological limitations. Despite that, the data presented contribute toward filling a gap indicated by the literature[25,26], by providing empirical evidence on the impacts perceived by former students of the program.

Thus, the results of this study reaffirm the role of PIBIC-EM as an effective public policy, combining education, science and social inclusion. Boosting and expanding PIBIC-EM, with continuous institutional support, can contribute toward the democratization of access to science and the education of more critical, autonomous and scientifically engaged generations.

CONCLUSION

Participation in the program enabled the students to develop essential skills such as critical thinking, autonomy, and decision-making capacity. Furthermore, it contributed to reducing the distance between secondary and higher education, fostering the permanence and completion of education by public school students. The findings also indicate the program's potential for replication in other institutions, contributing to increase access to science and support public policies that promote science education, reinforcing the role of PIBIC-EM as a disruptive public policy, capable of impacting life trajectories.

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