

An Enhanced Decision Support System through Mining of Teachers Online Chat Data

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Abstract: Educators' online dialog content information reveals insight into their intelligent reasoning. With the developing size of content information, the conventional method for manual coding, be that as it may, has been tested. Keeping in mind the end goal to process the substantial scale unstructured content information, it is important to incorporate the inductive substance investigation strategy and instructive information mining methods. An inductive substance examination on tests taken from 17624 posts was actualized and the classes of instructors' intelligent reasoning were gotten. In light of the consequences of inductive substance investigation, we actualized a solitary mark content arrangement calculation to group the example information. At that point we connected the prepared grouping model on an extensive scale and unexplored online talk content informational collection and two sorts of representations of the outcomes were given. By utilizing the classes picked up from inductive substance investigation to make a radar outline's, appearance level was spoken to. What's more, a combined contiguousness lattice was made to describe the advancement of educators' intelligent reasoning. This investigation could somewhat clarify how educators reflected in online expert learning conditions and brought attention to instructive strategy producers, instructor preparing directors, and training scientists.

Index Terms—Computers and Education, Text analysis, Collaborative learning

1. INTRODUCTION

In recent years, the Ministry of Education of China has issued a series of documents to push the implementation of the in-service K12 teachers' on-line skilled development program [1]. The web skilled development program provides multiple reflection opportunities for academics, as well as reading materials, video episode, workshops, and on-line interactions with colleagues and mentors. Teachers' reflections are often concentrated through the communication with similarly-interested colleagues, so they will challenge their previous assumptions, or raise vital queries they need ne'er thought of before [2] [3]. Hence, teachers' on-line discussion knowledge provides a good deal of implicit information for academic researchers and practitioners to grasp teachers' reflective thinking. The understanding will facilitate teacher coaching managers create correct intervention policies, improve the standard of teacher coaching, and so enhance teachers' teaching skills. The large-scale on-line discussion knowledge provides valuable info to grasp teachers' reflection, however additionally raises method issues, as well as knowledge assortment, cryptography and visual image. quite a pair of million in-service academics in China participate within the skilled development program once a year and every teacher pay nearly a year time learning within the on-line skilled Development Platform (OPDP). Facing the sheer information volumes, the variety of teachers' language expression, and therefore the complexness of reflective thinking, the normal

manner of manual writing, however, cannot manage this perplexity. Academic data processing and learning analytics offer a attainable thanks to solve this drawback, however pure machine learning ways sometimes cannot reveal in-depth meanings in on-line discussion information [4][5]. Academic researchers unremarkably use a spread of ways corresponding to schoolroom observation, content analysis, surveys and interviews to gather information and analyze teachers' reflective thinking [6] [7]. These ways will reveal in-depth meanings among the unstructured information, however ar long and can't be enforced in an exceedingly giant scale. The conclusions from these studies are also subject to the subjective impression of academic researchers. Moreover, the results obtained from these ways ar insulation behind and can't facilitate teacher trainers create timely intervention policies. On the opposite hand, the information-driven approaches corresponding to academic data processing and learning analytics ar able to analyze mass of relative data and visualize results. These approaches, however, ar principally used for the analysis of structured information, together with learning behavior information, performance information and body information recorded in course management systems (CMS) or on-line learning environments (OLE) corresponding to Moodle. Inductive content analysis may be a common technique for manually analyzing text content [8]. so as to mine and analyze teachers' on-line discussion information on OPDP for understanding their reflective thinking, it's required to integrate the inductive content analysis and academic data processing techniques. and level of teachers' reflection, had been obtained from inductive content analysis. additionally, we tend to had developed an information collector, the Hawk, to gather posts on OPDP. Therefore, we tend to selected to research teachers' posts for understanding their reflective thinking.

The needs of this analysis area unit 1) to explore the categories of teachers' reflective

thinking and perceive the machine-driven classification of the web discussion data by event the inductive content analysis and tutorial processing techniques; and 2) to analysis teachers' reflective thinking inside the online teacher virtuoso development program, along with teachers' reflection levels and evolution. Teachers' on-line discussion data has been collected and analyzed for understanding their reflective thinking mainly because:

(1). The peer work model has long been used in virtuoso development programs to spice up teachers' teaching practices and students' learning outcomes [9]. In reciprocal peer work, lecturers share the work role, sit down with each other, and elicit the reflection [10]. Teachers' on-line discussion data embodies their reflective thinking.

(2). supported the understanding of teachers' reflective thinking, teacher work managers and tutorial vogue further applicable on-line learning activities and provide correct services and interventions to support teachers' on-line reflection.

(3). Content analysis is commonly accustomed analyze transcript of on-line discussion for tutorial functions [11]. throughout this study, the writing frameworks, that focused on the most content the key contributions of this paper are: (1) it describes Associate in Nursing automatic writing methodology by integration the inductive content analysis and text classification techniques. We tend to acquire the reflective thinking classes by conducting Associate in Nursing inductive content analysis and base our text classification rule on the classes, therefore we tend to augment the manual methodology of writing. we tend to apply the trained classification model to a large-scale and unknown on-line discussion knowledge set, therefore we are able to have a comprehensive understanding of teachers' reflection. (2) This paper additionally provides 2 kinds of visualizations of the text classification results: the visualization of teachers' reflection level and therefore the visualization of teachers' reflection evolution. By mistreatment the classes gained

from inductive content analysis to make a radio detection and ranging map, we tend to visually represent teachers' reflection level when we tend to get the results of text classification. By shaping the weather during a writing theme because the node and therefore the co-occurrences of nodes inside a discussion knowledge because the connections, a additive contiguity matrix is made to characterize the event of teachers' reflective thinking. The results of this paper may shed some light-weight on however academics mirror in on-line skilled learning environments and produce awareness to instructional policy manufacturers, teacher coaching managers and education researchers.

II. CONNECTED WORK

During this section, teachers' on-line skilled development and reflection area unit introduced, followed by a review of learning analytics and visualization. Instruction acknowledge min-ing is then mentioned.

A. Teachers' on-line profession development and reflection

Academics would like continued skilled development to fulfill social and information demands and current support to form changes to their follow within the programme, instruction, and therefore the assessment of student learning [12] [13] [14]. The skilled development program provides the simplest opportunities for academics to unravel teaching issues, develop reflection, and improve their performance [15]. With the fast development of web technology, an excellent range of net two.0 tools (e.g., We Chat, Blog, Twitter), on-line learning platforms (e.g., Moodle, Blackboard), and course management systems (CMS) become another instruction medium for the skilled development pro-gram. The method of on-line profession development provides convenience and suppleness for academics to participate in learning activities, act and communicate with colleagues and mentors in ways in which would have antecedently been tough. operative blog-based

teaching portfolios as an internet learning community tool for academics to debate, talk terms and mirror on their own understanding of teaching expertise, researchers have showed a positive impact of blog-based teaching portfolios on teachers' skilled development [16]. the web learning community facilitate academics establish their skilled identity, scale back isolation, and enhance their reflective follow [17] [18]. Reflective follow has long been thought of as a key activity in quality teacher' skilled development programs [3].

Reflective thinking was initial distinguished from different kinds of thinking by the work of Dewey World Health Organization represented reflection thinking as "active, persistent, and careful thought of any belief or supposed kind of information within the light-weight of the grounds that support it and therefore the more conclusions to that it tends" [19]. Following Dewey's path, Valli represented reflective academics as "they will relive on events; create judgments regarding them; and alter their teaching behaviors in light-weight of craft, research, and moral knowledge" [20]. Hence, teacher's reflective thinking may be a complicated method of pondering perceived issues and manufacturing a sound response in later state of affairs [21]. the main target and level area unit 2 vital elements of teachers' reflective thinking [22]. the main target of reflection refers to teachers' main considerations. for instance, the main target of technical reflection includes general instruction and management behaviors inside a specific institutional context [3], and therefore the focus of personalistic reflection considerations teachers' personal growth and relationships with students. The of reflection evaluates however academics develop their reflective thinking method. for instance, description involves describing a schoolroom concern, a stimulating theory, or a sense, and critique involves rigorously considering a drag that has been set in light-weight of multiple views [23]. additionally to the current variety of

researchers have high-lighted the importance of reflective thinking in academics' skilled development [6] [16] [24] and teachers' reflective thinking will thrive after they acquire feedback from colleagues and mentors [25].

B. LEARNING ANALYTICS AND VISUALISATION

A unremarkably used definition of learning analytics is that provided by the Society for Learning Analytics analysis (SoLAR): "the activity, collection, analysis and re-reporting of information regarding learners and their contexts, for the needs of understanding and optimizing learning and therefore the environments during which it occurs" [26][27]. Learning analytics emphasizes application of well-known models and approaches to spot key variables that inform student retention and tutorial performance [27]. Many learning analytics systems are developed to spot student risk levels and support immediate course alterations, together with the Course Signals System at Purdue University and therefore the Moodog System getting used at the University of American state [28]. A learning analytic system named Tracer was developed to live and visualize students' behavioural engagement by recording the intermediate stages of document development and therefore the researchers found that the results mechanically calculable by the Tracer system were related with the extent reportable by students and therefore the visualizations were useful for reflective on the training method [29]. Within the recent years, the social artist theory and therefore the cooperative learning theory that pay special stress on interaction, cooperative learning, and social construction of information content are popularly applied in to the look of learning analytics approaches.

Discourse-centric learning analytics (DCLA) target learners' discourse to spot patterns of purposeful learning and information construction [30]. DCLA will re-veal the presence or absence of the meant information construction

processes which might function sensible indicators for trailing and assessing whether or not the development learning processes area unit productive or not from the attitude of co-construction of information [31] [32]. The emergence of so-cial artist approaches to education additionally prompts the looks of applications to research the discourse of users inside the context of social networks. When shaping the domain-specific epistemological frame, epistemological network Associate in Nursing analysis (ENA) uses the weather of the epistemological frame because the nodes and creates an contiguity matrix to represent the co-occurrences of nodes in every line of chat knowledge [33]. ENA will characterize students' discourse and visualize the structure of their epistemological frame. Underneath the steerage of ENA, we tend to outlined the nodes and therefore the co-occurrences of nodes inside a discussion knowledge because the connections, and created a additive contiguity matrix to characterize the event of teachers' reflective thinking.

The visual show of analyzed knowledge is intended for locating and understanding complicated ideas, relation-ships, patterns and trends in massive dynamic and heterogeneous datasets collected from complicated systems [34]. A spread of tools and techniques to make visualizations (charts, graphs, social network, and map-based) of enormous knowledgesets area unit rising and researchers area unit ready to simply explore and interpret data. 3 completely different visualizations, together with point-based visualisation, line-based visualisation, and height-based visualisation, are bestowed to assist students check their engagement, mirror and alter their behaviors in activities [29]. In Associate in Nursing intelligent tutoring system, a learner model are computed to adapt learning activities and results of playacting analytics on learner knowledge will be unreal for giving learner feedback regarding their learning performance and information [29].

C. INSTRUCTIONAL DATA PROCESSING

Instructional data processing develops machine and psychological ways and techniques for understanding however students learn by assembling and analyzing student knowledge, discovering learning patterns and trends, and creating new discoveries regarding however student learn. Learners' on-line discussion knowledge has been analyzed to come up with specific information of performance, learning behaviors and experiences. A representative set of classification algorithms has been used for predicting whether or not students can pass or fail the course on the premise of information regarding their on-line discussion forums usage [35]. Reliable and applicable proxy variables that mirror theoretical and empirical proof and a prediction model were made, and results indicated that the declaration model was highly accurate, and early detection and timely interventions were possible [36]. Similar studies are conducted for understanding learners' complicated drawback resolution [37], information building [38]. Instructional data processing researchers use a spread of ways and applies techniques from statistics, machine learning and data processing, together with prediction, classification, clustering, relationship mining, distillation for human judgment, and discovery with models. Among these methods and applies techniques, text classification may be a terribly mature analysis field and most relevant to the current study. Common classification algorithms are employed in instructional data processing and machine learning domain, together with Logistic Regression, Naïve mathematician, Support Vector Machine (SVM), call Tree, Boosting, etc. supported the amount of categories that every datum falls into, there are unit single-label and multi-label classification. Every datum will just comprise one category in single-label classification and every one categories in single-label classification are unit reciprocally exclusive.

The single-label organisation includes binary classification and multi-class classification approaches. There are unit solely 2 categories in binary classification, whereas quite 2 categories in multi-class classification. In multi-label classification, however, every datum will comprise many categories within the in the meantime. During this study, a single-label classification model was designed supported inductive content analysis and that we allowed every on-line discussion datum to comprise one class in classification model was then applied on a large-scale and unknown on-line discussion text knowledge set for understanding teachers' reflective thinking. Knowledge analyzed in learning analytics and academic data processing approaches are unit largely structured knowledge together with learning behavior knowledge, performance knowledge and body knowledge recorded in course management systems (CMS) or on-line learning environments (OLE) equivalent to Moodle. So as to method the large-scale unstructured text knowledge, it had been required to integrate the inductive content analysis and academic data processing techniques. The aim of this analysis was to increase the info scope of learning analysis, to attain automatic writing, and to understand teachers' reflective thinking through the method of visualisation.

II. METHODOLOGY

A. Analysis style

So as to grasp teachers' reflective thinking from the web discussion knowledge, this study went through six main phases (see Fig 1):

Phase 1: we tend to developed {a knowledge |an information} assortment tool to gather teacher-generated on-line discussion data. we tend to obtained 21388 posts by mistreatment the info assortment tool over a amount of vi months.

Phase 2: A random sample (2000 posts) were drawn from the web discussion

knowledge set and used for inductive content analysis.

Phase 3: 3 specialists World Health Organization had expertise with qualitative analysis and familiarity with pre-existing writing schemes collaborated on the inductive content analysis method. 3 specialists conducted Associate in Nursing inductive content analysis on the random sample of on-line discussion knowledge set. when part three, we tend to obtained the classes used for text classification.

Phase 4: A single-label Naïve mathematician Classification rule had been enforced to classify the tagged knowledge. Then, we tend to evaluated the performance of the single-label Naive mathematician classification rule by comparison it with different unremarkably used text classification rule.

Phase 5: we tend to enforced a large-scale text classification supported the trained classification model. All the web discussion knowledge has been mechanically coded.

Phase 6 : We visually represented teachers' reflection levels after we obtained the results of large-scale text classification. in addition, we tend to createda additive contiguity matrix to characterize the evolution of teachers' reflective thinking. Then, the results of text classification and visualisation were sent back to the info storage.

B. Participants

A complete of 6650 in-service K12 academics in China had participated in an internet skilled development program that was ten months in period from Sep first, 2014 to Gregorian calendar month thirtieth, 2015. the web skilled development pro-gram was divided into 3 continuous parts:

1) observance ICT-integrated courses on an individual basis (for four months),

2) 2 rounds of on-line cooperative learning (for four months), Associate in Nursingd

3) submitting an ICT lesson set up or a video-recorded class-room teaching method (for two months).

Each teacher was at random allotted to an internet study cluster. These academics were in the main composed of feminine participants (4120, 62%) and had a median of seventeen.48 years of teaching expertise. All the academics had participated within the on-line skilled development program before, so they so theycould complete the educational task swimmingly. additionally, every participant had a minimum of five years of expertise with on-line learning and will access the OPDP by computers or mobile phones.

C. Three-stage on-line cooperative learning approach

The approach of on-line cooperative learning provides Internet-based skilled development opportunities, as well as individual reflection, sharing resource, workshops, on-line interactions with colleagues, and mentors [12]. According to the theories of socio-cultural art movement and data construction, dialogic interactions and communication among lecturers are crucial for his or her skilled development [16]. several synchronous communication tools, such as QQ, WeChat, Videoconferencing, and asynchronous communication tools, admire diary, Microblog, Bulletin Board System, are utilized in teachers' on-line skilled development activities. owing to the limitation of synchronous communication, admire a scarcity of reflection time and difficulties in anodyne larger scale conversations [39], associate asynchronous discussion incould complete the learning task smoothly. In addition, each participant had at least 5 years of experience with online learning and could access the OPDP by computers or mobile phones.

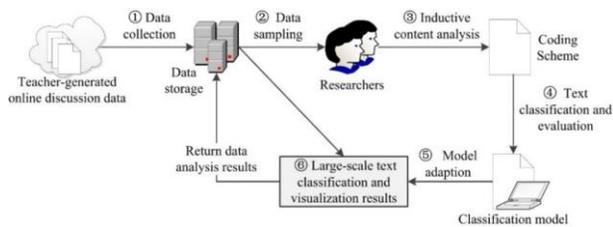


Fig. 1. The research design of this study

Instrument entitled OPDP was developed and accustomed support teachers' on-line cooperative learning activities (see Fig.). academics may participate in on-line discussion, publish data, transfer and transfer files in OPDP. All the web discussion information was recorded mechanically within the back-end info of OPDP. we tend to designed a three-stage on-line cooperative learning activity on the OPDP(see Fig. 3). At the start of the activity, a chief teacher designed associate activity arrange, selected a discussion topic and announce them on the OPDP. when the preparation work was completed, the academics began to replicate and discuss the subject consistent with the activity arrange. the complete on-line cooperative learning activity can be divided into 3 stages, as delineated below:

within the 1st stage, each teacher mirrored the discussion topic severally. when the chief teacher announce the activity arrange and discussion topic onto the OPDP, each teacher downloaded and browse the arrange and topic. Then, each teacher mirrored the discussion topic consistent with his/her teaching expertise. within the second stage, all teaches mentioned the subject jointly. each teacher expressed their own views, and exchanged views with others. this can be a method of externalization. academics expressed their concepts or thoughts a couple of specific topic via posts. within the ending, each teacher submitted a document, that recorded his/her learning expertise within the on-line cooperative learning activity. this can be a method of internalisation. academics recorded the information learned from communication with mentors and colleagues. every three-stage on-line cooperative learning

activity typically lasted for one month. when 3 stages were completed, the chief teacher and also the individual academics summarized the results. within the three-stage on-line cooperative learning activity, teachers' reflection thinking was expressed in 2 main ways: the web discussion posts and also the reflection documents. during this study, we tend to collected teachers' on-line discussion posts to investigate their reflective thinking.

D. Information Assortment And Preprocess

After obtaining permission for information use from the teacher coaching manager, we tend to nonheritable a back-end info account of the OPDP. we tend to then developed an information assortment tool, the Hawk, that helped North American country fetch on-line discussion information through the account. we tend to collected teachers' on-line discussion posts for regarding half dozen months from February first, 2015 to July twenty seventh, 2015 by mistreatment the Hawk. In total, we tend to obtained 21388 posts in eighty eight on-line skilled learning communities. we tend to then removed the duplicates caused by reposting, and there have been 17624 distinctive posts within the information set.

Teachers' online discussion information contained some special symbols to precise sure which means. maybe, emoticons were accustomed represent a mirrored image in themselves or add details to a mirrored image. However, solely knowing the sentiment of teachers' posts doesn't offer deeper and finer understanding of teachers' reflection. during this study, analysis was accustomed confirm the amount and evolution of teachers' reflective thinking that on-line discussion text information indicate. Sentiment analysis, therefore, not applicable to the current study. additionally, some non-Chinese symbols, stop-words and punctuation additionally bring noise to the information. we tend to preprocessed

the web discussion text information before coaching the classifier.

1. We tend to removed all the special symbols, non-Chinese symbols, punctuation, and numbers.
2. We tend to used the data retrieval toolkit, the IC-TCLAS system, to try and do word segmentation and take away all the common stop-words [40]. During this study, 3 steps we tend to be taken to safeguard the gathered information: (1) all participant names we tend to be replaced with pseudonyms; (2) we solely analyzed the web discussion text data; and (3) we solely gift the results of information analysis and didn't harness the first data.

E. Automatic coding scheme

A number of coding schemes for analyzing teachers' reflective thinking were developed [41]. Van Manen [42] distinguished three levels of reflection. At the first level of reflection, teachers' dominant concern was with technical rationality (applying knowledge in order to reach predetermined educational objectives). At the second level, teachers' reflection went beyond technical rationality into investigating, questioning and clarifying the end objectives and the assumptions behind teaching activities. At the highest level of reflection, the critical reflection, teachers incorporated moral and ethical questions into their line of thinking. Valli [20] summarized five different types of reflection as follows: technical reflection, reflection-in and on action, deliberative reflection, personalistic reflection, and



Fig. 2. The interface of the online collaborative learning activity.

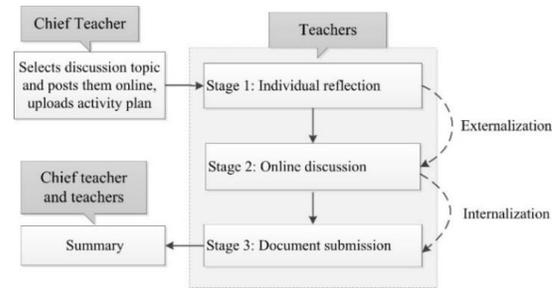


Fig. 3. The process of the three-stage online collaborative learning activity

Critical reflection. Among these types of reflection, technical reflection was concerned with the general instruction and management behaviors aspect of classroom teaching, deliberative reflection was concerned with the whole range of teaching (students, curriculum, rules and organization of the classroom, etc.), personalistic reflection was concerned with teachers' personal growth and relationships with students, and critical reflection was concerned social, moral, and political dimensions of schooling. A typology of reflection which was developed to bridge theory and practice in an effort to teach reflective practice to pre service teachers was proposed and the typology profiles three dimensions of teachers' reflective thought: descriptive, comparative, and critical [23]. The dimensions in these coding scheme provided important references to this study, but the reason why a new coding scheme to understand Chinese teachers' reflective thinking during the processes of online discussion was needed was that: 1) some dimensions, such as political dimensions of schooling, rarely appeared in Chinese teachers' online discussion, 2) technical reflection, reflection-on-action, and deliberative reflection often appeared simultaneously in one online discussion post, and 3) most of the pre-existing coding schemes for assessing reflection levels were often decided based on topics that concern teachers at particular times. In this study, inductive content analysis serves both as an observation tool for identifying variables in online discussion posts, and as an analytic tool for assigning variables to categories in coding.

The development of the coding scheme was to describe the focus and level of teachers' reflection which could help us assess the quality of teachers' reflective thinking and investigate how the process of reflective thinking develop in teachers[22]. Three experts who had experience with qualitative research and familiarity with pre-existing coding schemes collaborated on the inductive content analysis process. First, expert A read a random sample of 2000 posts from the 17624 unique posts in the data set and cataloged the types of reflective thinking. Then, expert A wrote de-tailed interpretation and provide examples for each category and sent the codebook and the 2000-posts sample to expert B and expert C for review. Finally, three experts discussed and reduced the coding scheme to a parsimonious set of categories. The final coding scheme is shown in Table 1. The focus of reflection could be technical and personalistic. Technical reflection was concerned with instructional, managerial, or contextual aspects of classroom teaching [20] [22] [43]. Personalistic reflection dealt with teaching beliefs(the assumptions or claims of in-service teachers about ideal way of education)or professional development aspects of teachers [19][20]. The level of reflection could be represented by description, analysis, and critique [22] [23]. Description provided descriptive information of an action. Analysis provided rationale and logic of an action. Critique provided explanations and evaluation of an action.

RESULT

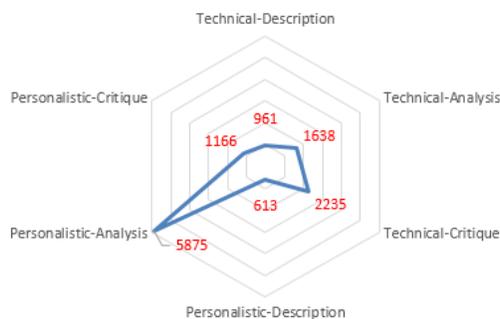


Fig4. Teachers' reflection level in the online collaborative learning activities

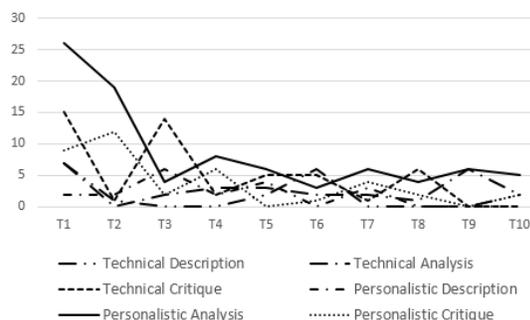


Fig.5. Top 10 teachers who posted the most of reflection posts

VI. CONCLUSION

Examination to make a radar outline's, appearance In this investigation, we encoded and envisioned the extensive scale unstructured content information in educators' online shared learning exercises with a specific end goal to understanding instructors' appearance levels and advancement, coordinating both the subjective substance examination strategy and instructive information mining methods. The subjective substance investigation strategy uncovered that educators' intelligent reasoning included Technical Description, Technical - Analysis, Technical-Critique, Personalistic Description, Personalistic Analysis, and Personalistic-Critique. In view of the aftereffects of inductive con-tentanalysis, we actualized a solitary mark content grouping calculation to order the example information. At that point we connected the prepared order show on an extensive scale and unexplored online talk content informational index. After the online dialog content information being grouped, two kinds of representations of the outcomes were given. By utilizing the classes picked up from inductive substance level had been spoken to. Furthermore, by characterizing the factors of the coding plan as the hubs and the co-events of hubs inside a dialog post as the associations, an aggregate nearness grid was made to portray the development of educators' intelligent reasoning.

This investigation gave a strategy to breaking down substantial scale unstructured content information and could defeat the confinements of manual substance examination and unadulterated machine learning technique. This investigation could likewise help instructive arrangement creators and educator preparing supervisors comprehend the status of instructor reflection and settle on choices on appropriate mediations in online expert advancement exercises.

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