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The Health Content Ecosystem of Bilibili Based on Behavioral Data Mining: An Analysis of the Correlation Between Content Professionalism and User Engagement in the Health Supplements Category

Yuxian Yang

Xiamen University Malaysia, Selangor Darul Ehsan, Malaysia
YANGYUXIAN1028@outlook.com

Abstract. This article is an empirical statistical analysis of health supplement contents in the Bilibili platform in January 2023-June 2024. 1,188 initial video samples were cleaned and validated and 589 of them were retained to be analyzed. The research is based on the joint impact of the content nature and product typology on users in terms of engagement behaviors, which are studied by the means of a two-way ANOVA. It is concerned with dealing with the mechanisms and the effects of interaction of content professionalism and health supplement categories on the light and deep engagement indices. These findings indicate that the High-Professional content is much better in facilitating light engagement behaviors like liking and collecting content. This implies that professional, credible content is received in a positive way by the users in the health supplement domain. Emerging-Social products cause a strong effect on the deep engagement behavior such as commenting and sharing whereas for the High-Decision-Difficulty products there is basically no effect which could probably be attributed to the high information needs and long decision making processes. Interaction effect content professionalism and product categories did not have significant effect to the user engagement indicating that the two are independent variables. This observation suggests that content strategy and product attributes have an impact on various aspects of engagement, and marketing strategies ought to aim at attracting them each separately instead of acting on them in a joint way.

Keywords: Bilibili, Health Supplements, Content Professionalism, User Engagement, Two-Way ANOVA

1. Introduction

With the progress of the Healthy China Initiative and the growth of the national health awareness, Bilibili, as an educational community that has become popular among generation Z, is experiencing a tremendous growth in the amount of videos posted on health supplements. It has turned out to be an important area in shaping the health consumption choices of the users. Nonetheless, there are significant differences between the professionalism of content created by creators of various

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backgrounds, and the difficulty involved in making decisions regarding the various types of health supplements. The study has considerable implications regarding enriching health communication theory, developing the content ecosystem of the platform, assisting students of the UP master's in the creation of content, and optimizing the marketing of the brand. The main aim of this research is to quantitatively examine the correlational patterns of content features, product categories and user engagement in Bilibili health supplement videos and also confirm the main and the interaction effects of content professionalism and, types of supplements. The final research purpose would be to establish, in an orderly manner, the mechanism of effectiveness of health supplement content in relation to Bilibili, and to support in detail the corresponding practices. To fulfill this objective, this study will take the form of logical structure of “Literature Review and Research Design and Results Analysis to Discussion and Conclusion and uses a quantitative analysis to explore the relationship between variables.

2. Literature review

2.1. Digital shift in health information dissemination and core theories

The old paradigm of health communication is being radically transformed into the socialized, visual, interactive media and is passed through authoritative organizations. Social media and short videos due to a high penetration and great popularity have become one of the important mediums of health information and have had great effect in the behavioral intention and decision making process of the users. According to the elaborated Technology Acceptance Model (TAM), as Liu et al. confirmed, perceived usefulness, ease of use, trust, and perceived interactivity of the users are good predictors of their intention to use them and positive attitudes in the context of using health-related short videos [1]. This implies that a complex analysis of technology acceptance psychology and building of relational trust needs to be applied in the case of content dissemination effectiveness. The observation echoes the classical theory of communication. According to the theories, the Source Credibility Theory offered by Hovland et al. implies that credibility, as well as professional authority, of the communicator, is at the center of the persuasive impacts [2]. This theory is not helpful to explain something new in the digital environment, which means that high-credible sources can better contribute to change in the attitude and compliance with the behavior of users. The authors Liu and Zhang created a five-stage model of Watch-Decide-Acquire-Fulfill-Evaluate-Use and the most important point was that users participate in the process of information reliability verification between platforms [3]. The psychological mechanisms of decision-making were expanded by experimental research of Guttner et al. because although the digital environment contributes to the expansion of information overload and mental impairment, the third-party views may lessen the level of regrets [4]. With these two studies added together, one may propose that product decision difficulty is a possible moderating factor of engagement behaviors. On this ground, this paper classifies health supplements into High-Decision-Difficulty type (high involvement needs a lot of information search), Emerging-Social type (product motivation is influenced by a trend), and Basic-Conventional type (low involvement) to investigate the various differences in the effects of product category characteristics on light and deep engagement.

2.2. Core content features influencing user engagement and platform context

The engagement behavior of users with health information is a multi-level construct, in which the light interaction (e.g. liking, sharing) is at one end (and the practical application at the other end).

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Paul and Headley-Johnson also indicate that although moderating variables are content format and type of platform, intrinsic nature of content is important [5]. A systematic study by Yip et al. had shown that the content that is associated with emotional support or positive behavioral change and that is of high quality, in terms of visual representation, can significantly increase the level of user engagement on social media [6]. This alludes to design logic of the content of High-Interaction type. At the same time, the information is received and the users engaged in the platform in such a way that the cultural context of a platform has a significant impact. Using the case of Bilibili, its audience has peculiarities of the youth subculture, with a variety of motivation drive to usage and a range of psychological demands. Their content consumption encompasses a comparison of actual life and online identity, reliance on customized advice and close community sharing of content via mutual interests [7]. This means that health communication on Bilibili needs to be deeply incorporated into the community culture and interactive rituals of Bilibili.

2.3. The trend of youth-oriented wellness and the uniqueness of health supplement communication

As a survey report by McKinsey revealed, the contribution of the younger generation (in particular, Millennials and Gen Z) in the health industry is becoming more apparent with the increase in global health consciousness [8]. The emergence of such phenomena as "punk wellness" and balancing nurturing and indulgence show that youths have adopted wellness as a symbol of lifestyle and a form of social capital instead of taking it as an aspect of health management [9]. The contextuality, efficiency, and convenience seek their consumption choices, and their consumption choices are easily triggered by the trend of social media. As a result, they demonstrate such specifics as short-lived excitement and lack of loyalty, which is supported by the destruction of trust as a result of product knowledge barriers and market abnormalities. This trend stipulates that health supplement communication with the young people cannot readily recycle the rational of the classic health teaching but have to address the emotional gratification, social identification and immediate satisfaction needs of the youth. Wang noted that, in opposition to the conventional health consumption habits, the young consumers are more concerned with the conditions of product use and real-life outcomes, and they can more likely select products that are familiarized with the use of modern means of communication (i.e. short videos, social media platforms) [10]. It means that marketing strategies of health supplements are successful, when digital marketing methods are innovative and are able to attract and maintain the attention of young consumers. Though the literature has explained this, the majority of them are at the stage where trend analysis and the marketing strategy is described but empirical studies regarding the various health supplement categories were not conducted (e.g., High-Decision-Difficulty vs. Emerging-Social types).

2.4. Research gaps and the positioning of this study

According to a systematic review of the available literature, the following principal gaps in research can be identified by the proposed study. To begin with, in the analyzed literature, the proposed research questions are addressed by a major portion of the studies on how a single dimension (e.g., content type or source characteristics) might influence the effectiveness of communication without the exploration of the interrelation between the attributes of content and the attributes of a product. As an example, does the impact of high-professionalism content effect vary across health supplements with varying decision difficulty differences? Second, there is limited research on the

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communication processes of the particular category of health supplements, such as high involvement, high perceived risk, on youth culture platforms such as Bilibili.

Thus, the given paper is devoted to a particular platform of Bilibili. It uses an empirical two-way ANOVA methodology and explores how two central variables (core) of content professionalism (High-Professional, Top-tier influencers, High-Interaction types) and health supplement category (High-Decision-Difficulty, Emerging-Social, Basic-Conventional types) influence user engage behaviors (distinguished into light and deep). The study can not only improve the comprehension of how effective the health supplement-related videos can be but also present information-driven insights into a specific content approach to be adopted by the health supplement brands concerning the youth subculture websites.

3. Research hypotheses

According to the theoretical analysis and literature review conducted above, the research hypotheses of this study are as follows:

H1 (Main Effect of Content Professionalism): The Light Engagement Index of the content with the High-Professional content is significantly higher than that with Top-tier influencers and the High Interaction content in the Bilibili platform.

H 2 (Main Effect of the Health Supplement Category):Since the Deep Engagement Index of the High-Decision-Difficulty category is largely larger than that of the Emerging-Social and Basic-Conventional one in the Bilibili platform, we will infer that this is the main effect.

H3 (Interaction Effect):High-Professional content combined with the High-Decision-Difficulty category will present the most user engagement on the Bilibili platform.

4. Research methods

4.1. Research design

The research design used in this study is quantitative research, where the unit of analysis will be health supplement-related videos on the Bilibili platform. The study will take place in the period between January 1, 2023, and June 30, 2024. It also examines the nature of the interaction between content professionalism and product categories and user engagement through systematic data collection and analysis.

The study design will be based on the two-way analysis of variance (ANOVA) where the independent variables will be the content professionalism and health supplement groups and user engagement is the dependent variable. The design is useful in testing the main effects of the two independent variables and the interaction effect. The main and interaction effects of content professionalism and health supplement category on user engagement are tested using a Two-way ANOVA. HSD post hoc tests of Tukey are used to make certain comparisons of differences in significant key dependent variables under various experimental conditions whose main effects are significant.

4.2. Data collection

This paper uses a dataset of the Bilibili platform as the sources of data in this research. The dataset includes all of the metadata of health supplement-related videos posted in the period between January 1, 2023, and June 30, 2024, including 16 measures including view count, comment count, collection (favorite) count, and share count.

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The study has first used the screening of keywords to target 11 varieties of health supplements that were further subdivided into three classes according to the product decision difficulty theory. In particular, High-Decision-Difficulty categories are defined by the effect that is not immediately obvious, the higher price status, and high technical complexity. The Emerging-Social categories have high influencer appeal and it is usually employed in social sharing. Basic-Conventional types are the ones with high levels of publicity and fairly low degrees of decision making. Following data cleaning of 1,188 entries as well as validity checks the study finally managed to gain 589 valid video samples.

4.3. Operational definitions of variables

Independent Variable 1: Content Professionalism. Through the Source Credibility Theory and creator characteristics, the paper has divided content professionalism into three. First, there is High-Professional content, which is made by the creators who should have the official Bilibili badge of UP Master Certification and presented by creators whose background is a doctor, nutritionist, or research institute. Their content usually contains professional information (e.g. ingredient analysis, clinical information). Second, the top-tier influencers activity is defined by the creators that have at least 1 million followers. The content type is that of personal experience and product reviews with high personal influence. Lastly, High-Interaction content is determined by the ratio of danmaku (bullet comment) counter to view count of 0.1% and above. The content is regularly filled with entertaining content like storylines, pets, or challenges, and in this regard users are encouraged to participate and to interact.

Independent Variable Two: Health Supplement. To classify health supplements, the paper breaks them into three categories because of the product decision difficulty theory. The first is the High-Decision-Difficulty group which contains NMN, NAD, active folate, glutathione as well as acetylcysteine. The second category is the Emerging-Social one which consists of melatonin and collagen peptides and bulletproof coffee. The final one is the Basic-Conventional group that consists of vitamins, magnesium, and probiotics.

Dependent Variable: User Engagement. This paper develops engagement indices on two dimensions to have a complete measurement of the user engagement behaviors. First, the Light Engagement Index will be calculated as the total of like count and share count as a percentage of one thousand views, as an indicator of immediate acceptance and the desire of users to share. Second, Deep Engagement Index relies on the amount of comment and collection (favorite) to thousand views, which expresses the comprehensive consideration of the content and readiness of users to store it.

5. Research results

5.1. Sample distribution characteristics

In general, the distribution of samples on a graph indicates that regions with high and low vigor capture more data points than those with intermediate vigor.<|human|>Sample Distribution Characteristics Generally speaking, the pattern of sample distribution on a graph shows that there are regions with large and small vigor with more data points than those with middle-large and middle-small vigor.

The quantity of the samples which was not considered in the classification was 346, which forms the percentage of 58.74, as far as the distribution of content professionalism is concerned. The

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largest number of videos was High-Interaction videos (29.54), then there were High-Professional videos (9.68). The videos of top-tier influencers were not very abundant, as constituting only 2.04 percent, which can be explained by the lack of such creators in the health supplements content ecosystem in Bilibili.

On the category distribution of health supplements, the highest number of samples were Emerging-Social 44.65, High-Decision-Difficulty type was 31.41, and the last one is the Basic-Conventional category with 23.94.

5.2. Statistical analysis results

This research has used quantitative analysis to evaluate the effects of content professionalism and the health supplement category as well as their impact on user behavior particularly with the two main measures: a Light Engagement Index and Deep Engagement Index.

Dependent Variable 1: Light Engagement Index (for H1)

Table 1. ANOVA summary table based on light engagement index

Variable	Degrees of Freedom (df)	Mean Square (MS)	F-value	p-value	Result
Content Professionalism	2	0.00532	5.689	0.0039	Significant
Supplement Category	2	0.00276	1.441	0.239	Not Significant
Interaction Effect	4	0.00165	2.179	0.503	Not Significant

Based on the results of ANOVA in the Light Engagement Index (Table 1):

Content professionalism ($F = 5.689$, $p = 0.0039$) has a significant effect, which suggests that content professionalism is among the factors that influence the Light Engagement Index of the user(s). Particularly, the Light Engagement Index in the case of content of High-Professional type is much greater than the Light Engagement Index of High-Interaction content. This implies that viewers on the Bilibili site have more light engagement behavior of liking and sharing when watching the High-Professional content.

The primary impact of the health supplement category ($F = 1.441$, $p = 0.239$) shows that the other categories of supplements (High-Decision-Difficulty, Emerging-Social, and Basic-Conventional) did not significantly impact the Light Engagement Index of the user. In other words, there were no significant variations in the liking and sharing behavior of users under different variations in the category of supplements.

The effect of the interaction ($F = 2.179$, $p = 0.503$) reveals that the relation between the content professionalism and the supplement category did not produce significant effect on the Light Engagement Index as well. That is, the joint effect of the content professionalism and supplement category did not create a notable joint effect on light engagement behaviors.

Dependent Variable 2: Deep Engagement Index (for H2)

Table 2. ANOVA summary table based on deep engagement index

Variable	Degrees of Freedom (df)	Mean Square (MS)	F-value	p-value	Result
Content Professionalism	2	0.04274	9.261	0.0026	Significant
Supplement Category	2	0.03708	4.197	0.016	Significant
Interaction Effect	4	0.01857	2.150	0.119	Not Significant

Based on the table of ANOVA results about the Deep Engagement Index (Table 2):

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The primary influence of the content professionalism (F = 9.261, p = 0.0026) is that content professionalism has a profound effect on the Deep Engagement Index of the users (e.g., commenting and collecting). In particular, the Deep Engagement Index of High-Interaction content is considerably larger than the Deep Engagement Index of the High-Professional one. This means that when watching High-Interaction content, users promote more intensive activities, e.g. commenting and collecting on the Bilibili platform.

The key impact of the category of health supplement (F = 4.197, p = 0.016) shows that various categories of the health supplement had a profound impact on users in terms of Deep Engagement Index. In particular, the Deep Engagement Index of Emerging-Social type is much more than the Basic-Conventional type. This means that on Bilibili, users can be more deeply occupied by the content related to Emerging-Social health supplements (e.g., melatonin, collagen peptides). Another difference was not witnessed however, between the High-Decision-Difficulty category and other categories.

The effect of the interaction (F = 2.150, p = 0.119) indicates that the interaction between content professionalism and the supplement category lacked the significant effect on Deep Engagement Index as well. Whereas there could be some interactive effects, they are not significant.

In order to visualize the relationships, the study used interaction plots in order to demonstrate the impact of the various levels of content professionalism and categories of health supplements on the engagement of the users.

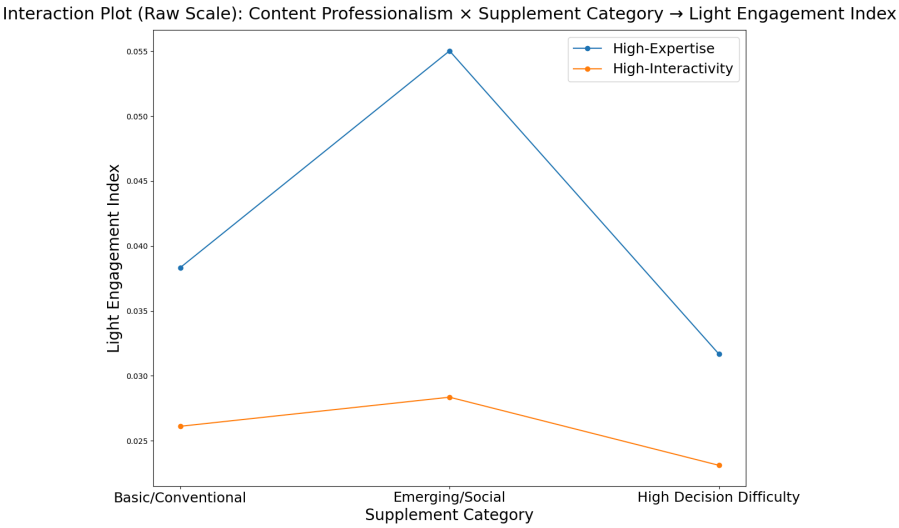

Figure 1. Interaction plot for light engagement index

Through this interaction plot, the interaction effect between content professionalism with health supplement category on index of Light Engagement is revealed. The Light Engagement Index of High-Professional content is significantly higher than that of the High-Interaction one as seen in Figure 1. This also conforms with the previous ANOVA results, which show that professional content on the Bilibili platform is more capable of stimulating the light engagement behaviors of users, including referring to liking and sharing. There is no substantial change between the High-Decision-Difficulty category (e.g., NMN, NAD) and two other categories (Emerging-Social and Basic-Conventional), thus indicating that the supplement category has a slight impact on the light engagement behaviors. Such plot is indicative of the difference in performance of High-Professional and High-Interaction content in terms of Light Engagement Index the former being the more competent content in terms of the capacity to attract user likes and shares.

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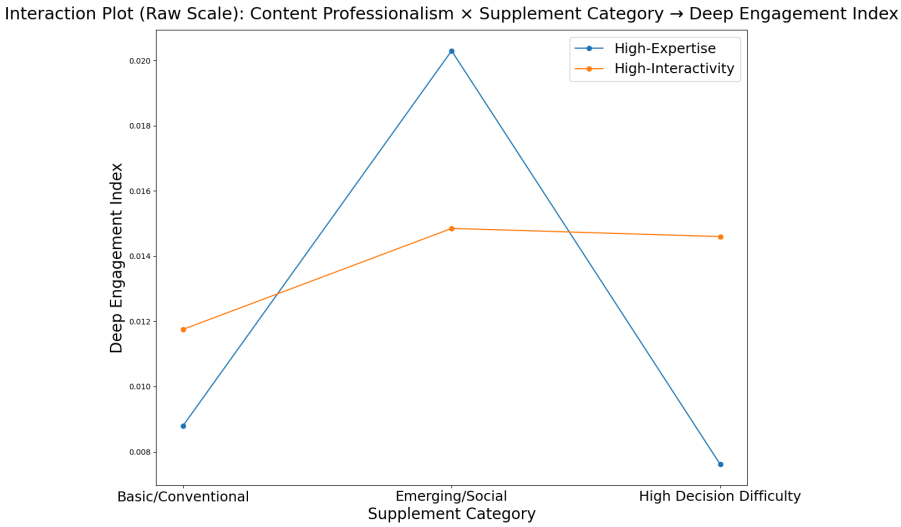

Figure 2. Interaction plot for deep engagement index

This is an interaction plot that shows the interaction effect of content professionalism and category of health supplements to Deep Engagement Index. The Deep Engagement Index in the case of the High-Interaction content is significantly greater than the one of the High-Professional content, as illustrated in Figure 2. This is agreeable to the above ANOVA findings, and it indicates that users show increased commenting and collecting behaviors watching highly interactive materials. The Emerging-Social category (e.g. melatonin, collagen peptides) is showing a stronger effect in terms of facilitating deep engagement particularly when supplying the High-Interaction content with a significantly larger Deep Engagement Index. Basic-Conventional, on the other hand, (e.g. vitamins, magnesium) does not experience the same type of profound engagement. The combination of content professionalism and category of supplement is notable in this plot since they demonstrate that the combination of High-Interaction and the Emerging-Social category of content can lead to a substantial improvement in the Deep Engagement Index of users.

5.3. Hypothesis testing results

The Light Engagement Index of High-Professional content is considerably greater than the index of High-Interaction content based on the test offered by Tukey ($p = .0119$). Thus, H1 is valid, i.e. High-Professional content works way better than High-Interaction one in regard to light engagement. The small group of the Top-tier influencers type did not show a statistically significant difference due to a small sample group. The Light Engagement Index showed no significant difference in the types of Top-tier influencers and the High-Interaction types.

The Deep Engagement Index of Emerging-Social category is greatly higher than that of the Basic-Conventional one ($p = .0126$). Nevertheless, the variations of the High-Decision-Difficulty category with the other two categories were not found to be significant. There were no notable differences between Deep Engagement Index in the High-Decision-Difficulty category versus Emerging-Social category, High-Decision-Difficulty category versus Basic-Conventional category ($p > .05$).

High-Professional content combined with the High-Decision-Difficulty category did not provide a significantly higher user engagement as compared with other combinations. This also confirms the findings of ANOVA and therefore H3 is not upheld.

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6. Conclusion

Overall, this paper had a goal to examine how user engagement (Light Engagement Index and Deep Engagement Index) on the Bilibili platform depends on the presence of various ranks of content professionalism and types of health supplements. It specifically compared three hypotheses on the main effect of content professionalism, the main effect of supplement category and the interaction effect of content professionalism and supplement category by two-way ANOVA and post hoc test of Tukey HSD. The findings show that on Bilibili the viewers tend to rate as more liked and share as the content starts at a higher level of professionalism, and not participate at the same level of light interaction content with a focus on interactivity. Content with Emerging-Social health supplements (e.g. collagen peptides, melatonin) can encourage more in-depth engagement behaviours on the part of the user like commenting and collecting. The category, on the other hand, High-Decision-Difficulty (e.g., NMN, NAD) did not present a noticeable difference relative to the other two categories. Although the combination of High-Professional content and the High-Decision-Difficulty category may have had a role to play the combination was not statistically significant in promoting user engagement.

This study also involves some limitations, as it proceeds towards the realization of the findings. First, the Top-tier influencers content sample was small in this study and this factor could have compromised the reliability and representativeness of the statistical findings. Future studies must put in mind the Top-tier influencers content sample size to be extended particularly when analyzing the differences in engagement based on the content ranked as High-Professional and top tier influencers. Second, even though this paper was based on content and supplement categories on Bilibili, multiple aspects determine how users engage with it, which include duration of videos, frequency of posting, and interactivity. This study did not take these factors into consideration thus future studies would involve more variables in order to be able to get a complete picture of what influences user engagement. Additionally, the effect of interaction in this research failed to have significant influence on the user engagement. The reason could be that the content professionalism and supplement category were rather simplistic. Further research in the future may consider more sophisticated categorizations and more than two way of interaction to understand the possible effect of interaction. Lastly, this research used cross-sectional analysis, the comparison of various contents and categories within one time. To gain a deeper insight into how the user behaviour works, future studies might implement the longitudinal analysis and trace the alteration of the interactions of the same users with the various contents and type using the distinct categories as time goes by.

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