

A Study of Students' Representations of Their Virtual Classroom*

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Abstract: An adequate cognitive map of the virtual classroom (VC) is necessary for one's successful adjustment to their learning environment. A student's cognitive map is reflected in his/her representation(s) of the VC. In our research we studied such representations in 72 graduate students specializing in education and enrolled in the same distance online psychology course. The method included: a) analysis of the participants' illustrations and descriptions of their VC; b) evaluation of correlations between the adequacy of their cognitive maps and other their characteristics, namely academic achievement and online learning experience. The results showed that the majority (73%) of the investigated population lacked adequate cognitive maps of their VC. No correlation was found between the degree of the students' cognitive maps adequacy and their online experience. We hypothesize that in their previous online courses many of our students were not taught to orient in a virtual environment. That is, while they were studying the subject, they failed to master the learning instruments. We conclude that additional instructional support — more goal-oriented and systematic — is essential for helping online students, especially novices, to develop skills for becoming successful and productive learners.

Key words: virtual learning environment, virtual classroom, orientation, cognitive map

1. Introduction

Nowadays, in the epoch of widespread incorporation of information technology into education, distance online programs have become very popular. The students, whose specialty is far from natural sciences and who lack general technical culture, come to online classes along with experienced computer users. However, distance online education is not a simple copy of traditional forms of education to the new environments. It has its pitfalls, specific difficulties, and requires new styles of teaching and learning. One of such specific features of online education is the necessity for online students to permanently explore technological innovations. In a virtual classroom (VC), the study of the subject goes hand-in-hand with the study of new instruments provided for studies. Mastering these tools may be hard tasks for those who lack technical know–how. If their need, such as assistance in orienting in the online classes, is not met, it may act as a barrier to successful learning.

Our research is devoted to the question of how well the online students know their VC and information-technological tools with which they study the major subject.

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2. Theoretical and Conceptual Frame

2.1 Educational Process

Education is the process by which society deliberately transmits its cultural heritage from one generation to another through schools and other social institutions. Traditionally, the process of learning, enlightenment, and transfer of knowledge from teacher to students — as well as the process of acquiring knowledge — takes place in classrooms. However, what occurs in a classroom is not limited to academic activities. The educational institutions and the educational process implemented by them follow certain administrative rules and regulations. In addition, the transfer of knowledge and its uptake are due to the constant communication between the participants. Finally, technical tools are widely used in education, and the VC itself can be considered as a useful information-technological tool. So, academic, administrative, communicational, and information-technological aspects are important components of any educational process. Internet-based distance programs add a new component, which we call virtual, to education. This new component transfers teaching, learning, and communication between participants into an artificial cyber environment based on electronic imitations of reality.

In Figure 1, our vision of the educational process in the VC is exposed. It includes the five basic aspects mentioned above. As our experience shows, this model of education is more or less fully embodied in the device of any online course.

2.2 Cognitive Map of the Virtual Environment

The term was first coined by the behaviorist Edward Tolman (Tolman, 1948). Eventually, cognitive maps became a subject of cognitive and environmental psychology (Kitchin, 1994). Typically, cognitive map is defined as a mental representation of the layout of one's environment. A more precise definition is: "a cognitive map (also: mental map or mental model) is a type of mental representation which serves an individual to acquire, code, store, recall, and decode information about the relative locations and attributes of phenomena in their everyday or metaphorical spatial environment" (Cognitive mapping; Lynch, 1960; Mapping: cognitive maps).



Figure 1 Major Aspects of the Educational Process Exposed in the VC

Virtual learning environment is a "metaphorical spatial environment". It does not surround us; it exists in insensible and untouchable space, and our mental image of it is rather a product of our imagination. However, it still exists and to perform learning activities successfully, one should adjust to it, orient in it, and develop its complete and adequate cognitive map.

Knowing the specifics of learning in a virtual environment, specialists develop toolkits purposefully directed to the formation of an adequate technological image of the VC for the online students. In their manuals, the

authors describe in detail how to navigate through and move step by step in a learning environment, to find the paths to various course objectives, and develop the cognitive map review of the course (Johns & Blake, 2001; Meilinger, 2008).

The virtual environment is an information environment. To create a cognitive map of the VC, a student explores all search paths of information contained in this VC about all aspects of the educational process needed for the study in the course.

2.3 Our Virtual Classroom: Developing of its Mental Model

Arriving to an unfamiliar city and finding oneself in a new space, first what we want to obtain is the city's map. We use it until the routes we need turn into stable cognitive maps of the paths. When all of them merge into a single mental picture, the cognitive map review occurs. Of course, virtual environment differs from the real geographic space, but the metaphor still helps to understand how online students develop mental models of their VC.

Figure 2 shows a fragment of the main page of our online course where this study was conducted. On the left side of the screen, there is a menu with links leading to the major content areas of our course site. Each content area has information about the course content and organization. When pushing buttons of the menu and examining the underlying content areas, students become familiar with various aspects of the educational process embodied in the VC where our course is running.



Figure 2 The Main Page of the Online Course Where the Study was Conducted (Fragment)

The *College Policies* link leads to the administrative aspect of the VC. On this page, the students find requirements pertaining to course participation, communication, and coursework submissions. They become familiar with the rules of online communication, net etiquette, and academic integrity standards concerning cheating, fabrication, and plagiarism. The college policy regarding grading students' work, as well as dropping the course and getting incomplete grades, is also located under this link.

The *Syllabus* link leads to information about all aspects of the educational process. The academic aspect is represented by descriptions of the course content, organization, structure, expected learning outcomes, and coursework (assignments, papers, projects); the course schedule includes all the topics of the study, required readings, activities on the Discussion Board, and homework assignments for every week. The administrative aspect includes grading rubrics, criteria for evaluation of course work, detailed requirements for course attendance, participation, and communication. The information-technological aspect includes requirements for the students' computers and their computer skills needed for taking the course. The communicational aspect includes descriptions of the ways in which the students communicate with their professor and classmates (online office hours, email, messages on the Discussion Board, feedback).

The *Course Information* link leads to a page notifying about the academic and administrative aspects of the VC. Here students become familiar with how the course is organized, the course activities, and the reading materials; they find requirements for the computer (hardware, software, operating system) and e-mail address. Disciplinary requirements for submitting the coursework are presented here also.

The *Coursework by Week* link has information about all aspects of the VC. The academic aspect is represented by assignments, Discussion Board activities, additional materials for mastering the topics, and learning outcomes for each week. The information-technological aspect includes the instructions on working with Blackboard software. The administrative aspect focuses on assessment criteria for grading coursework.

The next four links represent the communicational aspect of the VC. *Instructor Information* familiarizes students with their instructor's professional background and has instructor's contact information and office hours. *All Announcements* presents information about the ways to overcome various current academic or technical issues as well as recommendations on optimal use of the Blackboard. *Send E-mail* allows students to discuss professional as well as personal issues with their instructor and with each other. The *All Discussions* link leads to the Discussion Board, the only area of the VC where participants can "meet" each other, have conversations, and exchange opinions. Here students and their instructor have weekly asynchronous dialogues on the actual topics of the subject studied.

The *Blackboard Help* link leads to descriptions of technological resources (Blackboard Video Tutorials) and connects students who have technical problems with the college online Technical Support Center.

The *Library Homepage* link helps to perform academic tasks. It offers resources available at the college and helps students to reach the most popular Internet databases containing scientific resources needed for the course.

The data listed above are necessary and sufficient for students to develop adequate mental models of the online course with all its opportunities, specifics, requirements, and limitations. Without forming it, it would be impossible to successfully study in our VC.

3. Research

3.1 Goals, Hypotheses, and Methodology

The purposes of this research consisted of the following:

(1) To develop methods for obtaining and analyzing students' cognitive maps of the VC which they develop when operating the course site;

(2) To explore factors which affect students' mental images of their VC;

This research was based on the following postulate: A complete cognitive map of the VC includes a

representation of the five following aspects of the educational process: administrative, academic, communicational, information-technological, and virtual. Matching one's cognitive map with this model is an indicator of one's mastery of the VC.

Our hypotheses consisted of the following:

(1) Cognitive maps formed in the process of students' study in the online course can be represented verbally as well as illustratively;

(2) There is a connection between the degree of accuracy of students' representations of the VC and their academic achievement;

(3) Previous online experiences may influence students' ability to completely and adequately form cognitive maps of the VC they work in.

The method included:

(1) Formulation of rules for decoding and interpreting students' representations;

(2) Determination of students' cognitive maps' compliance with the model of the educational process specified in this study;

(3) Calculation of correlations between the degree of accuracy of the students' cognitive maps and their final grades as well as the number of online courses taken.

3.2 Participants

Seventy two students from the Graduate School of Education at Touro College participated in the study. All of them took the same online psychology course *EdPs620-Child Development and Learning in Cultural Context* in different semesters of 2015 with the same instructor (the author of this study). For 11 participants (approximately 15%) this was their first exposure to an online course, and they had to go through preliminary training to become familiar with the Blackboard platform. Thirty two (44.5%) participants were males, while 40 (55.5%) were females. The average age of participants was approximately 30 years.

3.3 Procedure

The experimental task was a part of a homework assignment in our online course. The instruction given to students consisted of the following: "Your task is to determine what our virtual classroom looks like and how it can be represented as an image on a paper. Please provide your image of our VC and include a description which may help us to understand your representation. It may be a drawing, plan, or chart. It is your choice how to create it." Students worked independently, and at first, submitted their assignments to the instructor for evaluation, secondly, it was then posted to the Discussion Board for online discussions amongst classmates.

4. Analysis of Data

4.1 Principles of Interpreting Students' Illustrations of the VC

Typically, students' representations of the VC were accompanied by descriptions. Some descriptions just repeated what was represented in illustrations. Some others complemented illustrations; it can be explained by some individuals' undeveloped abilities in the fine arts. Regardless, both illustrations and accompanying descriptions were accepted and analyzed.

We relatively easily identified aspects of the educational process in students' descriptions. For example, in the sentence, "The Virtual Classroom is a method to communicate ideas and provide learning materials and technical supports for the students", there are three key concepts — *to communicate ideas*, *provide learning materials*, and *technical support* — that precisely point to communicational, academic and information-technological aspects. In the other sentence, "Our professor provided us with the syllabus," all aspects of the educational process are reflected in the keyword *syllabus*.

To analyze and interpret students' non-verbal images of the VC, we invited two experts, an artist and a scientist. Their task was to determine by what symbols each of the five aspects of the VC may be represented. Experts worked together and discussed each student's illustration as well as each fragment of it until they came to a common opinion. They associated each aspect of the VC with a certain set of images produced by students. In other words, they worked out formal rules for interpreting the students' illustrations. These rules are shown in Table 1.

The elements of an illustration	Corresponding aspect(s) of the educational process		
A book or a pile of books; a handout with or without a pen	Academic		
Handout with an instructor's remarks and grades	Academic + communicational		
Syllabus	All aspects		
A computer or a computer network with no people	Information-technological		
A keyboard or a mouse with/without a cord	Information-technological		
Typing fingers on a keyboard	Information-technological		
A writing or reading student at the table	Academic		
A student or a group of students in front of the computer(s) with/without the fingers on keyboards	Information-technological		
A student/group of students in front of the computer(s) connected to each other/the instructor by lines with/without arrows	Information-technological + communicational		
Faces directed to each other as if they are speaking	Communicational		
Speech balloons	Communicational		
A teacher with a syllabus in his/her hand	Administrative		
A teacher with a pointer/book/handouts or next to a blackboard	Academic		
A teacher with her/his face directed to students	Communicational		
A teacher in front of a computer with fingers on a keyboard	Information-technological		
A teacher working with students in a computer network	Academic + info-technological + communicational		

Table 1 Rules of Interpreting Students' Illustrations of the VC

4.2 Examples of Cognitive Maps and Their Interpretations

Students used various techniques for creating the cognitive maps: drawings on a paper, many kinds of applications, and illustrations made with Microsoft SmartArt Graphic or Photo Shop software. Examples of these cognitive maps of our VC are demonstrated below.

The student A.J.'s illustration of our VC is presented in Figure 3. The syllabus and the instructor are at the center of this illustration; that is how an administrative aspect of the VC is presented. A group of the elements titled "Work and discussion between peers" at the bottom reflects academic, communicational, and technological aspects; the textbook is a symbol of learning, two speech balloons mean message exchange, and hands on the computer board point to technology. In the "Teacher Talk" element on the left side, attention is given to feedback provided by the instructor, i.e., a communicational aspect of the VC can be identified here. The element "Students on computers" on the top of the picture is associated with technical knowledge and skills and represents an

information-technological aspect of the VC. The element titled "Much thinking takes place" on the right side is obviously related to academic activity. The arrows outgoing from the center to the other elements of the picture symbolize interrelation between all aspects of the VC.



Figure 3 Our Virtual Classroom Represented by the Student A.J.

However, we consider A.J.'s cognitive map of our VC incomplete. By using big letters, she emphasized "Helpful Links" given in the course syllabus, but she did not specify which particular links were helpful, and we are not sure that she meant connections to external Internet resources. In our opinion, the virtual aspect is missing in this representation. This VC is somewhat isolated from general virtual learning environment.

The student S.R.'s representation of the VC is shown in Figure 4.

Inside the Internet's all-embracing virtual environment, Touro's virtual space can be seen and inside it, on its intersection with the instructor's virtual space, the students' virtual space appears. Among students, the virtual "Me" inhabits. This VC is not isolated; the student S.R. portrayed it as a component of a larger virtual learning environment which he perceived as a multistory construction.



Figure 4 Our Virtual Classroom Represented by the Student S.R.

S.R.'s illustration is complemented by the following description: "A virtual classroom is a very modern

invention. In fact, this course is the first time I've ever used the concept. I still, whenever I hear "virtual classroom," think of a science fiction film where there are holograms of students arranged in the good old-fashioned set-up of a regular classroom, desks and all. In many respects, the virtual is quite like the regular classroom set-up with students following a curriculum that is driven by the professor and college with their rules and expectations, except our tables are very far apart! <...> There has been great communication between fellow students and the professor, but in such a stilted manner we could be on a spaceship, far away from Earth, with the time lag that comes with great distance communication. Saying that, I really have enjoyed the freedom and responsibility the virtual classroom has provided."

In his Venn-diagram, S. R. showed a virtual aspect of the VC, and all other aspects of the VC are mentioned in his description. Academic and administrative aspects can be seen in the following sentence: "Students following a curriculum that is driven by the professor and college with their rules and expectations." Communicational aspect is obviously reflected in the phrase "*communication between fellow students and the professor*..." Information-technological aspect is mentioned in the phrase "*hours in front of a computer screen*". We consider this cognitive map of our VC to be accurate.



The student V.M.'s representation of the VC is shown in Figure 5.

Figure 5 Our Virtual Classroom Represented by the Student V.M.

In the student's chart, our online course (shown in orange) is a part of the Touro College portal (shown in grey) and is located at the lower level of the college virtual space. Each of the five orange rectangles represents one or more aspects of the educational process, so that all aspects are represented here: Course Policy shows

administrative aspect, Course Organization shows administrative and academic aspects, Course Content shows academic and technological aspects, Blackboard Resources shows technological aspects, and Discussion Board shows academic, communicational, and technological aspects. The college's and course's resources together provide necessary information and tools for learning. At the same time, the college is connected to a variety of Internet resources: external electronic libraries (shown in green) as well as technological tools (shown in violet) which are also needed for the study in the online course.

Like two other representations shown above, this one is a subjective view of our VC. However, despite possible deficiencies, it clearly embodies an important idea of a virtual learning environment as a multistory and multifunctional virtual space.

4.3 Mathematical Analysis

If it was reflected in a students' illustration, each of the five aspects of the educational process received 1 point; its absence was set to 0. The maximum number of points for the cognitive map's representation was 5. The students' academic achievement *AA* was represented by the final course grades. The students' online experience *EXP* was represented by the numbers of previously taken online courses. If a student had taken no online courses, his/her experience was set to 0. The sample fragment of students' data is presented in Table 2.

Tuoto 2 The Sumple Trughent Representing Students Data									
	Aspects of Educational Process illustrated in students' cognitive maps				students'	Cognitive Map	Academic Achievement	Online Experience	
	Ad	Ac.	С	I-T	V	СМ	AA	EXP	
1.	1	1	1	1		4	92	1	
2		1	1	1	1	4	94	0	
3.	1	1	1	1		4	95	3	
4.		1	1	1		3	90	2	
5.		1	1	1		3	90	4	
6.	1	1	1	1	1	5	97	5	
7.		1	1	1		3	90	3	
8.	1		1	1		3	94	7	
9.	1	1	1	1	1	5	100	1	
10	1	1	1	1		4	95	3	
11		1	1	1		3	86	3	
12			1	1		2	84	3	

 Table 2
 The Sample-Fragment Representing Students' Data

Note: The leftmost column presents students; Ad is a short abbreviation for *Administrative* aspect; Ac is the same for *Academic* aspect; C – for *Communicational* aspect; I-T – for *Information-Technological* aspect; V – for *Virtual* aspect of the educational process; CM is a short abbreviation for *Cognitive Map* and shows a sum of aspects of the educational process reflected in a student's illustration.

Every student can be specified by a tuple of three numbers shown in the three right columns of Table 2. Based on this data, the correlational analysis was conducted between three characteristics: accuracy of a cognitive map (CM), academic achievement (AA), and online experience (EXP).

From the mathematical point of view, a variable corresponds to every aforementioned characteristic. The variables belonged to the categories of quantitative and ordinal scales, and their distributions differed from normal one. To find how strong relationships were between the variables, Spearman's correlation coefficients were

calculated with the use of the following formula:

$$r_{s} = 1 - \frac{6\sum d_{i}^{2}}{n(n^{2} - 1)},$$

where *n* is the number of paired observations; x = (x1...xn) and y = (y1...yn) are distributions of the chosen variables; d = rg(xi) - rg(yi), is the difference between the two ranks of each observation (Spearman's rank correlation coefficient). The correlational analysis was done with the use of SPSS, a package of applied statistical programs for social sciences (Nie N., Bent D. & Hull C., 1970).

5. Results and Discussion

5.1 Performers vs. Nonperformers

In 2015, 72 students studied in the author's online classes, and all of them received this assignment: to illustrate our VC. However, not all of them performed the assignment; fifteen students (20%) did not even start it. They did not answer the question despite the additional instructor explanations and availability of the samples submitted by their classmates to the Discussion Board. It means that the concept of the VC was foreign to them. The task was beyond their knowledge and skills. They lacked overall preparation for the solution of the problem. Surprisingly, the majority of students in this category still completed the course with passing grades. However, it remains unclear what and how they have learned. Among them were diligent individuals but, apparently, not yet ready for new forms of education — distant and based on information technology.

5.2 Complete vs. Incomplete Cognitive Maps

We expected that students having worked with the course site during the semester and "walking" one and the same virtual paths many times, would memorize the information those paths led to, and also connect the paths, and build a complete cognitive map of the VC with the whole set of its functions. However, only four (approximately 7%) out of 72 students included all five aspects of the education process into their picture. In the pictures of the other 53 students (approximately 73%), the VC was incomplete that is, one, two, or three aspects of the educational process were missing. So, the majority of the investigated population did not provide a complete image of their VC. This result is shown in Figure 6.



Figure 6 Population of Students Who Took the Author's Online Psychology Course in 2015

Students' representation of different aspects of the educational process in their VCs is displayed in Figure 7. It is clearly visible that the triad of academic, communicational, and technological aspects was mentioned by most participants of the study. Meanwhile administrative and virtual aspects were included in the cognitive maps by a relatively low number of participants.



Figure 7 Aspects of the VC Represented in Students' Illustrations

5.3 Virtual Egocentrism and Virtual Anarchism

As the results show, most of our online students were not aware of their VC as a part of a broader virtual learning environment, all divisions of which are connected to each other. No doubt, when studying the students turned to e-libraries and technology tools but did not actually realize that they were dealing with external virtual institutions. Such individuals' perceptions of VC were limited by an image of the group of classmates and their instructor communicating about the coursework. This image of the virtual classroom is not very different from the traditional one, while the online learners, holding such a picture of the VC, are somewhat egocentric. We named the phenomenon that they exhibited *virtual egocentrism*.

As the results show, most of our online students ignored the administrative aspect of education in their illustration of the VCs. We named this phenomenon *virtual anarchism*. However, it was rather a spontaneous and unconscious tendency.

The administrative aspect of the educational process is a necessary bureaucratic framework for the instructor's as well as the students' activity. Normally our students followed disciplinary requirements and observed the rules of online communication. Otherwise, they would not pass the course. However, they might obey some policies disliking them. Strict deadlines for submitting coursework, special rules for formatting texts and files, grades affected for violations of the course requirements, — all of them could provoke discomfort in students, specifically online novices. Since many of them adopted a style to which they hadn't gotten used, they might experience cognitive dissonances (Festinger L., 1957). A cognitive dissonance always comes with anxiety, and it tends to be repressed (Freud S., 1935). When creating the cognitive maps of the VC, many students did not include the administrative aspect into their illustrations because they tended to forget circumstances associated

with discontent and anxiety. Probably, the students, mostly young, perceived bureaucratic order as an obstacle to their creative activity. Anyway, it takes time and experience to adjust to the new learning environment and learning style, rather productive and beneficial.

5.4 Academic Factors and Mapping of the VC

At first, we assumed that students with high academic achievement can easier build a complete cognitive map of the VC with a whole set of its functions. Indeed, correlational analysis showed a positive connection between the degree of completeness and adequacy of students' cognitive maps and their final grades for the course $[R_s(CM, AA) = 0.78, p < 0.001]$. In other words, the more adequate a student's cognitive map of the VC is, the higher his/her academic achievement and vice versa: the better a student is prepared academically, the better s/he masters the VC.

The result is not a surprise. If students are diligent and curious, it impacts both how they learn the subject and how they master the tools for learning. After all, the VC is nothing but a tool for learning.

At second, we hypothesized that students, who have already taken online classes, came to our online course with already formed generalized maps of the VC, and could easier build cognitive maps of our VC. This hypothesis was not confirmed. Correlational analysis showed no connection between the degree of completeness and adequacy of students' cognitive maps and number of online courses previously taken by them [$R_s(CM, EXP$) = 0.03, p < 0.05].

Completeness and adequacy of one's cognitive map did not depend on a number of previously taken online courses. In our study, novices expressed interesting ideas and even made discoveries, while experienced online students who had already taken several courses in distance programs demonstrated poor mental images of our VC. So, previous online experience was not helpful. Possibly, in the past, when moving from one course to the other, these students had not acquired skills for developing cognitive maps of their VCs.

Perhaps such a goal was not posed before them in their previous online courses. Online instructors of social sciences often overlook that the online students also need to be taught the instruments of learning. So, students were taught the subjects and were not taught how to become productive online learners.

We cannot exclude another possibility: the online classes they attended before might not have provided them with an opportunity to successfully navigate through a new learning environment and successfully develop its cognitive map. It usually occurs when the online courses' design is confusing. It may happen in the field of social sciences if online courses are developed by non-experts. The online courses which are developed unprofessionally become a serious obstacle for training qualified online learners.

6. Conclusion

One of the most important features determining adjustment to a new learning environment is the ability to quickly, independently, and flexibly orient oneself in all aspects of this environment. It means grasping ideas of information-technological resources as well as the online course organization with its academic, administrative, and communicational requirements. It means developing an adequate cognitive map of this virtual environment.

According to the results of our study, the majority of the investigated population had incomplete and inaccurate cognitive maps of our VC. Their previous online experience did not help to adequately form a mental image of a learning environment in which they study. This research was conducted in an average American college. There are reasons to believe that such a result reflects some general tendency that characterizes the

students specializing in social sciences, and specifically, in education.

The author concludes that a confusing design of online courses, which does not allow a direct and simple navigation through it, can be responsible for students' inability to eventually develop complete and adequate cognitive maps of their VCs. This point of view is consistent with the other specialists' views considering the usability of virtual learning environments responsible for online students' skills to quickly and easily accomplish tasks, the steps of which were learned previously (Graetz, 2006).

Online education is not only teaching a subject. Teaching in the VC should also aim at transmitting knowledge and skills needed for students to become competent online learners. A preliminary orientation session for online students is necessary but not sufficient. To form "virtual mentality" in students, certain training for managing the technological tools should occur simultaneously with the actual teaching of the subject. Ideally, each online instructor should carry out this mission.

If education is for the masses, it loses some of its quality, a fact which seems to be undeniable at least for traditional education (Ravitch, 2000; Harden, 2012). The same may happen with distance online education. The issue seems to be multidisciplinary and can be solved by joint efforts of various specialists: psychologists, information technology experts, and educators. We have to cooperate if we do not want the distance online education for social sciences to turn into fiction.

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