Editor's Note: The following article is reprinted (with updated format editing) from the Phi Beta Delta International Review, Volume III, Fall 1992-Spring 1993, pp. 99-114. The *International Review* is the predecessor of the current publication. It is re-printed here to provide international educators with an historical view of scholarship on efforts to develop international educational research.

International Consortium for Research in Science and Mathematics Education (ICRSME): A Model For International Educational Research

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Introduction

Cooperative measures are defined as those endeavors which enable an association of a number of people to operate jointly toward the same end and share in the ensuing benefits. It is assumed that groups of educators and institutions are more effective in solving the complex problems of education than if independent and unilateral actions are taken (Houston, 1979). Much of the literature related to cooperative measures in educational research includes observations and specific case studies and is based upon intuition or folklore (Hord, 1985). Few cooperative efforts have been developed based upon an articulated cooperative model. Little attention has been given to the specific components and processes related to cooperative measures in research including the structure, key elements, operating principles, impediments, positive and negative consequences, and support and reward systems (Hord, 1985; Houston, 1979). The result has been a number of descriptions related to collaborative research projects and comparative education studies (Scheirer,1986). Clearly, there is a need to articulate a model for international cooperation to guide international educational research exchange.

The review of the literature and an in-depth analysis of experiences related to the International Consortium for Research in Science and Mathematics Education (ICRSME) has led to the identification of several essential components and operating principles for maximizing the success of similar international education consortiums. This paper will describe a model for the development of an international consortium focused upon educational research along with a discussion of its implementation. Each of the model components will be described along with a discussion of the activities, consequences, and recommendations related to the efforts of ICRSME. With increased attention to the elaboration of the consortium model, its components, operation, and benefits, both the consortium model and ICRSME have evolved over time.

Mission and Goals

The consortium's primary mission is the improvement of educational opportunities in participating countries. Improvement in education should not be limited to the universities

involved; activities should have positive benefits for all grades, from elementary to the 9raduate school including faculty. The underlying rationale for the international consortium model for educational research . and exchange is that the collective efforts of students and faculty of participating institutions and countries will through synergy produce results that could not be achieved by any one institution or country acting alone. The importance of individuals and institutions working together, cooperating, to solve educational problems and improve educational practice transcends national boundaries (Scheirer, 1986).

In order to serve the mission, the consortium model includes five interrelated goals:

1. Promoting cooperative efforts among scholars in participating countries
2. Designing, facilitating, and conducting research toward the
3. pursuit of a better understanding of teaching and learning
4. Developing academic exchange programs between universities in order to broaden the educational experiences of students and faculty
5. Acting as an impetus in establishing ties between the local, state, and national educational associations in the participating countries
6. Identifying the particular educational needs facing current and emerging minorities in the participating countries and directing research to meet those needs.

Participants

A philosophy intrinsic to the consortium model is the need for the commitment to individuals within the consortium. While organizations and institutions may be the enabling factors in cooperative endeavors, the people within the organizations must do the work. Participants in an international cooperative program should:

- have shared concerns, interests, and goals (i.e., professional ties);
- value, agree on the need, and choose to be involved in the cooperative endeavor (e.g., willing to commit great amounts of time and energy);
- value and appreciate the perceptions, perspectives, and contributions of others; and
- be flexible, patient, persistent, and willing to share.

Collaboration

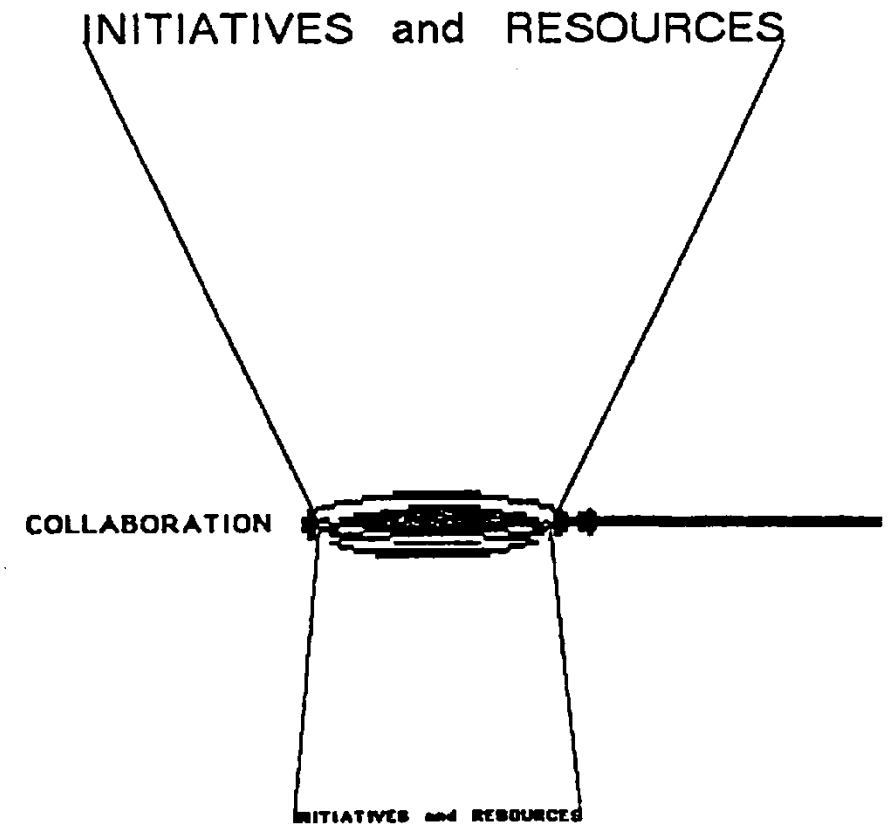
A productive consortium must move beyond the cooperation level and be involved in truly collaborative efforts. Collaboration implies co-investigation and is characterized by respect for differing perspectives and expertise, open and honest communication, ongoing material and collegial support, and recognition of the contributions and efforts of others. Research productivity and impact, expanded educational knowledge, and improved education in the participating institutions and countries will result from collaborative efforts. An international consortium focused upon education may be involved in a number of collaborative activities including research, curriculum development, innovative initiatives, shared resource

opportunities, and information dissemination.

International collaboration will increase opportunities for identifying the common and unique research needs in education thereby facilitating conceptualization of research problems. This in turn leads to development of concrete proposals for research; pooling of resources (human and otherwise) across school and national boundaries; improvement in research skills; delineation of coordinated data gathering procedures; and dissemination of findings, interpretations, conclusions, and implications of research in the participating countries.

Collaborative efforts related to curriculum development and innovative initiatives may involve coordinated development; evaluation; and refinement of instructional models, materials, and teaching methods as well as the translation of existing materials from one language to another.

Figure 1
Initiatives and resources



The initiatives and resources that each individual and their country brings to the consortium is magnified by collaboration as Illustrated in Figure 1 (page 103). As resources are brought together and shared they serve as seed monies and cost sharing contributions to aid in obtaining still more resources.

A key element in promoting collaborative efforts is information dissemination. Recognizing that research is useful only if the relevant public is informed of tile results, an international education consortium should emphasize communications, not only among the consortium participants, but in the broader international community of educators within and beyond participating countries.

Operation

The operation of an international consortium should be characterized by:

- association based upon mutual needs, goals, expectations, and benefits; not institutional mandates;
- shared planning, implementation, dissemination, evaluation, decision making, and control (i.e., actively involved working together with equal status);
- fair and just interactions;
- on-going communication at many levels (individual, small, and large group); and
- mutually shared resources and distributed responsibilities.

The success of an international consortium is dependent upon the active commitment of individuals involved in collaborative efforts directed toward common goals.

Description

International Consortium for Research in Science and Mathematics Education (ICRSME) was conceived by Arthur White in 1983 as a result of working on various projects in Central America and the Caribbean under the auspices of The Ohio State University in Columbus, Ohio and the United States Information Agency in Washington, D. C. The consortium was organized by White along with Juan Esquivel from The University of Costa Rica and Pamera Fraser-Abder from The University of West Indies. The charter member institutions of the consortium included these three universities plus the University of Panama, the National Pedagogical University of Mexico; and the American School in Puebla, Mexico. By 1985, a variety of projects and activities were underway involving institutions and individuals in each of these countries. In 1986, Donna Berlin from The Ohio State University at Newark in Newark, Ohio joined the administrative team for the International Consortium for Research in Science and Mathematics Education.

The goal of the International Consortium for Research in Science and Mathematics Education (ICRSME) is the improvement of educational opportunities for the school populations of the participating countries. This goal is based on the premise that all peoples can benefit from the knowledge and experiences of their local, national, and international colleagues. In view of this goal, the consortium emphasizes the application of theoretical models related to learning, Instruction, and curriculum to the conceptualization of research and educational practice. ICRSME focuses on programs for collaborative research, curriculum development, instructional improvement, academic exchange, professional development, innovation initiatives, and shared

resource opportunities. ICRSME constantly attends to the cultural similarities and differences of the member countries. Discussions related to, educational organization, financial constraints, resource availability, logistics, language characteristics, custom and tradition, social and personal priorities, communication differences and needs, level and nature of expertise, and educational needs specific to the country and common to other countries within the ICRSME are promoted. Linkages provide the mechanism to mobilize and sustain ICRSME's collaborative efforts. Linkages are facilitated through activities related to research and development, communication and dissemination, personal and professional development, and human and material resources.

Research and Development. Research in education is very much influenced by the specific samples and conditions of the research. It becomes extremely important to have replication of research in order to identify those findings which have stability and consequently the generalizability necessary to build a knowledge base. In order to establish a broad base it is valuable, and perhaps necessary, to have parallel efforts in a variety of settings to test hypotheses and evaluate the practical application of theories.

Members of ICRSME have engaged in collaborative research efforts which have included the identification of both the common and the unique research needs in science and mathematics education, conceptualization of research problems, development of proposals, pooling of human and material resources, development of relevant research skills, delineation of coordinated data gathering procedures, and the dissemination of results and initial collaborative research projects focused upon the integration of technology with other instructional resources into the teaching and learning of science and mathematics. This topic was of special interest to researchers in the United States and to educators in Costa Rica, Mexico, Panama, and Trinidad and Tobago. An instructional model was developed (Berlin & White, 1986, 1987) for the selection, development, and sequencing of instructional resources. In order to reflect the needs and available resources in the participating countries, the research agenda related to the instructional model included calculators and computers. The collaborative research efforts have been directed toward testing aspects of this model and translation of the results into application for curriculum and instruction in the various cultures. In addition, an instrument to measure spatial-symbolic information processing was constructed and validated with school populations from the consortium.

Other collaborative activities have included workshops and development efforts related to the identification of science and mathematics research priorities as perceived by elementary and secondary school teachers; use of calculators, computers, and manipulative materials in elementary school mathematics; problem solving in elementary school mathematics; learning and developmental theories applied to science and mathematics education; and the translation of instructional materials into other languages.

In the future, the concept of action research (i.e., teachers actively and significant! involved in research) will be infused into ICRSME's endeavors. This development may lead to a different, collaborative style wherein research is done by and with, rather than, on the teacher." (White &

Tisher, 1986, p. 897) Action research may "help us vie research as integrated with practice rather than as .a process which is conducted separately and then implemented m classrooms" (Ross, 1984, p. 114). Action research may be the catalyst for classroom teachers to translate theory into practice and research into implementation.

Communication and Dissemination. ICRSME has convened four International Consultation meetings since its conception. The First Consultation (February, 1986) was held in Port of Spain, Trinidad and Tobago and included 60 participants representing 11 countries. San Jose, Costa Rica, the site of The Second Consultation (December, 1987), involved 64 participants representing 7 countries. The Third Consultation (February, 1991) convened in Merida, Mexico included 40 participants from 6 countries. The largest meeting, The Fourth Consultation, was held in San Juan, Puerto Rico in February, 1992. Over 235 participants representing 9 countries were in attendance at this most recent consultation. Each of these consultations have included research and curriculum development reports, symposia, professional development seminars, research skill development workshops, proposal development work sessions, social events, and cultural experiences. Proceedings from the consultations have been published and disseminated.

A newsletter published since May, 1985 has served as a primary mechanism for communication and dissemination among consortium members. The newsletter provides a means to announce consortium activities, announce and recognize consortium members' publications and scholarly activities, provide communications from individuals to the consortium members at large, identify collaborative research opportunities, announce professional association meetings and information, and identify employment and funding opportunities.

In addition to the consultations and newsletters, the consortium has employed a number of other communication and dissemination strategies. Consortium members have been active in sponsoring conferences and symposia as well as in making presentations at ' various academic and professional association meetings in the participating countries. The consortium maintains a database of consultation participants and a comprehensive mailing list of educators active in the field of science and mathematics education. Electronic communications (e.g., INTERNET) are also utilized.

Professional and Personal Development. ICRSME has provided professional and personal development opportunities through short and long range academic exchange activities. These activities include undergraduate teacher education field-experience arrangements; exchange of graduate students; team instruction of courses, seminars, workshops, and symposia; leave of absence and sabbatical arrangements; academic in-service workshop/seminar opportunities; and academic camp (including computer camp) opportunities in the United States and other participating countries. Future activities are planned related to exchange of academic credit agreements, adjunct faculty appointments, post-doctoral fellowships, academic consulting assignments, and "off campus" course credit arrangements.

The professional and personal development of ICRSME members 1s nurtured and continues to be sustained through their relationship with other programs and organizations.

Consortium members have and will continue to benefit from affiliation with Phi Beta Delta Honor Society for International Scholars, the National Association for Research m Science Teaching (NARST), the National Center for Science Teachin9 and Learning (NCSTL) at The Ohio State University, and the United States Information Agency (USIA). For example, NARST has provided official endorsement for ICRSME and over fifteen of the past presidents and other association leaders have participated in ICRSME activities such as collaborative research projects, Consultation meetings, and Special Interest Group (SIG) meetings at the NARST Annual Meetings. NCSTL, through the efforts of Arthur White (director) and Donna Berlin (coordinator) can provide state-of-the-art information and resource networking.

Human and Material Resources. ICRSME is the result of the efforts of individuals who have similar academic interests and visions for the future. The current foundation and the basis for future success lies in the dedication of these individuals toward the improvement of educational opportunities in their own and neighboring countries. The participants in the consortium can be characterized as having shared concerns, interests, and goals; mutual respect; individual commitment; appreciation for the contributions of others; flexibility; patience; tolerance; and persistence. The consortium participants engage in academic pursuit based upon needs not mandates; shared conceptualization, responsibilities, actions, commitment, recognition, and benefits; fair and just interactions; on-going communication; and shared resources.

Funding sources (over 31) have been varied but total monies to support ICRSME activities have been limited. Professional development funds (e.g., small grants, seed grants, teaching and learnin9 grants) have been available from the institutions of consortium members. In some cases, monies from the local, state, and federal governments have been available. Local business and industry have been particularly supportive in the Caribbean countries. This "grassroots" approach has been functioning for the last nine years due to the dedication and commitment of the members of the consortium and the effective pooling of human and material resources.

Benefits

General benefits that have been derived from involvement in the International Consortium for Research in Science and Mathematics Education include:

- awareness and appreciation for differences in educational practices;
- consideration of alternative solutions to problems similar to one's own;
- insights into one's own educational system through analysis of similarities and differences;
- genuine collegial relationships, mitigation of academic isolation, and the promotion of friendships;
- professional development and sustained professional motivation through commitment to the activities and the other collaborators;
- promotion of "collective creativity" (Fox & Faver, 1984);

- a support system and research efficiency through sharing ideas, providing feedback, writing together, and joint presentations;
- an economic savings through the sharing of resources, human and material;
- resources that might otherwise be unavailable;
- improved educational practices and the broadening of individual and public benefits through greater dissemination of research results and curriculum developments; and
- promotion of peaceful relationships among the peoples of the participating countries.

The collaborative research activities advanced by ICRSME members have provided the following benefits specific to international research:

- clarification of the basic concepts (constructs) involved in the research;
- opportunities for feedback and more focused research;
- replication sites to establish new generalizations and to reaffirm previous ones;
- opportunities to expand the generalizations to broader populations;
- identification of the cultural differences in the populations and the relevance of these differences to the generalizations; and
- promote broad ownership in the research process and thus greater potential for using research results.

Evaluation and Modifications

This section of the paper is an evaluation of ICRSME activities based upon the results of formal and informal procedures. Responses to the evaluations have resulted in implemented and planned modifications. Often this feedback has required the reconsideration of the consortium strategies along with a rethinking of the model for international educational research.

Research and Development. The activities in this area have included collaborative pro1ects which at times involved original research and other times involved the replication of research conceived and planned in another country. The researchers from the replicating country and the practitioners from both countries were involved in the data collection phases of the research process. The data was generally sent to a research facility in the United States (e.g., The Ohio State University) where it was organized, analyzed, and summarized. Reports of the results were synthesized and reported as a team with the researchers from each participating country.

Many researchers from the developing countries aspired for opportunities to participate in the replication of studies with some acculturation in the replication relevant to their country. Common to educational researchers, consortium members were concerned that research results would never reach classroom teachers and consequently would not be implemented. Teachers need to be involved in such a way as to give them some sense of ownership in the process and the findings. Also, many researchers in the participating countries expressed a need to acquire and update their research skills. It is particularly difficult in developing countries to keep abreast of the new paradigms and methodologies related to educational inquiry.

In response to these comments, ICRSME participants continue to look for opportunities for collaborative research including replication studies and modified replication studies which involve multi-nation teams the conceptualization, planning, and execution of research projects. In order to better link the teacher to the research process, there are plans underway to add an action research component to the next Consultation. This would include workshops and presentations that would acquaint would-be researchers with knowledge, skills, and experiences necessary for participation in the research process as well as trends and innovations in science and mathematics education. Plans for the 1993 meeting include the introduction of a classroom-based research model for involving teachers more directly in research and development efforts patterned after the model described by Berlin and White (1992).

Communication and Dissemination. The activities in this area have included consultations, newsletters, limited translation of oral and written communications into Spanish, and cultural experiences for visitors to the host countries of the Consultations. Evaluation of these activities reveals an urgent need to obtain information in a timely manner, improve the mechanism for identification and recognition of common educational goals and needs, for more native language versions of information and resources, and more frequent day-to-day communication among consortium members.

In order to improve communication, ICRSME proposes to publish all abstracts and papers from the consultations in both Spanish and English. Efforts will be directed toward providing translation for all presentations at the Consultations as well as a bilingual glossary of educational terms related to each presentation. NCSTL will add all ICRSME members to their mailing list and establish and maintain an electronic mail network for the consortium.

Professional and Personal Development. The activities in this area have included collaborative symposia at meetings on the campuses of the respective countries as well as at international and national professional meetings. Graduate teaching and research associateships have been made available to students from developing countries at institutions within the United States. Social and cultural events have been shared involving participants from all countries both in the United States and in the developing countries. All of these activities tend to develop a sense of collegiality and commitment both individually and by institution. In this collaborative atmosphere, the expertise of each individual becomes more apparent and more effectively utilized for the benefit of all.

Individuals from the developing countries have requested more opportunities to study abroad. In response, ICRSME is working cooperatively with NCSTL and U. S. universities to establish post- doctoral fellowship programs so that newly graduated Ph.D.'s can continue their research efforts for one-to-three years after they receive their degree. They can function in a work situation in their own country or in the United States free of the usual responsibilities which accompany the first few years as a college or university professor. This opportunity along with exchange programs for undergraduate and graduate students, for faculty, and for schoolteachers will be explored.

Human and Material Resources. The activities in this area have included establishing working relations with established Research Centers in participating countries and affiliations with major national professional associations in the United States. Resources and services which have been shared include library materials; instructional materials, technical equipment and assistance, and data processing capabilities.

With regard to resources,, the major need is the procurement of funding beyond that available through institutional channels. These funds are needed to promote and sustain communication, increase knowledge-access capability, secure additional equipment and material, support a broader base of expertise, and facilitate consultation and academic exchange travel. In response to this need ICRSME is facilitating the development of proposals for external funding for collaborative research. Through the resources and communication networks of the National Center for Science Teaching and Learning, the consortium is identifying large and small, public and private, funding sources at all levels (local, state, regional, national, international). With. additional resources, ICRSME would also like to establish and administer a small grants program for collaborative research and development.

Conclusions

This model for international educational research while fluid in design has generally adhered to its original goals. These goals have been manifested in the activities of the International Consortium for Research Science and Mathematics Education. Evaluation of the consortium activities have resulted in modifications or changes in emphasis including more involvement of classroom teachers, translation of oral and written communications from English to Spanish and Spanish to English, development and maintenance of electronic mail capabilities, and expanded efforts to obtain external funding.

Too many programs are initiated because of a large infusion of external funds before the commitment to the work has been established. Although operating with only limited financial support, the activities of ICRSME have become institutionalized as the result of the dedication and commitment of the individual consortium members. Consequently, activity will undoubtedly continue regardless of external funding.

References

Abder, P., Barnett, D., Berlin, D., Esquivel, J., Mora, H., & White, A. (1988, April). A *symposium on science education research In Latin America and the Caribbean.* Symposium presented at the 61st Annual Meeting of the National Association for Research in Science Teaching, Cake of the Ozarks, MO.

Abder, P.F., Berlin, D.F., Butts, D. Esquivel, J., Petterson, R., & White, R.L. (1986, March). A *symposium on science education research in Latin America and the Caribbean.* Symposium presented at the 59th Annual Meeting of the National Association for Research in Science Teaching, San Francisco, CA.

Berlin, D.F.,& White, A.L. (1992). *Action research as a solution to the problem of knowledge utilization.* A paper presented at the Annual. Meeting of the American Association for the

Advancement of Science, Chicago, IL.

Berlin D.F., & White, A.L. (1987). An instructional model to integrate the use of the calculator. *Arithmetic Teacher, 34* (6), 52-54.

Berlin, D.F., & White, A.L. (1986). Computer simulations and the transition from concrete manipulation of ob1ects to abstract thinking in elementary school mathematics. *School Science and Mathematics, 86,* 468-479.

Berlin, D.F., White, A.L., & Abder, P.F. (1987, April). *The use of concrete, manipulative materials and computer simulations for learning elementary school science process skills in Trinidad and Tobago.* Paper presented at the 60th Annual Meetin9 of the National Association for Research in Science Teaching, Washington, D.C.

Fox, M.F., & Faver, C.A. (1984, May/June). Independence and cooperation in research: The motivations and costs of collaboration. *Journal of Higher Education, 55* (3), 347-359.

Hord, S.M. (1985, January). *Collaboration or cooperation: Comparisons and contrasts, dilemmas, and decisions.* Paper presented at the Meadow Brook Symposium on Collaborative Action Research in Education, Oakland University. (ERIC Document Reproduction Service No. ED 258 356).

Houston, W.R. (1979). Collaboration - See 'treason'. In G.E. Hall, S.M. Hord, and G. Brown (Eds.), *Exploring issues in teacher education: Questions for future research.* Austin, TX: The Research and Development Center for Teacher Education, The University of Texas.

Kyle, D. W., & McCutcheon, G. (1984, April-June). Collaborative research: Development and issues. *Journal of Curriculum Studies, 16* (2), 173-179.

Plant, A. M. (1986, June). Reading research: Its influence on classroom practice. *Educational Research, 28* (2), 126-131.

Ross, D. D. (1984, Winter). A practical model for conducting action research in public school settings. *Contemporary Education 55* (2), 113-117.

Scheirer, E.A. (1986, April). A *model for collaborative ethnography in schools for an international perspective.* Paper presented at the 67th Annual Meeting of the American Educational Research Association, San Francisco, CA. {ERIC Document Reproduction Service No. ED 72 413).

White, A.L., Berlin, D.F., & Abder, P.F. (1986, November). *Cross- cultural replication: The use of concrete and computer simulation activities for elementary school mathematics concepts.* Paper presented at the 28th International Conference of the Association for the development of Computer-Based Instructional Systems, Washington, D.C.

White, A.L., Berlin, D.F., & Abder, P.F. (1986, November). Cross- cultural replication: The use of concrete and computer simulation activities for elementary school mathematics concepts. *Proceedings of the 28th International Conference of the Association for the Development of Computer-Based Instructional Systems,* Washington, D.C.

White, A.L., Berty, A., Esquivel, J., Berlin, D.F., Abder, P.F., Rahaman, N., & Pilar; V. (1985, April). *An international consortium for learning research in four countries (U.S.A., Trinidad and Tobago, Costa Rica, and Mexico).* Symposium presentation at the 58th Annual Meeting of the National Association for Research in Science Teaching, French Lick Springs, IN.

White, R. T., & Tisher, R. P. (1986). Research on natural sciences. In M. C. Wittrock (Ed.), *Handbook of Research on Teaching,* Third Edition (pp. 874-905). New York. NY: Macmillan Publishing Company.

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