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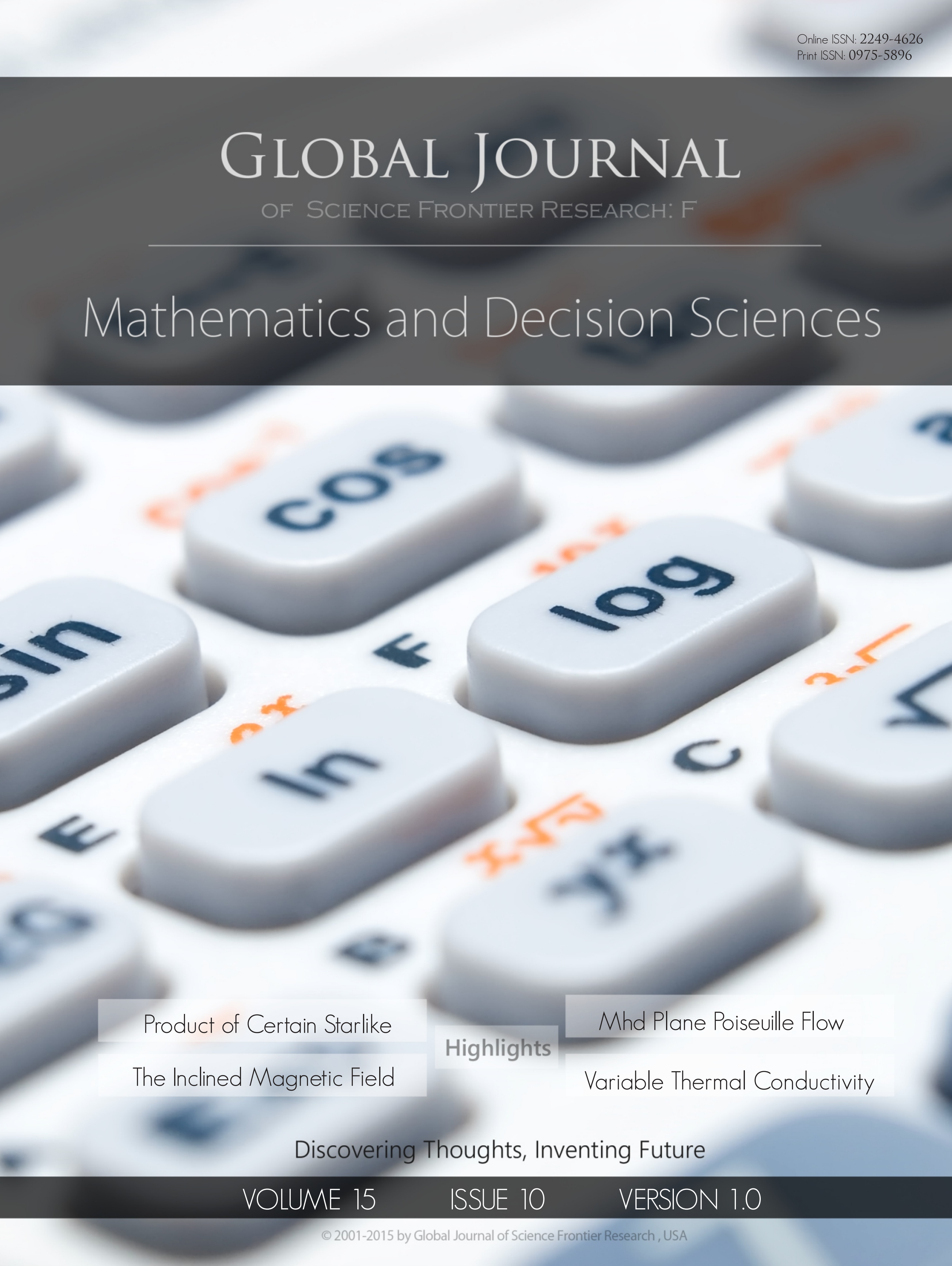

Highlights

Product of Certain Starlike

The Inclined Magnetic Field

Mhd Plane Poiseuille Flow

Variable Thermal Conductivity

Discovering Thoughts, Inventing Future

VOLUME 15 ISSUE 10 VERSION 1.0

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Mathematics & Decision Sciences

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Quasi-Hadamard Product of Certain Starlike and Convex Functions

By H. E. Darwish, A. Y. Lashin & A. N. Alnayyef
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Abstract- In this paper, we establish certain results concerning the quasi-Hadmard product for two classes related to starlike and convex univalent functions with respect to symmetric points.

Keywords: starlike and convex functions with respect to symmetric points, quasi-hadamard product.

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Quasi-Hadamard Product of Certain Starlike and Convex Functions

H. E. Darwish α, A. Y. Lashin σ & A. N. Alnayyef ρ

Abstract- In this paper, we establish certain results concerning the quasi-Hadmard product for two classes related to starlike and convex univalent functions with respect to symmetric points.

Keywords: starlike and convex functions with respect to symmetric points, quasi-hadamard product.

I. INTRODUCTION

Throughout this paper, let S denote of the functions of the form :

$$\mathcal{F}(z) = a_1 z - \sum_{k=2}^{\infty} a_k z^k \qquad (a_1 > 0, a_k \geq 0)\,, \tag{1.1}$$

$$\mathcal{F}_r(z) = a_{1,r} z - \sum_{k=2}^{\infty} a_{k,r} z^k \qquad (r \in \mathbb{N}, a_{1,r} > 0, a_{k,r} \geq 0)\,, \tag{1.2}$$

$$\breve{g}(z) = b_1 z - \sum_{k=2}^{\infty} b_k z^k \qquad (b_1 > 0, b_k \geq 0) \tag{1.3}$$

and

$$\breve{g}_j(z) = b_{1,j} z - \sum_{k=2}^{\infty} b_{k,j} z^k \qquad (j \in \mathbb{N}, b_{1,j} > 0, b_{k,j} \geq 0) \tag{1.4}$$

which are analytic in the unit disc $U = \{z : |z| < 1\}$.

Let $S^{\star}$ be the subclass of functions S consisting of starlike functions in U. It is well known that $\mathcal{F} \in S^{*}$ *if and only if*

$$\operatorname{Re}\left\{\frac{z\mathcal{F}'(z)}{\mathcal{F}(z)}\right\} > 0, \quad (z \in U)\,, \tag{1.5}$$

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and $C^{\star}$ be the subclass of functions S consisting of convex functions in U. It is well known that $\mathcal{F} \in C^{\star}$ *if and only if*

$$\operatorname{Re}\left\{1+\frac{z\mathcal{F}''(z)}{\mathcal{F}'(z)}\right\} > 0, \quad (z \in U). \tag{1.6}$$

Let $S_s^{\star}$ be the subclass of S consisting of functions of the form (1.1) satisfying

$$\operatorname{Re}\left\{\frac{z\mathcal{F}'(z)}{\mathcal{F}(z)-\mathcal{F}(-z)}\right\} > 0, \quad (z \in U). \tag{1.7}$$

These functions are called starlike with respect to symmetric points and were introduced by Sakaguchi [10] (see also Robertson [9] , Stankiewics [12] Wu [14] and Owa et al. [5]).

In [13], Sudharsan et al. introduced the class $S_s^{\star}(\alpha,\beta)$ consisting of functions of the form (1.1) and satisfying the following condition (see also [11])

$$\left|\frac{z\mathcal{F}'(z)}{\mathcal{F}(z)-\mathcal{F}(-z)}-1\right| < \beta\left|\alpha\frac{z\mathcal{F}'(z)}{\mathcal{F}(z)-\mathcal{F}(-z)}+1\right| \tag{1.8}$$

for some $0 \le \alpha \le 1$, $0 < \beta \le 1$ and $z \in U$.

Let $S_c^{\star}(\alpha,\beta)$ denote the class of function $\mathcal{F}(z)$ of the from (1.1) for which $z\mathcal{F}' \in S_s^{\star}(\alpha,\beta)$.

By using the same technique of Sudharsan et al. [13] and Aouf et al. [1], we get the following theorem.

Theorem 1. Let the function $\mathcal{F}(z)$ *defined by* (1.1) *. Then*

(i) $\mathcal{F}(z) \in S_s^{\star}(\alpha,\beta)$ if and only if

$$\sum_{k=2}^{\infty}\left[(1+\alpha\beta)k+(\beta-1)\left[1-(-1)^k\right]a_{k,r}\right] \le [\beta(2+\alpha)-1]\,a_{1,r} \tag{1.9}$$

where $0 \le \alpha \le 1$, $0 < \beta \le 1$, $0 \le \frac{2(1-\beta)}{1+\alpha\beta} < 1$ and $z \in U$.

(ii) $\mathcal{F}(z) \in S_c^{\star}(\alpha,\beta)$ if and only if

$$\sum_{k=2}^{\infty}k\left[(1+\alpha\beta)k+(\beta-1)\left[1-(-1)^k\right]a_{k,r}\right] \le [\beta(2+\alpha)-1]\,a_{1,r} \tag{1.10}$$

where $0 \le \alpha \le 1$, $0 < \beta \le 1$, $0 \le \frac{2(1-\beta)}{1+\alpha\beta} < 1$ and $z \in U$.

(iii) $\mathcal{F}(z) \in S_{s,h}^{\star}(\alpha,\beta)$ if and only if

$$\sum_{k=2}^{\infty}k^h\left\{(1+\alpha\beta)k+(\beta-1)\left[1-(-1)^k\right]\right\}a_{k,r} \le [\beta(2+\alpha)-1]\,a_{1,r}, \tag{1.11}$$

Ref

5. S. Owa, Z. Wu and F. Ren, A note on certain subclass of Sakaguchin functions, Bull. Soc. Roy. Liege 57 (1988), 143-150.

where $0 \leq \alpha \leq 1$, $0 < \beta \leq 1$, $0 \leq \frac{-}{1+\alpha\beta} < 1$ and $z \in U$. Where h is an nonnegative real number.

We note that for every nonnegative real number h, the class $S^{\star}_{s,h}(\alpha,\beta)$ is nonempty as the functions of the from

$$\mathcal{F}(z) = a_1 z - \sum_{k=2}^{\infty} \frac{\beta(2+\alpha)-1}{k^h \left[(1+\alpha\beta)k + (\beta-1)\left[1-(-1)^k\right]\right]} a_1 \lambda_k z^k, \tag{1.12}$$

where $a_1 > 0$, $\lambda_k \geq 0$,and $\sum_{k=2}^{\infty} \lambda_k \leq 0$, satisfy the inequality (1.12). It is evident that $S^{\star}_1(\alpha,\beta) \equiv S^{\star}_c(\alpha,\beta)$ and, for $c = 0$, $S^{\star}_c(\alpha,\beta)$ is identical to $S^{\star}_0(\alpha,\beta)$. Further, $S^{\star}_c(\alpha,\beta) \subset S^{\star}_k(\alpha,\beta)$ if $c > k$, the containment being proper. Hence, for any positive integer$c$, the inclusion relation

$$S^{\star}_c(\alpha,\beta) \subset S^{\star}_{c-1}(\alpha,\beta) \subset \ldots \subset S^{\star}_2(\alpha,\beta) \subset S^{\star}_c(\alpha,\beta) \subset S^{\star}_s(\alpha,\beta).$$

The quasi-Hadamard product of two or more functions has recently been defined and used by Owa [6, 7, 8], Kumar [2, 3, 4] and others. Accordingly, the quasi-Hadamard product of two functions $\mathcal{F}(z)$ and $\breve{g}(z)$ is given by

$$\mathcal{F} * \breve{g}(z) = a_1 b_1 z - \sum_{k=2}^{\infty} a_k b_k z^k.$$

II. THE MAIN THEOREMS

Theorem 2. *A functions $\mathcal{F}_i(z)$ defined by (1.2) in the class $S^{\star}_c(\alpha,\beta)$ for each $r = 1, 2, \ldots, u$. Then we get the quasi-Hadamard product $\mathcal{F}_1 *$*

$$\mathcal{F}_2 * \ldots * \mathcal{F}u(z) \in S^{\star}_{2(u-1)+1}(\alpha,\beta).$$

Proof. To prove the theorem, we need to show that

$$\sum_{k=2}^{\infty} k^{2(u-1)+1} \left\{(1+\alpha\beta)k + (\beta-1)\left[1-(-1)^k\right]\right\} \Pi_{r=1}^{m} a_{k,r} \leq \left[\beta(2+\alpha)-1\right] a_{1,r}. \tag{2.1}$$

Since $\mathcal{F}_r(z) \in S^{\star}_c(\alpha,\beta)$,we have

$$\sum_{k=2}^{\infty} k \left\{(1+\alpha\beta)k + (\beta-1)\left[1-(-1)^k\right]\right\} a_{k,r} \leq \left[\beta(2+\alpha)-1\right] a_{1,r}, \tag{2.2}$$

for each $r = 1, 2, \ldots, u$.Therefore,

$$k\left\{(1+\alpha\beta)k + (\beta-1)\left[1-(-1)^k\right] a_{k,r}\right\} \leq \left[\beta(2+\alpha)-1\right] a_{1,r}$$

or

$$a_{k,r} \leq \left\{\frac{\left[\beta(2+\alpha)-1\right]}{k\left((1+\alpha\beta)k + (\beta-1)\left[1-(-1)^k\right]\right)}\right\} a_{1,r}$$

Ref

2. V. Kumar, Hadamard product of certain starlike functions, J. Math. Anal. Appl. 110 (1985), 425-428.

for each $r = 1, 2, ..., u$. The right-hand expression of this last inequality is not greater then $k^{-2} a_{1,r.}$. Hence

$$a_{k,r} \leq k^{-2} a_{1,r.} \tag{2.3}$$

for each $r = 1, 2, ..., u$.

By (2.3) for each $r = 1, 2, ..., u-1$, and (2.2) for $r = u$, we get

$$\sum_{k=2}^{\infty} k^{2(u-1)+1} \left\{ (1+\alpha\beta) k + (\beta - 1) \left[1 - (-1)^k \right] \right\} \Pi_{r=1}^{u} a_{k,r}$$

$$\leq \left\{ k^{2(u-1)+1} \left[(1+\alpha\beta) k + (\beta - 1) \left[1 - (-1)^k \right] k^{-2(u-1)} \Pi_{r=1}^{u-1} a_{1,r} \right] a_{k,u} \right\}$$

$$= \quad \left[\Pi_{r=1}^{u-1} a_{1,r} \right] \sum_{k=2}^{\infty} \left\{ k \left[(1+\alpha\beta) k + (\beta - 1) \left[1 - (-1)^k \right] a_{k,u} \right] \right\}$$

$$\leq \quad \left[\beta (2+\alpha) - 1 \right] \left[\Pi_{r=1}^{u} a_{1,r} \right] \ .$$

Hence $\mathcal{F}_1 * \mathcal{F}_2 * ... * \mathcal{F}_u(z) \in S^{\star}_{2(u-1)+1}(\alpha, \beta)$.This completes the proof of Theorem 2. ☐

Theorem 3. *A functions* $\mathcal{F}_r(z)$ *defined by* (1.2) *in the class* $S^{\star}_{s}(\alpha, \beta)$ *for each* $r = 1, 2, ..., u$. *Then we get the quasi-Hadamard product* $\mathcal{F}_1 *$

$$\mathcal{F}_2 * ... * \mathcal{F}_u(z) \in S^{\star}_{(u-1)}(\alpha, \beta).$$

Proof. Using $\mathcal{F}_r(z) \in S^{\star}_{s}(\alpha, \beta)$,we have

$$\sum_{k=2}^{\infty} \left[(1+\alpha\beta) k + (\beta - 1) \left[1 - (-1)^k \right] a_{k,r} \right] \leq \left[\beta (2+\alpha) - 1 \right] a_{1,r} \tag{2.4}$$

for each $r = 1, 2, ..., u$. Therefore,

$$a_{k,r} \leq \left\{ \frac{\left[\beta (2+\alpha) - 1 \right]}{(1+\alpha\beta) k + (\beta - 1) \left[1 - (-1)^k \right]} \right\} a_{1,r}$$

and hence

$$a_{k,r} \leq k^{-1} a_{1,r} \tag{2.5}$$

for every $r = 1, 2, ..., u$.

By (2.5) for $r = 1, 2, ..., u-1$,and (2.4) for $r = u$, we get

$$\sum_{k=2}^{\infty} \left\{ k^{(u-1)} \left[(1+\alpha\beta) k + (\beta - 1) \left[1 - (-1)^k \right] \Pi_{r=1}^{u} a_{k,r} \right] \right\}$$

$$\leq \sum_{k=2}^{\infty}\left\{k^{(u-1)}\left[(1+\alpha\beta)\,k+(\beta-1)\left[1-(-1)^{k}\right]\left[k^{-(u-1)}\Pi_{r=1}^{u-1}a_{1,i}\right]\right]a_{k,u}\right\}$$

$$= \left[\Pi_{r=1}^{u-1}a_{1,r}\right]\sum_{k=2}^{\infty}\left\{\left[(1+\alpha\beta)\,k+(\beta-1)\left[1-(-1)^{k}\right]\right]a_{k,u}\right\}$$

$$\leq \left[\beta\,(2+\alpha)-1\right]\left[\Pi_{r=1}^{u}a_{1,r}\right]$$

Hence $\mathcal{F}_1 * \mathcal{F}_2 * ... * \mathcal{F}_u(z) \in S^{\star}_{(u-1)}(\alpha,\beta)$. This completes the proof of Theorem 3. ☐

Theorem 4. A functions $\mathcal{F}r\,(z)$ *defined by* (1.2) *in the class* $S^{\star}_{c}(\alpha,\beta)$ *for each* $r = 1, 2, ..., u$; *and the functions* $\breve{g}_j(z)$*in the class* $S^{\star}_{s}(\alpha,\beta)$ *for every* $j = 1, 2, ..., q$. *Then we get the Hadamard product* $\mathcal{F}_1 * \mathcal{F}_2 * ... * \mathcal{F}_u * \breve{g}_1 * \breve{g}_2 * ... * \breve{g}_q\,(z) \in S^{\star}_{2u+q-1}(\alpha,\beta)$.

Proof. We denote the quasi-Hadamard product $\mathcal{F}_1 * \mathcal{F}_2 * ... * \mathcal{F}_u * \breve{g}_1 * \breve{g}_2 * ... * \breve{g}_q\,(z)$ by the function $h\,(z)$, for the sake of the convenience.

Clearly,

$$h(z) = \left[\Pi_{r=1}^{u}a_{1,i}.\Pi_{j=1}^{q}b_{1,j}\right]z - \sum_{k=2}^{\infty}\left[\Pi_{r=1}^{u}a_{k,r}.\Pi_{j=1}^{q}b_{k,j}\right]z^{k}.$$

To prove the theorem, we need to show that

$$\sum_{k=2}^{\infty}\left\{(k)^{2u+q-1}\left[(1+\alpha\beta)\,k+(\beta-1)\left(1-(-1)^{k}\right)\right]\left[\Pi_{r=1}^{u}a_{k,r}.\Pi_{j=1}^{q}b_{k,j}\right]\right\}$$

$$\leq \left[\beta\,(2+\alpha)-1\right]\left(\Pi_{r=1}^{u}a_{1,r}.\Pi_{j=1}^{q}b_{1,j}\right). \tag{2.6}$$

Since $\mathcal{F}_r\,(z) \in S^{\star}_{c}(\alpha,\beta)$,the inequalities (2.2) and (2.3) hold for every $r = 1, 2, ..., u$. Further, since $\breve{g}_j\,(z) \in S^{\star}_{s}(\alpha,\beta)$,we have

$$\sum_{k=2}^{\infty}\left[(1+\alpha\beta)\,k+(\beta-1)\left[1-(-1)^{k}\right]b_{k,r}\right] \leq \left[\beta\,(2+\alpha)-1\right]b_{1,r} \tag{2.7}$$

for each $j = 1, 2, ..., q$. Whence we obtain

$$b_{k,j} \leq k^{-1}b_{1,j} \tag{2.8}$$

for each $j = 1, 2, ..., q$.

By (2.3) for $r = 1, 2, ..., u$, (2.8) for $j = 1, 2, ..., q-1$, and (2.7) for $j = q$, we get

$$\sum_{k=2}^{\infty}\left\{k^{2u+q-1}\left[(1+\alpha\beta)\,k+(\beta-1)\right]\left[1-(-1)^{k}\right]\left[\Pi_{r=1}^{u}a_{k,r}.\Pi_{j=1}^{q}b_{k,j}\right]\right\}$$

$$
\begin{aligned}
&\leq \sum_{k=2}^{\infty}\left\{k^{2u+q-1}\left[(1+\alpha\beta)\,k+(\beta-1)\left(1-(-1)^{k}\right)\right]\right\} \\
&\quad \times k^{-u(2)}\left(\Pi_{r=1}^{u}a_{1,r}.\Pi_{j=1}^{q}b_{k,j}\right) \\
&\leq \sum_{k=2}^{\infty}\left\{k^{-2u-(q-1)}\left[(1+\alpha\beta)\,k+(\beta-1)\left(1-(-1)^{k}\right)\right]\right\} \\
&\quad \times\left[k^{-2u}.k^{-(q-1)}\Pi_{r=1}^{u}a_{1,r}.\Pi_{j=1}^{q-1}b_{1,j}\right]b_{k,q} \\
&= \left[\Pi_{r=1}^{u}a_{1,r}.\Pi_{j=1}^{q-1}b_{1,j}\right]\sum_{k=2}^{\infty}\left[(1+\alpha\beta)\,k+(\beta-1)\left(1-(-1)^{k}\right)\right]b_{k,q} \\
&\leq [\beta\,(2+\alpha)-1]\left[\Pi_{r=1}^{u}a_{1,r}.\Pi_{j=1}^{q-1}b_{1,j}\right].
\end{aligned}
$$

Hence $h(z)\in S^{\star}_{2u+q-1}(\alpha,\beta)$. This completes the proof of Theorem 4. □

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Importance of Mathematical Communication and Discourse in Secondary Classrooms

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Abstract- Through mathematical communication and discourse, teachers can foster student engagement and participation while focusing on the deep conceptual understanding called for in the Common Core mathematics standards. This qualitative study focuses on the importance of students' mathematical communication (i.e. verbal and written) and discourse as they engage in problem solving, reasoning and proofs. Furthermore, the study demonstrates the development of mathematics language in order for students to better grasp the underlying mathematical concepts. The study finds that the discursive teaching strategies used by the classroom teacher can transform mathematics discourse from informal to formal. The study concludes discursive teaching strategies are viable option for secondary mathematics classrooms to effectively implement the recommendations of the Common Core State Standards for Mathematics (CCSSM).

Keywords: *mathematics discourse, mathematical communication, inquiry-based learning, common core state standards.*

GJSFR-F Classification : *MSC 2010: 00A05*

Importance of Mathematical Communication and Discourse in Secondary Classrooms

Roland G. Pourdavood [α] & Patrick Wachira [σ]

Abstract- Through mathematical communication and discourse, teachers can foster student engagement and participation while focusing on the deep conceptual understanding called for in the Common Core mathematics standards. This qualitative study focuses on the importance of students' mathematical communication (i.e. verbal and written) and discourse as they engage in problem solving, reasoning and proofs. Furthermore, the study demonstrates the development of mathematics language in order for students to better grasp the underlying mathematical concepts. The study finds that the discursive teaching strategies used by the classroom teacher can transform mathematics discourse from informal to formal. The study concludes discursive teaching strategies are viable option for secondary mathematics classrooms to effectively implement the recommendations of the Common Core State Standards for Mathematics (CCSSM).

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I. INTRODUCTION

Across the US teachers are implementing the Common Core State Standards for Mathematics (CCSSM).These are a single set of standards for Kindergarten to twelfth grade (K-12) in mathematics which outlines what a student should know and be able to do at the end of each grade. In addition to content coverage, the standards also specify the mathematical ways of thinking students should develop while learning mathematics content. These process standards are described as eight Common Core Practices for Mathematics (CCSSM 2010). One of these is the ability to construct viable arguments and critique the reasoning of others. Engaging in discourse to make conjectures, justify and defend one answer in a collaborative exchange of ideas about a mathematics concept provides students with the ideal opportunity to construct viable arguments and critique the reasoning of others, which is key to achieving mathematical understanding.

Another key component necessary for success in mathematics highlighted in the common core standards is the need to attend to precision which explicitly calls for students to attend to precision both calculation and language. The use of discourse is so important that it fits into the National Council of Teachers of Mathematics (NCTM, 2000) communication standard which calls for Instructional programs to enable all students to communicate their mathematical thinking coherently and clearly to peers, teachers, and others; to analyze and evaluate the mathematical thinking and strategies

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of others and to use the language of mathematics to express mathematical ideas precisely.

This paper is based on the NCTM's communication standard and the Common core standards for mathematics practices and focuses on how a secondary mathematics teacher orchestrated classroom discourse with an emphasis on the importance of students' mathematical communication, both verbal and written as they engaged in problem solving, reasoning and proofs. The paper focuses on how the teacher's emphasis on discourse and specifically on the promotion of formal mathematics language influenced students' thinking and beliefs about learning.

II. MATHEMATICS DISCOURSE

Reform-based mathematics invites students to investigate mathematical problems and encourages students to use mathematical discourse in order to develop a deeper conceptual understanding called for in the Common Core mathematics standards. Mathematical discourse means that students are able to make conjectures, talk, question, and agree or disagree about problems in order to develop important mathematical concepts (Stein, 2007). Pirie & Schwarzenberger, 1988 as cited in Truxaw, Gorgievski & DeFranco, 2008, p. 58) defined mathematical discourse as "Purposeful talk on a mathematical subject in which there are genuine contributions and interactions". Mathematical discourse contributes to deeper analyses of mathematics on the part of teachers as well as students (Manouchehri, 2007; Manouchehri & St. John, 2006).

According to Schwols & Dempsey (2012b), there are several components to high quality mathematics discourse. One of these is facilitation of conversation. The level and effectiveness of classroom discourse depends heavily on the facilitation skills of the teacher. First, classroom norms should be set up so everyone knows their role. Teachers need to provide a safe and appropriate learning environment that encourages students to participate including building on the response of others, support students throughout their conversations, and show students that they value conceptual understanding, rather than simply focusing on arriving at the right answer (Stein, 2007). During mathematics discourse, teachers need to pose questions that challenge students thinking. Questioning should challenge students to be inquisitive and help them extend their existing mathematics knowledge. Divergent questions which elicit a broader response can help foster students' problem solving and increase conceptual understanding. Teachers need to listen very carefully and monitor students' understanding. The role of the student includes listening and responding to the teacher and to other students. In addition students ought to be comfortable to make arguments of particular concepts and procedures and be able to communicate clearly their reasoning.

Another in dispensable component of mathematical discourse is formal mathematical language. The quality of classroom discourse depends on the ability of students to process language in order to build on the ideas of others. The ability to process language promotes mathematical thinking(Kabasakalian, 2007). Students need to know the meaning of mathematics vocabulary words, whether written or spoken, in order to better understand and communicate mathematical ideas (Gay, 2008). Teachers need to provide learning opportunities that encourage students to use mathematical language so that students better grasp the underlying mathematical meaning of concepts (Adler, 1999; Kotsopoulos, 2007. Likewise, teachers must remain mindful of their own use of mathematical language because a teacher's choice of words directly contributes to a student's understanding or misunderstanding of concepts (Gay, 2008).

a) Problem and significance of study

Communication and discourse are most effective in the context of inquiry-based instruction, however despite the power and benefits of inquiry-based instructionteachers and students resist to use these viable strategies. Students may not engage in instructional conversations because they may not know how. Often students' contributions relate more to procedure rather than deeper level of mathematical concepts. Further in attempting classroom discourse, students' experience interference when they borrow language from their everyday lives to use in their mathematical world; their inability to minimize this interference could potentially undermine their ability to learn (Kotsopoulos, 2007).Thus implementing and managing classroom communication and discourse can be difficult.

This paper focuses on how a high school mathematics teachers orchestrated classroom discourse with an emphasis on the importance of students' mathematical communication, both verbal and written as they engaged in problem solving, reasoning and proofs and how this influenced their thinking. Because discourse is most effective in the context of inquiry-based instruction this study is important to research and report educators' and students' experiences when they change from a predominantly teacher-centered to a more student-centered and inquiry-based learning environment.

III. The Study

a) Participants and methods

The study was conducted in an Introduction to Calculus (IC) course in a suburb of a large Midwestern city in the USA. Participants of this study were twelfth grade students enrolled in the *Introduction to Calculus* (IC) course that focused on inductive treatments of functions, limits, differential calculus, and integral calculus. The class consisted of students who dropped out of the prerequisite track for the advanced level calculus or those who transferred into the course during the first semester of their 12th grade year in lieu of receiving a poor grade in the advanced level calculus courses. This qualitative and descriptive study is grounded in constructivist inquiry (Guba & Lincoln, 1989, 1994; Lincoln & Guba, 1985; McCracken, 1988). Further, this study uses the social constructivist theory (Cobb, 1994) to explain and interpret the mathematical discourse of students as they engaged in solving non-routine problems and communicated their solutions. From a socio-constructivist perspective, individuals build learning and knowing within the social and cultural milieu. The teacher's role becomes that of a facilitator to students; learning, guiding and supporting students construction of viable mathematical ideas. Data sources include transcripts of audio tape recordings of classroom discussions, students written responses to various problems, interviews with the classroom teacher, and the field notes of the researchers. In the analysis of data the researchers had focus group discussions after every observation about their understanding and interpretation of the data. The recursive relationship between student voice and classroom problem solving discourse is pivotal for understanding and explaining the mathematical understanding of students.

b) *Facilitating discourse*

The classroom teacher incorporated four instructional strategies inspired by Hafferd-Ackles, Fuson, & Sherin (2004), to engage his students in mathematical discourse. The four instructional strategies that helped transform the informal classroom mathematics discussions into productive dialogue were inspired by the four levels of mathematics talk learning community framework as explained by Hufferd-Ackles et al, (2004). For this study, the levels were renamed and defined as; Establishing expectations, Mathematics language, Mathematics community, and Establishing Formal Discourse. These four strategies were interactive and emerging throughout the year and not used in a linear fashion. During any lesson two or more of the strategies could be present, but one was always dominant.

Four lessons are presented below to highlight these strategies. The mathematical content of each lesson focused on the line that is tangent to a graph for a given function at a given point on a graph. For each lesson a worksheet stated the pedagogical strategy for conducting the lesson, identified the mathematical tasks, provided a blank grid for drawing graphs, and allowed space for indicating methods, explaining thinking, and justifying responses. All four lessons revisited the same four tasks and relied on the same given function, the same tangent line, and the same graphs. However, the pedagogical strategy and content varied in that each lesson employed a more sophisticated strategy and included an additional task that extended the lesson.

c) *Strategy 1: Establishing Expectations*

In the first lesson the teacher led and dominated the lesson by speaking in a purposeful manner, by demonstrating every detail on the board, by explaining his thinking, justifying his methods and by telling students what to write. The teacher purposefully used this strategy in communicating his expectations regarding how to talk and write about mathematics and also to connect with students' prior experiences in which they were accustomed to listen and maintain silence as they watched the teacher and copied notes. In this first lesson it was important for the students to observe how the language changed from informal language into formal language using standard mathematical vocabulary including graphing calculator syntax to clarify directives.

> Teacher: Key it in. By *it*, I mean the expression $4x^2 + 5$ and by "in", I mean Y_2 on the "Y=" screen. I'll say *it* again without pronouns. Go to the function screen on your calculator by pressing the "Y=" key. On the function screen, enter the expression $4x^2 + 5$ to define Y_2.

From lesson one, students became aware of the important differences between informal language riddled with pronouns and formal language clarified with appropriate mathematical vocabulary.

> Teacher:[pointing to a graph on the board] See how it touches right here? See how it, this line, touches this graph right here, at this point? See how this line, Line l, touches the graph of function f right here, at the point $(1, 8)$ where x is one and f of one is 8? Line l is tangent to the graph for function f at the point where x equals 1.

At the end of the lesson, the teacher entertained questions from students. Students' questions were short and vague and avoided standard mathematical language and vocabulary in which case the teacher had to guess the meaning.

d) *Mathematics language*

The second lesson which the teacher titled *Say "It" in Words,* directed students to complete the same four tasks, indicate their methods and justify their responses and in addition to write step-by-step instructions. In this lesson, the students were to experiment with the formal language. They were to reflect and contribute responses by formulating a brief but meaningful response before responding aloud. The teacher posed questions, challenged students with follow up questions and helped students to clarify their responses. He also ensured classroom norms were followed where classmates did not distract others who were formulating responses.

Teacher: I ask a question; you answer. Use vocabulary words; not pronouns. No *its*. And don't interrupt the speaker.

Students persisted in requesting yet another teacher dominated lesson that avoided standard mathematical vocabulary and notation but the teacher used the lesson for demonstrating the inadequacy of informal mathematics language.

Teacher: Okay, okay. Apparently, yesterday didn't make sense. Maybe I did all the talking and maybe I was too formal. Okay, I'll explain it again. I'll use informal everyday English instead of standard mathematical vocabulary. Okay?

Group: [chatter and agitation subside]

Teacher: We will talk about the complete graph for the given function f and the Line$l$ that is tangent to the graph for function f at the point where $x = 1$.

Student 6:*English?*

Teacher: Okay, okay, not formal, informal. In *English*.

Teacher:[mimicking and exaggerating informal language patterns] I will talk about it and this one. Plug it into the calculator and it's approximately eight. It's f; so it's $4x^2 + 5$. When it's zero, it's five and when it's one, it's nine. Plug it into the original problem, work it out, it's exactly eight. Plug it into the problem, work it out, it's $y = 8x + 1$. So it's l. See?

Group: [chatter and agitation]

Teacher: The problem is: Too many pronouns. Each *it* refers to something different. You must say *it* in words. Clarify; use antecedents. Don't use pronouns. Don't say *it*.

Group:[silence]

In this lesson, the teacher encouraged students to use adequate mathematics language for communication by shifting from informal to more formal mathematical language. Using a list of five powerful rules of engagement for classroom discourse developed by the teacher, each student was helped to formulate at least one meaningful response during the lesson. These rules were; calling upon each student individually by name; Posing a question that the student should be able to understand; providing a reasonable length of time for the student to formulate a response; Verifying that the response is meaningful, delving and prompting to clarify if needed and finally validating the significance of the response before engaging the next student. The second rule often involved more than a quick answer therefore some students hesitated as they responded. The teacher responded by asking everyone to treat others as high achievers thus establishing a supportive climate. As the lesson proceeded, the teacher called on a different student each time. Students generally gave vague responses. The teacher continued to prompt and delve until responses made sense, for example:

Teacher: So, (Student 9), f of x is $4x^2 + 5$. What is f of zero?

Student 9: It's five.

Teacher: What *it* is five?

Student 9: Zero is five.

Teacher: Zero and five are two different numbers. Sorry, but zero is not five.
Student 9: It's still five, you know.
Teacher: Yes. *It* is still five. What *it* is still five?
Student 9:You know. I just can't say it.
Teacher: When you can't say *it* as a fact, ask *it* as a question. We'll give you a minute to collect your thoughts. What *it* can't you say?
Student 9: You know. How do you say what the ***f*** of the zero is? Oh! ***f*** of zero is five.
Teacher: Sounds good. Spoken with authority, like a college professor: ***f*** of zero is five.

With prompting from the teacher, students began to learn to speak with authority, justifying their answers. They depended less and less on the teacher. The students were also learning to combine speaking with writing in order to clarify their thinking. They attempted to write step-by-step instructions in general for finding the specified equation. The teacher offered several suggestions to help them.

1. Pick any step that makes sense to you and say it to yourself; use pronouns.
2. Write the step exactly the way you said it to yourself including pronouns.
3. Replace pronouns with standard mathematical vocabulary or notation.
4. Revise the step until it makes sense to you and to the person next to you.
5. Repeat the process and arrange the steps in an order that makes sense.

Conversations developed in the classroom as students attempted to write and revise the steps. The teacher moved around the room prompting students in order to help them transition their language from informal to formal. At this point most of the students wrote a partial list of vague steps while some were able to write more complete lists that included more than one precise, clearly worded step. Generally, students accepted this second strategy and valued its potential but they were not completely happy with it. The students felt that the teacher consumed too much time talking with individuals rather than to the whole class thus leading to loss of focus. Students also did not like a lesson that involved academic risks and being on the spotlight. They also did not like the inherent lack of closure for open-ended lessons. The teacher was however encouraged because this lesson provided for multiple levels of questioningand provided for differentiated levels of thinking, speaking and writing mathematically.

e) *Mathematics Community*

In Lesson 3 the teacher directed students to complete the same four tasks, indicate their methods and justify their responses. In addition the students were to work collaboratively with a partner to develop an analytical method for finding an equation for the line that is tangent to a graph for a given functionat a given point. Each student was to make sure they understood their method thoroughly. The role of the students in this lesson was to attempt using formal discourse. The role of the teacher was the same as in Lesson 2 including enforcing the social/behavioral norms to provide a supportive environment. In this lesson, work varied among the pairs of partners who used mathematical vocabulary and standard mathematical notation in various ways to explain their thinking. The analytical method varied among the groups. Regardless, nearly all students could use at least one form with confidence to determine an equation for the tangent line. More importantly, students acquired communication skills, which in turn helped clarify their explanations and justifications. The teacher helped the class became aware of its collective intelligence by connecting Lesson 3 to previous lessons. Their own work clearly had value for students but their collective

Notes

work appeared to have added value. The teacher further motivated the students by awarding every student points not for writing correct answers but for connecting formal mathematical language with important mathematical ideas. As students became more collaborative and less competitive, the teacher felt reassured, noting that students not only valued their points but also valued their work.

f) *Formal Discourse*

Notes

Lesson 4 – The directions for lesson 4 were similar to the previous lessons. In addition the teacher directed the students to;

> Draw a graph in general that represents any function g in the family – (x, y): $x \in R$ and $0 \leq x \leq 2$ and $n \in J+$ and $y = 4xn + 5$ ″ ; draw a line that is tangent to the graph for function $\boldsymbol{g}$ at the point where $\boldsymbol{x = t}$; state the coordinates in general for the point of tangency and for the $\boldsymbol{y}$-intercept of the line.

In this lesson, the student were to take turns adding steps to problems at the board while analyzing and thinking mathematically, by speaking loudly, and by writing clearly. The role of the teacher was to monitor and to assist in order to help students connect their own responses in earlier lessons to possible contributions in this lesson. An important feature of this lesson was the manner in which students were able to distinguish between meaningful contributions and less-than-meaningful contributions. Statements that either explained a method or justified a response were meaningful. Likewise, statements that either validated or challenged a contribution were meaningful. Even incorrect statements could be meaningful provided that they initiated an exchange of mathematical ideas.

> Teacher: Simply saying, "I don't know," is not a meaningful contribution.
>
> Student 29: What about "I don't know blank." and you say something mathematical. Is that meaningful enough?
>
> Teacher: Yes, those are all meaningful enough if you fill in the blank with something specific.

Another important feature of this lesson was the way in which students maintained the formality of the class discussion. The teacher directed that only one person speak at a time with points taken off for interrupting the speaker. Students took turns at the board to contribute pieces and parts of the complete response that they learned in the previous lessons. Some students spoke as they wrote; others wrote in silence and then read the contribution aloud. While their mathematical language had some flaws, students spoke with authority. At times students' contributions reverted to old habits with comments and language that avoided standard mathematical language. Sometimes informal questions were directed at the teacher rather than authoritative statements directed at the class. The teacher monitored the discussion and interpreted any lapse into old habits as an indicator of stress. Instead of reverting to Strategy 1, a teacher dominated lesson, the teacher assisted by reminding students to transform their questions into statements.

> Student 33: [plotting and labeling the point at *(0,5)*] I'll do zero, five.
>
> Student 34: [directed at teacher] How did she know that?
>
> Teacher: We have a challenger; (Student 33) made a statement without justification and (Student 34) wants justification. Don't ask me, ask her.
>
> Student 34: [directed at (Student 33)] How did you know that?
>
> Student 33: It says *it* on the paper. Wait, I can't say *it*.
>
> Teacher: That's terrific. You know what not to say. That's progress. Now look for

words.

Student 33:[pausing to formulate a response] It says x is a real number and x is greater than or equal to zero. Can I just say that? What about y?

Teacher: Turn your questions into a statement. Try to use the word *because*.

Student 33: [pausing to formulate a response] The endpoint must be $(0, 5)$ because the smallest x is zero … and 0^n is always zero, so $g(0)$ is five.

Teacher: That makes sense to me; you plotted and labeled an endpoint, that's one of the essential features of a complete graph.

In lesson 4 students made significant progress. They produced a generalized graph for function g, plotted and labeled endpoints, plotted and labeled the point of tangency, drew the tangent line and began to discuss an equation for the tangent line. While most students still did not speak with authority or clarity, a few students, however, made somewhat formal summary statements. For example;

Student 37: [Writing $y - (4t^n + 5) = (4nt^{n-1})(x - t)$ on the chalk board and read it]I did more with g prime. I worked *it* all out and *it's*…[Writing $g'(t) = \lim_{h \to 0} \left(\frac{g(t+h) - g(t)}{(t+h) - (t)}\right) = 4nt^{n-1}$ on the chalkboard] Does *it* always work this way?

Teacher: That's the kind of question that mathematicians ask. We'll see. Can you tell us what *it* you are talking about?

The student justified his contribution step by step, referring to his conclusion as a *short cut* for his analytical work. With minor adjustments, of course, his *short cut* would be the Power Rule; a significant accomplishment for a high school student.

Student 37: Can I use the *short cut* on the test instead of writing out all these steps?

Teacher: Logical *short cuts*, like yours, are what mathematicians call theorems. So, if you state your short cut clearly and explicitly (by) using standard mathematical vocabulary and notation, then you'll have a theorem. You may always use theorems on tests.

As the lesson proceeded, students determined the y-intercept for the tangent line in general. Some students, feeling overwhelmed by the breadth and depth of the discussion, lost their focus. The teacher assisted by reassuring students that the important mathematical ideas would make sense in due time and by reassuring the class as a whole that they were making commendable progress even if they did not understand every detail yet. A few students seemed to become empowered and convinced about the meaningfulness of their classroom discourses. Most others remained either passive resistors or active opponents; participation points were a small reward for their discomfort.

IV. DISCUSSION

Students' verbal and written communication and discourse should not be under-estimated. Communication and classroom discourse fulfill three broad and interlocking goals for learning, teaching and assessment. First, as students communicate their mathematical thinking and reasoning they become observers of themselves. They make invisible mathematical solutions more clear and visible to themselves and to their peers. That is called metacognition (i.e. thinking about thinking). In addition, as they explain their thinking and problem solving to their peers, they become teachers in the classroom. They become more confident in their abilities to do significant mathematics. In this sense, they become more empowered mathematically (NCTM, 2000).

Second, students' verbal and written communication helps their classroom teachers to understand students' understanding. Therefore, students' communication and classroom discourse not only enhances student learning but also it inform teacher's instructional decision making. Third, classroom communication and discourse are powerful tools for Teacher to assess students' learning and can create a safe environment for risk taking, exploring ideas, and genuine dialogue. Furthermore, it may involve parents regarding their children's education build a stronger communication between the classroom teacher and parents(Tsuruda, 1994).

Notes

This study examined four pedagogical strategies that a secondary mathematics classroom teacher used to engage students in mathematical discourse as part of an inquiry-based mathematics classroom. The findings of this study suggest that mathematical discourse can promote mathematical understanding among secondary school students. First, the study finds that the discursive teaching strategies used by the classroom teacher are mainly responsible for transforming mathematics discourse. While the lessons seemed time consuming and repetitive, students not only learned about tangent lines but also how to use formal language skills to clarify their thinking and communicate important mathematical ideas. Most students came to prefer Strategies 2 and 3 thus losing their dependency on Strategy 1 in which the teacher played a dominant role during the discursive process. As their confidence grew, their resistance to Strategy 4 diminished slowly but did not dissipate completely as the students still needed time to accept a classroom culture that differed significantly from their prior experiences. Over time, the teacher can minimally engage in the discourse by opting for more of a student-led discourse and acting solely as a guardian and facilitator of the process.

This study also found that students' attitudes towards discourse can change over time. At the onset, all of the participating students were more comfortable with conventional instruction, most in which the teacher demonstrates mathematical procedures and students practice the procedures (Kawanaka & Stigler, 1999). After being immersed in the classroom setting for the better part of a school year, most of the participating students in this study become more open to inquiry-based instruction as indicated by one of the students Dan;

> "I learned that there's more than one way to learn math. In the past…, we've gone over a section and then you'd do the homework for that section that night and the process repeats everyday without any change. In this new way that I've been learning, it is not with homework but with group discussions and taking notes. It varies. That's a good way to learn it because it keeps you interested more than it would if you just did the same thing over and over again."

Students, over time, show increasing appreciation for mathematical discourse.As noted by another student;

> "I get frustrated when I can't do math, when I don't know what to say. But when I am able to communicate my thinking using mathematical vocabulary, I think that's cool. That's an accomplishment. So, I won't say that this class was a waste of time. Ask me next year, after college [laughing]. Because, maybe I'll go to college and found out I learned a lot. I don't see that happening but it's possible".

One of the challenges of creating a meaningful classroom communication and discourse is change in epistemology by teachers as well as students. Teacher's view on how students learn mathematics and their role in the classroom is crucial for creating learning opportunities for all students. Most teachers teach the way they were taught (i.e. direct instruction). In the U.S. most teachers see their role as dispenser of knowledge and students' role as passive recipients of the knowledge that imposed to them. Another challenge is students' view of learning and knowing and their role in mathematics classroom. Most students have not experienced learning as active construction of meaning. Discrepancy between teacher's view and students' view on learning may create a dilemma in the classroom. These epistemological differences may impact students' participation in and contribution to the classroom activities.

g) Concluding remarks

"[T]he most critical shift in education in the past 20 years has been a move away from a conception of 'learner as sponge' toward an image of 'learner as active constructor of meaning'" (Wilson & Peterson, 2006, p. 2).For several decades educational practices were significantly influenced by behaviorist perspective. American classrooms still largely exemplify the behaviorist approach. As such, lessons are very procedure-oriented. During a typical U.S. mathematics lesson, students can expect to spend half of the class reviewing content they have already learned. The remainder of class time is normally split between introducing new material and practicing it (Hiebert et al, 2003; Kilpatrick, Martin, & Schifter, 2003).

This behavioral perspective has been challenged by current research on how students learn mathematics. It is a shift that pulls away from dominant educational practices rooted in behaviorism toward practices reflective of constructivism and socio cultural perspectives. These perspectives are largely accepted by mathematics education community such as NCTM. According to constructivist view, knowing and learning is constructed by individuals as they participate in and contribute to the classroom activities (Cobb, 1994).Ways of knowing and understanding differs from individual to individual even in the same sociocultural situation. Constructivism sees the role of teacher as a facilitator of the process of learning. It argues that in the classroom mathematical activity, as the individual student is involved in problem solving, he/she may be faced with conflicting situations. The resolution of this perturbation helps the student to reorganize his/her thought (cognition).

Another dimension of learning is the notion culture. Mathematics learning is influenced by social and cultural situations. One of the important roles of a teacher is to mediate between students' personal mathematical meaning and wider sociocultural norms of the society. The coordination of constructivism and sociocultural perspectives are pivotal for creating learning opportunities for all students.

> I contend that the two perspectives [constructivism and sociocultural] are complementary…I argue that the sociocultural perspective informs theories of the conditions for the possibility of learning, whereas theories develop from the constructivist perspective focus on what students learn and the processes by which they do so, (Cobb, 1994, p.13)

Although the coordinating perspective has focused on understanding student's mathematics learning. It may offer insights as to how teachers may collect authentic data and analyze data relative to students' understanding of mathematical concept. In particular, the coordinating perspective may provide teacher a viable window to look at how students make sense of their mathematical activities.

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The Effect of Variable Thermal Conductivity and the Inclined Magnetic Field on MHD Plane Poiseuille Flow Past Non-Uniform Plate Temperature

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Keywords: poiseuille-flow, thermal conductivity, inclined uniform magnetic field.

GJSFR-F Classification : MSC 2010: 65H20. 34D10

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I. Introduction

In MHD plane Poiseuille flow, the flow velocity is driven by non- zero pressure gradient and the plates are kept at a standstill. The axis of $\overline{x}$, for the sake of convenience is taken in the middle of the flow field.

The study of heat transfer by thermal conduction is a great importance in fluid dynamics. The temperature difference in fluid, in the span of time is reduced by heat flowing from higher temperature to those of lower temperature in regions. Fourier laws govern the heat transfer by conduction. Cooling procedure can be controlled effectively by theory of variable conduction for which the high quality product may be produced. Small Prandtle number of liquid metals is as used as coolants because of its higher thermal conductivity. The study of magneto hydrodynamic (MHD) Poiseuille flow between two parallel Plates has been on recent years of important research topic due to its numerous applications in solar technology, MHD power generators, MHD pumps, aerodynamics heating, electrostatic precipitation, purification of oil and fluid sprays and

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droplets, etc. MHD plane Poiseuille flow with high conducting fluid is also considered to have importance in transpiration cooling. Several engines can be protected from the influence of hot gases, applying high conducting fluid for its character coolants and are effective in heat transfer between the fluid and boundary with much application to exhaust nozzles, combustion chamber walls, and cooling of rockets and jet. He (2000, 2009), Bizarre, and Ghazvini (2008) perceived the solution of non-linear coupled equations by homotopy perturbation technique.

The subject of the above applications, different researchers, and scholars have made a series of investigations.

Alfven (1942) considered the existence of electromagnetic hydrodynamic waves. Nahme (1940) examined the temperature dependant viscosity in Couette flow. Hausenblas (1950) analysed the viscosity and temperature relation keeping both the walls at the same temperature in plane Poiseuille flow. Bansal and Jain (1975) discussed the same problem when both the walls are different temperature. Shercliff (1956), Cowling (1957), Schlichting (1960), Sinha et al. (1965), and Palm et al. (1972) studied on the steady free convection in porous matrix and extended their work in an isotropic porosity with heat exchange effect. Arunchalm and Rajappa (1978) discussed the force convection in liquid metal with variable conductivity and capacity. Drake (1965) measured the flow in a channel with periodic pressure gradient. Raptis et al. (1982) considered MHD free convective flow past parallel plates with porous medium, Ram et al. (1984) studied Hall Effect and heat with mass transfer through porous matrix. Singh (1992) analyzed MHD fluid flow between two parallel plates and extended his work in (2000) with the study of unsteady flow of fluid under the influence of inclined magnetic field through channels with changing pressure gradient exponentially. Al-Hadhrami et al. (2003) considered fluid flow through horizontal channels and resulted velocity in terms of Reynolds numbers using the porous matrix. Ganesh et al. (2007) discussed the MHD unsteady stokes flow problem between two parallel plates. They studied fluid being withdrawn through both the walls at the same rate. Mayonge at al. (2013) discussed the flow problem between Poiseuille flow channels if one plate of channel is porous under the influence of the inclined magnetic field. Kiema et al. (2015) analyzed the steady MHD Poiseuille flow between two infinite parallel porous plates under the inclined transverse magnetic field applying the finite difference method.

The proposed study on the effect of variable thermal conductivity and the inclined uniform magnetic field on steady MHD plane Poiseuille flow are through non-uniform plate temperature and constant suction.

a) *Mathematical Formulation and its Solution*

Consider the viscous incompressible electrically conducting plane Poiseuille fluid flow bounded by two parallel plates separated by a distance 2h. Taking x-axis along the centre line of the parallel plates and the $y^{\emptyset}$-axis is perpendicular to the plates i.e. $y^{\emptyset}$ =±h. A uniform transverse magnetic field β_0 is applied normal to the wall. Both of the plates are kept stationary and maintained at constant dissimilar temperatures $\theta^{\emptyset}{}_0$ & $\theta^{\emptyset}{}_1$. It is assumed that the magnetic Reynold number is very small, so that the induce electric field caused by induce magnetic field is assumed negligible. The poiseuille flow is driven by the constant pressure gradient. The flow in the region is unidirectional, steady laminar and fully developed so all the physical variables except pressure depend on $y^{\emptyset}$ only. The suction velocity V= -V$_0$ is at one porous plate $y^{\emptyset}$ = -h so $\frac{\partial V_0}{\partial y^{\emptyset}} = 0$

b) Governing Equations

Equation of momentum:

$$-V_0 \frac{\partial u^\emptyset}{\partial y^\emptyset} = -\frac{1}{\rho}\frac{\partial p}{\partial x} + \upsilon \frac{\partial^2 u^\emptyset}{\partial y^{2\emptyset}} - \frac{\sigma \beta^2{}_0 u^\emptyset}{\rho} \qquad \text{............(1)}$$

Equation of energy with thermal conductivity is:

$$-\rho C_p V_0 \frac{\partial \theta^\emptyset}{\partial y^\emptyset} = \frac{\partial}{\partial y^\emptyset}\left(K^\emptyset \frac{\partial \theta^\emptyset}{\partial y^\emptyset}\right) + \mu\left(\frac{\partial u^\emptyset}{\partial y^\emptyset}\right)^2 \qquad \text{............(2)}$$

Corresponding boundary conditions are

$$y^\emptyset = h \qquad u^\emptyset = 0 \qquad \theta^\emptyset = \theta_1$$

And

$$y^\emptyset = -h \qquad u^\emptyset = 0 \qquad \theta^\emptyset = \theta_0 \qquad \text{............(3)}$$

Following Arunachalam and Rajappa (1978), the thermal conductivity is assumed to vary linearly with temperature and it is of the form:

$$K^\emptyset = K\,(1 + \epsilon\theta)$$

$$V = -V_0 \text{ Suction constant velocity} \qquad \text{............(4)}$$

Introducing dimensionless quantities:

$$y = \frac{y^\emptyset}{h}, \quad Re = \frac{+V_0 h}{\upsilon}, \quad P = \frac{-h^2}{2\mu U_m}\frac{dp}{dx}$$

$$\theta = \frac{\theta^\emptyset - \theta^\emptyset{}_0}{\theta^\emptyset{}_1 - \theta^\emptyset{}_0}, \qquad \bar{M}^2 = \frac{\sigma \beta_0{}^2 h^2}{\nu}$$

$$Pr = \frac{\rho C p \upsilon}{K}, \quad Ec = \frac{U_m{}^2}{Cp(\theta^\emptyset{}_1 - \theta^\emptyset{}_0)} \qquad \text{............(5)}$$

Fluid motion is maintained owing to the constant pressure gradient. It is sufficiently assumed that the maximum velocity ($U_m = -\frac{h^2}{2\mu}\frac{dp}{dx}$) contained in the middle of the channel in the plane Poiseuille flow with constant fluid properties (Schilichting). Equation (1) and (2) ease into non-dimensional momentum and energy equations using equation (5) (the dimensionless parameters).

Non-dimensional equation of momentum:

$$\frac{d^2u}{dy^2} + Re\frac{du}{dy} - \bar{M}^2 u = -P$$

Or

$$\frac{d^2u}{dy^2} + Re\frac{du}{dy} - \bar{M}^2 Sin^2\alpha u = -P \qquad \text{............(6)}$$

Where α is the angle between v and β_0 which means that the two fields able to be assessed at any one angle α for $0 \leq \alpha \leq \pi$

Equation (6) became

$$\frac{d^2u}{dy^2} + Re\frac{du}{dy} - M^2u = -P \qquad ....(7)$$

Non-dimensional equation of energy:

$$(1+\varepsilon\theta)\frac{d^2\theta}{dy^2} + RePr\frac{d\theta}{dy} + \epsilon\left(\frac{d\theta}{dy}\right)^2 = EcPr\left(\frac{du}{dy}\right)^2 \qquad ....(8)$$

Normalize boundary conditions are

$$y = -1,\ u = 0,\ \theta = 0$$

$$y = 1,\ u = 0,\ \theta = 1 \qquad ------\ (9)$$

where σ is the coefficient of electrical conductivity, Cp is the specific heat, β_0 is the applied magnetic field, υ is the kinematic viscosity, μ is the viscosity of the fluid and $-V_0$ is the suction velocity, 2h is the distance between plates, K is thermal conductivity, ε is variable conductivity of fluid, u is dynamic velocity, ρ is density, θ is the temperature of fluid at any point, α is the inclined angle between fluid velocity and applied magnetic field, Cp is specific heat, θ_1, θ_0 are the temperature of the upper and the lower plate temperature where $\theta_1 > \theta_0$. $\bar{M}$ the Hartmann number, $M = \bar{M}\sin\alpha$ the Hartmann number with inclined angle α, Pr the Prandtl number, Ec the Ekert number, Re the Reynold number. P the normalize constant pressure gradient, U_m the maximum velocity of fluid.

II. SOLUTIONS

The boundary value problem described by the equations, non-coupled (7) and coupled (8) through (9) which provide analytical solutions. Firstly, the solution of the momentum ordinary differential equation (7) is obtained which used to solve the equation (8) by homotopy perturbation technique. Solution of equation (7) using boundary conditions (9) is obtained as given below:

$$u(y) = C_1e^{a_1y} + C_2e^{a_2y} + \frac{P}{M^2} \qquad ....(10)$$

Where integration constants C_1 & C_2 are computed with boundary conditions (9) and are obtained as:

$$C_1 = \frac{-\left[C_2e^{a_2} + \frac{P}{M^2}\right]}{e^{a_1}}$$

And

$$C_2 = \frac{P}{M^2}\left[\frac{e^{a_1} - e^{-a_1}}{e^{(a_2-a_1)} - e^{(a_1-a_2)}}\right]$$

Again

$$a_1 = \frac{-Re + \sqrt{Re^2 + 4M^2}}{2}$$

$$a_2 = \frac{-Re - \sqrt{Re^2 + 4M^2}}{2}$$

And M = $\bar{M}$ Sin α

On using dynamic velocity of fluid u, given by equation (10) in the coupled energy equation (8) and is solved by homotopy perturbation technique.
Construct homotopy for energy equation, [Ref. 24, 25, 26]:

$$H = L\ (\theta) - L\ (\theta_i) + P\ [L\ (\theta_i) + N\ (\theta) - F\ (r)] = 0 \qquad \text{--------}\ (11)$$

Where L (θ) and N (θ) are the Linear and Non-linear term of θ and L (θ_i) is the initial term of linearity.

$$\text{Let } \theta\ (y) = \theta_{00} + p\ \theta_{01} + \qquad \ldots\ldots\ldots\ldots\ldots\ (12)$$

We get the solution of energy equation (8) for the temperature θ in view of boundary conditions (9) is obtained as follows:

$$\theta(y) = \frac{1}{2}\left(1 + Sin\frac{\pi}{2}y\right) + \gamma_2 + \gamma_1 e^{-PrRey} - \beta_2 Sin\frac{\pi}{2}y - \beta_3 Cos\frac{\pi}{2}y$$

$$+\beta_4 Cos\pi y - \beta_5 Sin\pi y + \beta_6 e^{2a_1 y} + \beta_7 e^{2a_2, y} + \beta_8 e^{(a_1 + a_2)y} \qquad \ldots\ldots\ldots\ (13)$$

Where γ_2, γ_1, β_2, β_3, β_4, β_5, β_6, β_7 and β_8 are constants and their values are not given here for the sake of brevity.

III. Result & Discussion

The study on the effect of variable thermal conductivity and the inclined uniform magnetic field on steady MHD plane Poiseuille flow through non-uniform plate temperature and constant suction have been discussed numerically and are performed for the velocity and temperature profile. The consequences are displayed graphically in figure (1) to (5) for pertinent parameters such as Hartmann number M, Reynold number Re, thermal conductivity Parndtl parameter (Pr) and variable thermal conductivity (ε).

Figure 1 shows the effect of different inclination angle of magnetic parameter M on the velocity profile against y. It is evident that an increase in inclination angle (α), reducing the velocity of the flow field, maximum retardation of the velocity of flow occurs at the inclination angle $\alpha = 90°$, signifies the increase of maximum resistive type force (Lorenz force) which tends to parallel opposite direction of flow field has a tendency to slow down the motion of fluid flow.

Figure 2: illustrates the velocity profile for different values of the suction parameter (Re) when taking all other parameters constant. The fluid velocity accelerates near the lower plate and decelerates near the upper plate [Das and Jana (2013)]. Suction parameter (Re) affects the main velocity of the flow field, which accelerate at the hand of suction (Lower plate) because suction parameter sucks the obstacle dust particles thus decreases the boundary layer thickness.

Figure 3: It is encountered to conclude that the temperature profile for different values of Reynold number (Re), increasing of suction parameter (Re) reduces the temperature at all the points of fluid flow. It is attributed to the fact that suction parameter absorbs the heat.

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Figure 4: It is observed that decreasing of Parndtl (Pr) number increases the thermal conductivity and therefore, heat is able to diffuse away from plate than the higher value of Pr. Hence, in case of small Prandtl number, the thermal boundary layer is thicker, and the temperature profile increasing.

Figure 5: The effect of variable thermal conductivity parameter is shown in figure 5 for the high conducting fluid. It is observed from this depict that the increasing value of ε results in increasing the magnitude of temperature causing thermal boundary layer thickening reaches at the certain point of the fluid, but after reaching a certain point, the figure shows the effect of thermal layer thinning thus heat may be transferred from the fluid to plate

IV. CONCLUSION

(1) Increasing Re (Reynold number) decreases the dynamic velocity near to the suction plate, but the reversal effect shows at another plate coincides with the results of [Das and Jana 2013].
(2) Maximum retardation of velocity occurs at the inclination angle 90 degree that are between velocity and magnetic field.
(3) The effect of Prandtl number is to decrease the thermal boundary layer thickness.
(4) The thermal variable thermal conductivity also has an impact in enhancing the temperature at the certain point of temperature profile, then decay to the adjacent to the heating plate for high conducting fluid.
(5) Fluid temperature decreases with the increases in Reynold number

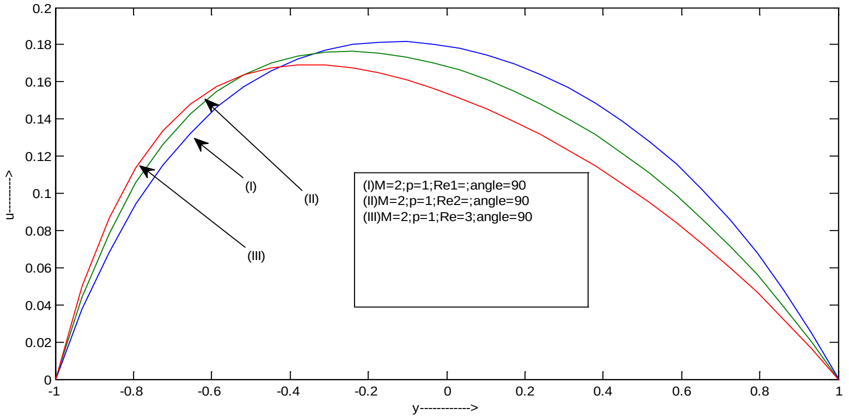

fig1:Velocity against y

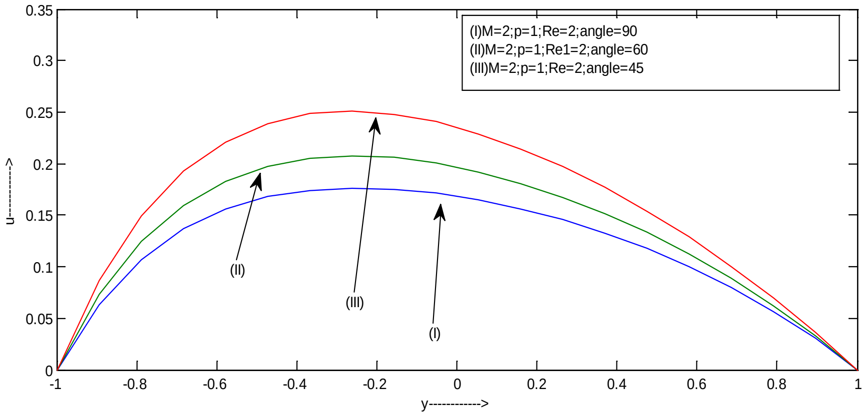

fig2:Velocity against y

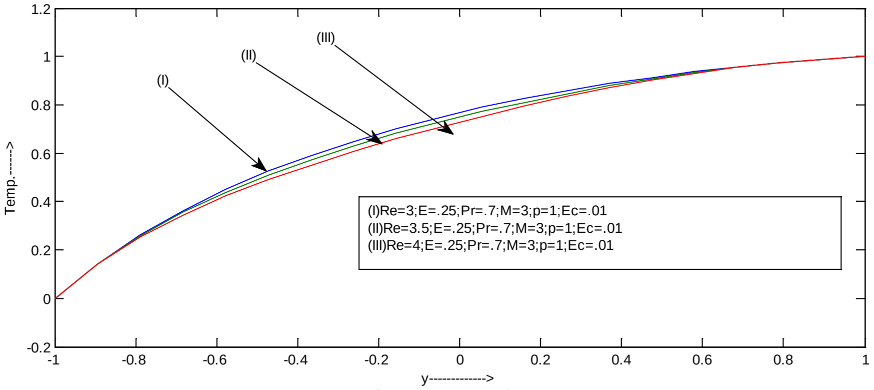

fig3:Temperature against y

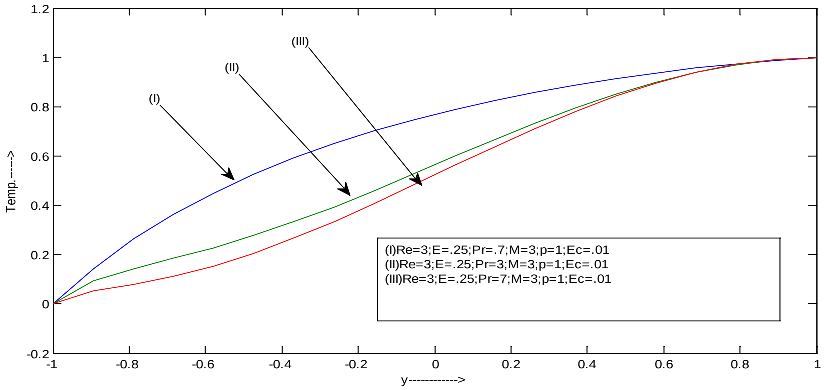

fig4:Temperature against y

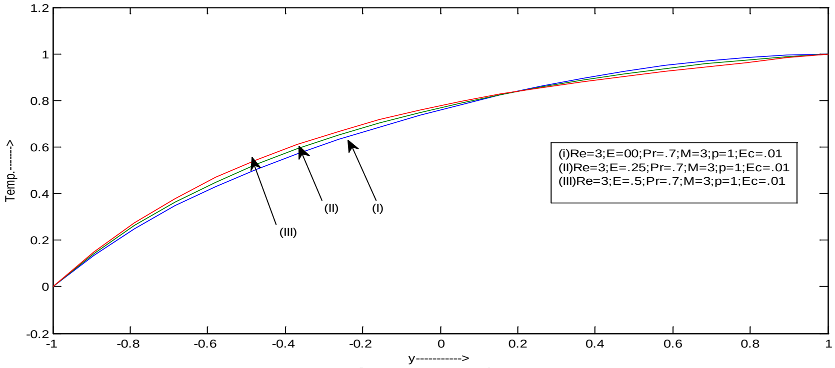

fig5: Temperature against y

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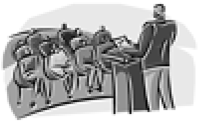

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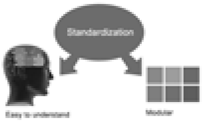

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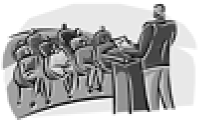

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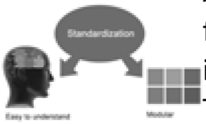

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> "
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15. Use of direct quotes: When you do research relevant to literature, history or current affairs then use of quotes become essential but if study is relevant to science then use of quotes is not preferable.

16. Use proper verb tense: Use proper verb tenses in your paper. Use past tense, to present those events that happened. Use present tense to indicate events that are going on. Use future tense to indicate future happening events. Use of improper and wrong tenses will confuse the evaluator. Avoid the sentences that are incomplete.

17. Never use online paper: If you are getting any paper on Internet, then never use it as your research paper because it might be possible that evaluator has already seen it or maybe it is outdated version.

18. Pick a good study spot: To do your research studies always try to pick a spot, which is quiet. Every spot is not for studies. Spot that suits you choose it and proceed further.

19. Know what you know: Always try to know, what you know by making objectives. Else, you will be confused and cannot achieve your target.

20. Use good quality grammar: Always use a good quality grammar and use words that will throw positive impact on evaluator. Use of good quality grammar does not mean to use tough words, that for each word the evaluator has to go through dictionary. Do not start sentence with a conjunction. Do not fragment sentences. Eliminate one-word sentences. Ignore passive voice. Do not ever use a big word when a diminutive one would suffice. Verbs have to be in agreement with their subjects. Prepositions are not expressions to finish sentences with. It is incorrect to ever divide an infinitive. Avoid clichés like the disease. Also, always shun irritating alliteration. Use language that is simple and straight forward. put together a neat summary.

21. Arrangement of information: Each section of the main body should start with an opening sentence and there should be a changeover at the end of the section. Give only valid and powerful arguments to your topic. You may also maintain your arguments with records.

22. Never start in last minute: Always start at right time and give enough time to research work. Leaving everything to the last minute will degrade your paper and spoil your work.

23. Multitasking in research is not good: Doing several things at the same time proves bad habit in case of research activity. Research is an area, where everything has a particular time slot. Divide your research work in parts and do particular part in particular time slot.

24. Never copy others' work: Never copy others' work and give it your name because if evaluator has seen it anywhere you will be in trouble.

25. Take proper rest and food: No matter how many hours you spend for your research activity, if you are not taking care of your health then all your efforts will be in vain. For a quality research, study is must, and this can be done by taking proper rest and food.

26. Go for seminars: Attend seminars if the topic is relevant to your research area. Utilize all your resources.

27. Refresh your mind after intervals: Try to give rest to your mind by listening to soft music or by sleeping in intervals. This will also improve your memory.

28. Make colleagues: Always try to make colleagues. No matter how sharper or intelligent you are, if you make colleagues you can have several ideas, which will be helpful for your research.

29. Think technically: Always think technically. If anything happens, then search its reasons, its benefits, and demerits.

30. Think and then print: When you will go to print your paper, notice that tables are not be split, headings are not detached from their descriptions, and page sequence is maintained.

31. Adding unnecessary information: Do not add unnecessary information, like, I have used MS Excel to draw graph. Do not add irrelevant and inappropriate material. These all will create superfluous. Foreign terminology and phrases are not apropos. One should NEVER take a broad view. Analogy in script is like feathers on a snake. Not at all use a large word when a very small one would be sufficient. Use words properly, regardless of how others use them. Remove quotations. Puns are for kids, not grunt readers. Amplification is a billion times of inferior quality than sarcasm.

32. Never oversimplify everything: To add material in your research paper, never go for oversimplification. This will definitely irritate the evaluator. Be more or less specific. Also too, by no means, ever use rhythmic redundancies. Contractions aren't essential and shouldn't be there used. Comparisons are as terrible as clichés. Give up ampersands and abbreviations, and so on. Remove commas, that are, not necessary. Parenthetical words however should be together with this in commas. Understatement is all the time the complete best way to put onward earth-shaking thoughts. Give a detailed literary review.

33. Report concluded results: Use concluded results. From raw data, filter the results and then conclude your studies based on measurements and observations taken. Significant figures and appropriate number of decimal places should be used. Parenthetical remarks are prohibitive. Proofread carefully at final stage. In the end give outline to your arguments. Spot out perspectives of further study of this subject. Justify your conclusion by at the bottom of them with sufficient justifications and examples.

34. After conclusion: Once you have concluded your research, the next most important step is to present your findings. Presentation is extremely important as it is the definite medium though which your research is going to be in print to the rest of the crowd. Care should be taken to categorize your thoughts well and present them in a logical and neat manner. A good quality research paper format is essential because it serves to highlight your research paper and bring to light all necessary aspects in your research.

INFORMAL GUIDELINES OF RESEARCH PAPER WRITING

Key points to remember:

- Submit all work in its final form.
- Write your paper in the form, which is presented in the guidelines using the template.
- Please note the criterion for grading the final paper by peer-reviewers.

Final Points:

A purpose of organizing a research paper is to let people to interpret your effort selectively. The journal requires the following sections, submitted in the order listed, each section to start on a new page.

The introduction will be compiled from reference matter and will reflect the design processes or outline of basis that direct you to make study. As you will carry out the process of study, the method and process section will be constructed as like that. The result segment will show related statistics in nearly sequential order and will direct the reviewers next to the similar intellectual paths throughout the data that you took to carry out your study. The discussion section will provide understanding of the data and projections as to the implication of the results. The use of good quality references all through the paper will give the effort trustworthiness by representing an alertness of prior workings.

Writing a research paper is not an easy job no matter how trouble-free the actual research or concept. Practice, excellent preparation, and controlled record keeping are the only means to make straightforward the progression.

General style:

Specific editorial column necessities for compliance of a manuscript will always take over from directions in these general guidelines.

To make a paper clear

· Adhere to recommended page limits

Mistakes to evade

- Insertion a title at the foot of a page with the subsequent text on the next page
- Separating a table/chart or figure - impound each figure/table to a single page
- Submitting a manuscript with pages out of sequence

In every sections of your document

· Use standard writing style including articles ("a", "the," etc.)

· Keep on paying attention on the research topic of the paper

· Use paragraphs to split each significant point (excluding for the abstract)

· Align the primary line of each section

· Present your points in sound order

· Use present tense to report well accepted

· Use past tense to describe specific results

· Shun familiar wording, don't address the reviewer directly, and don't use slang, slang language, or superlatives

· Shun use of extra pictures - include only those figures essential to presenting results

Title Page:

Choose a revealing title. It should be short. It should not have non-standard acronyms or abbreviations. It should not exceed two printed lines. It should include the name(s) and address (es) of all authors.

Abstract:

The summary should be two hundred words or less. It should briefly and clearly explain the key findings reported in the manuscript--must have precise statistics. It should not have abnormal acronyms or abbreviations. It should be logical in itself. Shun citing references at this point.

An abstract is a brief distinct paragraph summary of finished work or work in development. In a minute or less a reviewer can be taught the foundation behind the study, common approach to the problem, relevant results, and significant conclusions or new questions.

Write your summary when your paper is completed because how can you write the summary of anything which is not yet written? Wealth of terminology is very essential in abstract. Yet, use comprehensive sentences and do not let go readability for briefness. You can maintain it succinct by phrasing sentences so that they provide more than lone rationale. The author can at this moment go straight to shortening the outcome. Sum up the study, with the subsequent elements in any summary. Try to maintain the initial two items to no more than one ruling each.

- Reason of the study - theory, overall issue, purpose
- Fundamental goal
- To the point depiction of the research
- Consequences, including definite statistics - if the consequences are quantitative in nature, account quantitative data; results of any numerical analysis should be reported
- Significant conclusions or questions that track from the research(es)

Approach:

- Single section, and succinct
- As a outline of job done, it is always written in past tense
- A conceptual should situate on its own, and not submit to any other part of the paper such as a form or table
- Center on shortening results - bound background information to a verdict or two, if completely necessary
- What you account in an conceptual must be regular with what you reported in the manuscript
- Exact spelling, clearness of sentences and phrases, and appropriate reporting of quantities (proper units, important statistics) are just as significant in an abstract as they are anywhere else

Introduction:

The **Introduction** should "introduce" the manuscript. The reviewer should be presented with sufficient background information to be capable to comprehend and calculate the purpose of your study without having to submit to other works. The basis for the study should be offered. Give most important references but shun difficult to make a comprehensive appraisal of the topic. In the introduction, describe the problem visibly. If the problem is not acknowledged in a logical, reasonable way, the reviewer will have no attention in your result. Speak in common terms about techniques used to explain the problem, if needed, but do not present any particulars about the protocols here. Following approach can create a valuable beginning:

- Explain the value (significance) of the study
- Shield the model - why did you employ this particular system or method? What is its compensation? You strength remark on its appropriateness from a abstract point of vision as well as point out sensible reasons for using it.
- Present a justification. Status your particular theory (es) or aim(s), and describe the logic that led you to choose them.
- Very for a short time explain the tentative propose and how it skilled the declared objectives.

Approach:

- Use past tense except for when referring to recognized facts. After all, the manuscript will be submitted after the entire job is done.
- Sort out your thoughts; manufacture one key point with every section. If you make the four points listed above, you will need a least of four paragraphs.

- Present surroundings information only as desirable in order hold up a situation. The reviewer does not desire to read the whole thing you know about a topic.
- Shape the theory/purpose specifically - do not take a broad view.
- As always, give awareness to spelling, simplicity and correctness of sentences and phrases.

Procedures (Methods and Materials):

This part is supposed to be the easiest to carve if you have good skills. A sound written Procedures segment allows a capable scientist to replacement your results. Present precise information about your supplies. The suppliers and clarity of reagents can be helpful bits of information. Present methods in sequential order but linked methodologies can be grouped as a segment. Be concise when relating the protocols. Attempt for the least amount of information that would permit another capable scientist to spare your outcome but be cautious that vital information is integrated. The use of subheadings is suggested and ought to be synchronized with the results section. When a technique is used that has been well described in another object, mention the specific item describing a way but draw the basic principle while stating the situation. The purpose is to text all particular resources and broad procedures, so that another person may use some or all of the methods in one more study or referee the scientific value of your work. It is not to be a step by step report of the whole thing you did, nor is a methods section a set of orders.

Materials:

- Explain materials individually only if the study is so complex that it saves liberty this way.
- Embrace particular materials, and any tools or provisions that are not frequently found in laboratories.
- Do not take in frequently found.
- If use of a definite type of tools.
- Materials may be reported in a part section or else they may be recognized along with your measures.

Methods:

- Report the method (not particulars of each process that engaged the same methodology)
- Describe the method entirely
- To be succinct, present methods under headings dedicated to specific dealings or groups of measures
- Simplify - details how procedures were completed not how they were exclusively performed on a particular day.
- If well known procedures were used, account the procedure by name, possibly with reference, and that's all.

Approach:

- It is embarrassed or not possible to use vigorous voice when documenting methods with no using first person, which would focus the reviewer's interest on the researcher rather than the job. As a result when script up the methods most authors use third person passive voice.
- Use standard style in this and in every other part of the paper - avoid familiar lists, and use full sentences.

What to keep away from

- Resources and methods are not a set of information.
- Skip all descriptive information and surroundings - save it for the argument.
- Leave out information that is immaterial to a third party.

Results:

The principle of a results segment is to present and demonstrate your conclusion. Create this part a entirely objective details of the outcome, and save all understanding for the discussion.

The page length of this segment is set by the sum and types of data to be reported. Carry on to be to the point, by means of statistics and tables, if suitable, to present consequences most efficiently.You must obviously differentiate material that would usually be incorporated in a study editorial from any unprocessed data or additional appendix matter that would not be available. In fact, such matter should not be submitted at all except requested by the instructor.

Content

- Sum up your conclusion in text and demonstrate them, if suitable, with figures and tables.
- In manuscript, explain each of your consequences, point the reader to remarks that are most appropriate.
- Present a background, such as by describing the question that was addressed by creation an exacting study.
- Explain results of control experiments and comprise remarks that are not accessible in a prescribed figure or table, if appropriate.
- Examine your data, then prepare the analyzed (transformed) data in the form of a figure (graph), table, or in manuscript form.

What to stay away from

- Do not discuss or infer your outcome, report surroundings information, or try to explain anything.
- Not at all, take in raw data or intermediate calculations in a research manuscript.
- Do not present the similar data more than once.
- Manuscript should complement any figures or tables, not duplicate the identical information.
- Never confuse figures with tables - there is a difference.

Approach

- As forever, use past tense when you submit to your results, and put the whole thing in a reasonable order.
- Put figures and tables, appropriately numbered, in order at the end of the report
- If you desire, you may place your figures and tables properly within the text of your results part.

Figures and tables

- If you put figures and tables at the end of the details, make certain that they are visibly distinguished from any attach appendix materials, such as raw facts
- Despite of position, each figure must be numbered one after the other and complete with subtitle
- In spite of position, each table must be titled, numbered one after the other and complete with heading
- All figure and table must be adequately complete that it could situate on its own, divide from text

Discussion:

The Discussion is expected the trickiest segment to write and describe. A lot of papers submitted for journal are discarded based on problems with the Discussion. There is no head of state for how long a argument should be. Position your understanding of the outcome visibly to lead the reviewer through your conclusions, and then finish the paper with a summing up of the implication of the study. The purpose here is to offer an understanding of your results and hold up for all of your conclusions, using facts from your research and generally accepted information, if suitable. The implication of result should be visibly described. Infer your data in the conversation in suitable depth. This means that when you clarify an observable fact you must explain mechanisms that may account for the observation. If your results vary from your prospect, make clear why that may have happened. If your results agree, then explain the theory that the proof supported. It is never suitable to just state that the data approved with prospect, and let it drop at that.

- Make a decision if each premise is supported, discarded, or if you cannot make a conclusion with assurance. Do not just dismiss a study or part of a study as "uncertain."
- Research papers are not acknowledged if the work is imperfect. Draw what conclusions you can based upon the results that you have, and take care of the study as a finished work
- You may propose future guidelines, such as how the experiment might be personalized to accomplish a new idea.
- Give details all of your remarks as much as possible, focus on mechanisms.
- Make a decision if the tentative design sufficiently addressed the theory, and whether or not it was correctly restricted.
- Try to present substitute explanations if sensible alternatives be present.
- One research will not counter an overall question, so maintain the large picture in mind, where do you go next? The best studies unlock new avenues of study. What questions remain?
- Recommendations for detailed papers will offer supplementary suggestions.

Approach:

- When you refer to information, differentiate data generated by your own studies from available information
- Submit to work done by specific persons (including you) in past tense.
- Submit to generally acknowledged facts and main beliefs in present tense.

THE ADMINISTRATION RULES

Please carefully note down following rules and regulation before submitting your Research Paper to Global Journals Inc. (US):

Segment Draft and Final Research Paper: You have to strictly follow the template of research paper. If it is not done your paper may get rejected.

- The **major constraint** is that you must independently make all content, tables, graphs, and facts that are offered in the paper. You must write each part of the paper wholly on your own. The Peer-reviewers need to identify your own perceptive of the concepts in your own terms. NEVER extract straight from any foundation, and never rephrase someone else's analysis.
- Do not give permission to anyone else to "PROOFREAD" your manuscript.
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- To guard yourself and others from possible illegal use please do not permit anyone right to use to your paper and files.

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Topics	Grades		
	A-B	**C-D**	**E-F**
Abstract	Clear and concise with appropriate content, Correct format. 200 words or below	Unclear summary and no specific data, Incorrect form Above 200 words	No specific data with ambiguous information Above 250 words
Introduction	Containing all background details with clear goal and appropriate details, flow specification, no grammar and spelling mistake, well organized sentence and paragraph, reference cited	Unclear and confusing data, appropriate format, grammar and spelling errors with unorganized matter	Out of place depth and content, hazy format
Methods and Procedures	Clear and to the point with well arranged paragraph, precision and accuracy of facts and figures, well organized subheads	Difficult to comprehend with embarrassed text, too much explanation but completed	Incorrect and unorganized structure with hazy meaning
Result	Well organized, Clear and specific, Correct units with precision, correct data, well structuring of paragraph, no grammar and spelling mistake	Complete and embarrassed text, difficult to comprehend	Irregular format with wrong facts and figures
Discussion	Well organized, meaningful specification, sound conclusion, logical and concise explanation, highly structured paragraph reference cited	Wordy, unclear conclusion, spurious	Conclusion is not cited, unorganized, difficult to comprehend
References	Complete and correct format, well organized	Beside the point, Incomplete	Wrong format and structuring

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