

Research on the Obstacles and Paths of the Educational Role of Popular Science Books

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Abstract: In recent years, the dissemination of science and popular science books has received a lot of attention. However, people now face significant shortcomings, such as the development of social media overshadowing popular science books, oversimplification, and the prevalence of misleading information. Based on this, this paper analyzes the purpose, challenges, and strategies for improving popular science books. It identifies possible limitations in the current system, including repetitive content, and inaccuracies in information, which undermine the effectiveness of these books in science education. This paper proposes the following strategies. First of all, the update of popular science books should focus on integrating real-world applications and bridging the gap between science and daily life. In addition, the content of the book should focus on the implementation of cutting-edge themes to modernize the content. At the same time, based on the background characteristics of the current era of artificial intelligence, the update and development of books can use engaging tools such as animation and interactive online books to improve information dissemination and apply feedback tools to cultivate engagement and interest, to enhance the popularity and educational role of popular science books.

Keywords: STEM Education, Popular Science Books, Digital Era

1. Introduction

In the current era that is complex, digital, and fast-paced, people often encounter unverified, but easily accessible information. Popular science books, in this scenario, play a crucial role in bridging the gap between what the community perceives and what's real, providing a path to access studies supporting information in the science field [1]. Books like these can make science concepts understandable, relatable, and engaging, which fosters self-directed learning that is outside of schools. Given the rapid development of technology and social media, students or people who are not professionals in the specific field will be provided with brief and sometimes misleading content from social media [2]. For example, trends on WeChat Channels and TikTok. The importance of popular science books is more evident in this context; good ones offer reliable, in-depth explanations and exploration of science topics.

However, there are several obstacles faced in the development of popular science books in today's world as mentioned above. The choice of studying possible methods of improvement on the current system of popular science books arises from an observation of repetitive content and the growing need for this system to adapt to the digital environment. Some main challenges faced include digital

and social media influence, repetitive structure, oversimplification, and inaccuracy of information. To truly bring up the benefits of popular science books in today's community, which is to foster meaningful engagement with science, these challenges must be overcome [3].

This study explores the purpose, challenges, and strategies for the improvement of popular science books. Analyzing and modifying the system of popular science books to keep it as a strong tool for science literacy in the new digital age. The following aspects are considered in the suggestions section: the book creation process, the teaching component, and the spread of information. It covers the whole process of "using" a popular science book, which will help popular science books to fulfill their potential.

2. Purpose of Popular Science Books

2.1. Outside-of-School Education

Education is not just limited to schools. Many methods of teaching in classrooms can, or should be expanded to go beyond classrooms. A student-centered approach prioritizes student engagement, active participation, and autonomy, which fosters self-directed inquiry, critical thinking, and adaptability [4]. Students, ideally, interact with material based on their interests. This approach expands beyond traditional classrooms and is beneficial to lifelong learning and skill development [4]. Turns out, there's a strong relationship between the student-centered approach with popular science books.

Popular science books support outside-of-school education as they're designed to make scientific knowledge accessible and engaging for readers who may not have formal science education [5]. Unlike in traditional classrooms, these books allow readers to pace their learning, promoting curiosity without the pressure of exams or grades. Self-directed learning is flexible. In the field of science, some topics that are not talked about in-depth in schools or cutting-edge discoveries might not be accessible to the general public. This is where the purpose of popular science books comes in. By presenting information like the mentioned examples to all different age groups and various levels of prior knowledge, popular science books democratize science, allowing people who may not have advanced education to also engage in scientific discussions.

2.2. Context of the Time

As science education evolves, popular science books become a good tool for outside-of-school learning, providing fun and accurate information and bridging the gap between science and real life.

Historically, science education has undergone major shifts in teaching and learning. Science used to be taught to fit a standardized outcome, and is more on what is called "rote learning" [6]. Rote learning is getting new knowledge, rejecting some of the previous knowledge that is incorrect, but not creating any connection from new knowledge to anything [6]. Without any connection and not learning because of interest can make science learning unattractive to younger audiences. Popular science books, in this case, support a shift to expand science study outside of school and drive learning based on interest [4,5].

People in the modern world are starting to value cultural relevance more and more. It's not limited to relating to previous knowledge but also making students resonate with what they learn, making these concepts "close" to students' lives [3]. This also aligns with the reason for reading popular science books. They can help science to gain diverse audiences and be more understandable to people even without formal science education since they are more related to the real world and are less formal than in classrooms. Popular science books should be able to show real-world applications that help with understanding content.

The rapid transformation in how people consume information further emphasizes the relevance of popular science books. Building on their role as a tool for self-directed learning and cultural relevance, these books also serve as an important source of accurate information in the modern age. Content on social media can often lead to oversimplification or even misinformation. Furthermore, these contents are usually more easily accessible online in daily life due to the prevalent platform. All this highlights the importance of the existence of popular science books, which teach more detailed and nuanced understandings of science concepts. While these books are beneficial for getting supported information in science fields, the development of society points out the need for this popular science books system to change with it.

2.3. Addressing Students Needs

Different students will have different student needs. Popular science books are available to students as a flexible, engaging, and culturally relevant place to learn about science, supporting curiosity.

Finding an interest in a science field and finding a popular science book to read is not the only thing included in the purpose. Sometimes it's not from interest to book, but from book to interest. Some students can thrive in a less structured learning environment, which is exactly the "environment" a popular science book would provide. Some approaches are already proposed that can be implemented into how popular science books are made and taught. One example is the PBL [7]. PjBL, which is "Project Based Learning", supports creative problem-solving by encouraging students to connect scientific knowledge with real-world issues [7].

Avraamidou proposed an approach similar to culturally relevant pedagogy. Students will be more engaged and retain information better when elements from their daily lives, backgrounds, and interests are reflected in what teachers are showing them [1]. For popular science books, the information included should consider this aspect. Also, Avraamidou emphasized the importance of using inquiry-based learning approaches in science education. Students should be encouraged to ask questions, investigate questions they are proposed or come up with by themselves, and draw conclusions about them [1]. The purpose of popular science books is to encourage inquiry-based learning by presenting science in a way that encourages readers to be critical thinkers, ask questions, and explore more topics after getting the "inspiration" from the book.

3. Obstacles Faced During the Development of Popular Science Books

Lots of purposes of popular science books are mentioned above, such as allowing student-centered learning outside of school, spreading scientific knowledge to people who may not have formal science education, providing in-depth content, fostering interest in science, and so on. While these are good qualities that ideally should be included in popular science books, some of them are hard to accomplish or are not met by some popular science books.

3.1. Keeping up with Digital and Social Media Influence

It is mentioned that popular science books should make up for the misleading information on social media. But how to accomplish it when people prefer faster information on social media? Popular science books now face the challenge of resolving misinformation and keeping the content engaging at the same time.

Höttecke & Allchin proposed that traditional science education struggles to compete with the influence of social media [2]. Research shows that less than 20% of US teens prefer reading a book, magazine, or newspaper daily, the rest use social media like Facebook and TikTok every day [8]. The shift from consuming information through books to social media puts pressure on scientific

communicators to simplify complex content to what's more engaging while maintaining the accuracy of information. This pressure can lead to inaccurate information.

3.2. Inaccuracy of Information in Popular Science Books

As mentioned by Höttecke & Allchin, science can be inaccurate [2]. There are more problems with the information included in popular science books. In the discussion on pop psychology, many popular psychology works that are supposed to be used for understanding concepts or self-help advice lack empirical support and rely on anecdotal evidence or untested theories [9]. This is problematic and not limited to the field of psychology. For instance in astronomy, when discussing wormholes and time travel, the topic captivates audiences. However, they often rely on speculative theories or preliminary findings that are not experimentally validated. Similar to psychology and other science fields, presenting ideas that are not empirically supported (or insufficiently supported) can blur the lines between fiction and facts.

There are also cases where science discoveries are sensationalized or misrepresented when presented, to attract public attention [9]. For instance, when talking about genetics, discoveries are sometimes hyped as the "gene for" traits like intelligence, behavior, or disease [9]. Another example is framing introversion and extroversion as fixed and biologically driven traits without considering environmental effects can result in a reductionist view of personality. The simple representation of concepts does not represent the complexity of real-life studies, and sensationalized information can reinforce stereotypes or leave an impression that science is simple [9]. But books like the ones described do not fit this purpose, and it's a challenge to modify or eliminate books like these.

3.3. Repetitive Information

Some popular astronomy books often follow similar structure or content themes, such as Big Band, the Sun, planets, and so on. While to beginners in astronomy, knowing these foundational concepts is essential, presenting information with the same level of simplicity in too many sources will cause the content to be unchallenging. This will then lead learners to think that there's little depth to explore, thus making the subject feel shallow.

Being exposed to the same simplified explanations repeatedly will cause cognitive overload, where learners become overwhelmed and disengaged because of the repetitive content [10]. In this case, readers may feel as though they're not advancing in their understanding which will cause a reduction in motivation and eventually lose interest in science, while interest is an important aspect of popular science communication [10].

Overall, in this case, imagine popular science books face a strong competitor, social media, some books no longer present accurate or in-depth enough knowledge, and there is a lot of repetitive content. These components are making popular science books less and less prevalent and preferred by people.

4. Strategies for Improvement

4.1. Choice of Information

As Martín-Páez et al. says, it is important to integrate science, technology, engineering, and mathematics to reflect real-world applications [5]. To make STEM learning more interesting and suitable for learners, especially younger ones, popular science books should include real-life context helping learners see the purpose of learning the knowledge and make it more relatable [5].

If the above one focuses more on keeping readers interested, the following will emphasize modernizing science education. In "Developing and Implementing an Einsteinian Science Curriculum from Years 3 to 10" Kaur et al. point out to include quantum physics and relativity from an early age

to modernize science education, showing the need to include information outside of traditional knowledge such as classical mechanics or basic astronomy [11]. This will form a better curriculum that demonstrates a contemporary scientific understanding [11].

As an example, in biology, books can mention modern scientific advancements such as CRISPR gene-editing technology. The book could illustrate CRISPR's role in curing genetic disorders or help enhance crops so it would address food security challenges in other fields. By connecting advanced topics to real-world science advancement makes contemporary biology both accessible and relevant to readers [1,5].

4.2. Spread of Information

The key to successfully spreading information, especially with the development of social media and quick information nowadays is to adapt to the fast-paced and engaging nature of information nowadays. When choosing information for popular science books, authors should aim to strike a balance between depth and simplicity, making content engaging for beginners while retaining intellectual rigor for more advanced readers [11]. To achieve this, there can be engaging visualizations together with the information taught.

Strategies from the Einsteinian curriculum can be very useful for instructors to teach popular science books, which utilize visuals and hands-on demonstration, such as using props or simulations [11]. Some knowledge encompassed in popular science books can also be made into music videos or videos with pictures or animations. These methods can help explain the knowledge more clearly, in more detail, or expand on that. For instance, music videos can include catchy lyrics that help memorize science facts, like the periodic table; animations showing the dynamics of black holes or DNA replication can provide clarity that static images and text cannot.

Another way is to make popular science books into interactive, online books. Putting the book online allows the book to be linked with much more content, such as online simulations, and 3D models. Readers would be able to click on links when they encounter a topic they are interested in. This makes the online book not simply a digital version, but more advanced, which motivates readers to be active participants in the learning process.

5. Conclusion

To conclude, popular science books can still be a useful tool to spread science knowledge to all people in a rapidly evolving digital world nowadays. By putting together real-world applications, modern scientific advancements, and engaging, interactive activities, popular science books can be easily digested by various readers even under the influence of social media and the oversimplification of information that lessen the effect of these books. The audience can include self-learners as well as students from all levels of education.

Going forward from now, the role of popular science books in science education will not fade away, and their impact can be strengthened with the strategies mentioned and with the adaptation to the digital age. Popular science books will be an important step in filling the gap between science and society.

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